Focus on

Flood mapping in Canada

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About the Institute for Catastrophic Loss Reduction

The Institute for Catastrophic Loss Reduction (ICLR), established in 1997, is a world-class centre for multidisciplinary disaster prevention research and communication. ICLR is an independent, not-for-profit research institute founded by the insurance industry and affiliated with Western University, London, Ontario.

The Institute’s mission is to reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society’s capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

ICLR’s mandate is to confront the alarming increase in losses caused by natural disasters and to work to reduce deaths, injuries and property damage. Disaster damage has been doubling every five to seven years since the 1960s, an alarming trend. The greatest tragedy is that many disaster losses are preventable. ICLR is committed to the development and communication of disaster prevention knowledge. For the individual homeowner, this translates into the identification of natural hazards that threaten them and their home. The Institute further informs individual homeowners about steps that can be taken to better protect their family and their homes.

Waiver

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Foreword

This booklet has been produced in order to provide interested stakeholders with a basic overview of the many issues related to flood maps, including what they are, the various forms they may take, why they are important, and where they can be accessed.

A string of costly and disruptive floods in Canada in recent years, beginning with the $1.5 billion insured loss event in Southern Alberta in June 2013 and the $1 billion insured event in Toronto just a few weeks later, brought the issue of flood risk and flood maps to the fore. This came as many property owners directly impacted by these and other events demanded to know why they weren’t informed that they live in a flood risk zone, and those unaffected but concerned about future events investigated the potential flood risk presented to their own properties.

As a direct result of the 2013 flooding in Alberta, property insurers in Canada began to offer overland flood insurance to homeowners in early 2015 for the first time. This change put even more emphasis on the need for flood maps in Canada to be updated regularly and made easily available to those in need of the important information they provide.

However, it would be a mistake to assume that only insurance companies have an interest in up-to-date flood maps that reflect current knowledge and technology. Flood maps are used for a host of reasons and are needed by key decision makers in a number of areas, including land use planning, property development, government disaster assistance and emergency management/first response.
Flood maps may present a variety of different information and may look different in different areas, but one thing all flood maps have in common is that they provide an indication of which areas are at greatest risk of overland flooding related to a defined storm impacting a specific river or coastal area.

Because there are different kinds of floods it is vital to know that each type of flooding usually requires a different set of preventative or mitigative measures for property owners to take in order to prevent damage. For instance, actions that homeowners would take to prevent basement flooding/sewer backup are largely (though not solely) independent of the measures that should be taken to prevent overland flooding caused when, say, a river bursts it banks.

Hence, while homeowners can take measures to protect themselves by knowing the risk, it is key that the actions they take before an event occurs be commensurate with the type of flood that is being planned for. It is also important to note that while homeowners can take many mitigative actions themselves – particularly for the urban/heavy rainfall type of flooding – many of the permanent measures that would need to be taken to mitigate river/overland flood require technical expertise such as from professional engineers.

As important as flood maps are, it is vital to note that they do not necessarily define all areas that are at risk of flooding as there are different types of floods and different mechanisms that cause flooding. For instance, urban or pluvial flooding – which can cause homes to flood from a combination of surface/stormwater flows, sewer backups, water seeping into homes from the surface or ground, plumbing failures, etc. – can occur almost any place where it rains heavily over a short time. Several very costly, disruptive floods have hit Canadian communities in recent years with many of them being independent of rivers, streams or other bodies of water. Few Canadian communities offer public maps which indicate where the highest risk of urban flooding exists due, at least in part, to the rare and random nature of such flood events.
One of the challenges associated with floods and flood management in Canada is that there is a fairly large number of government departments and agencies (local, provincial and federal) and other stakeholders that are responsible for, among other things, the issuance of flood maps. This can make gaining access to maps for a given area challenging, as it is often difficult to determine where to go and who to speak to about accessing such maps. However, for homeowners and other stakeholders interested in learning about the flood risk that is presented to a specific property or area, it is always best to begin by speaking to your local government or agency.
Focus on flood mapping in Canada Q&A

Thank you to Natural Resources Canada, Canada Centre for Mapping and Earth Observation, Ottawa, Ontario, and to the editor of HazNet, the magazine of the Canadian Risks and Hazards Network (CRHNet) for their kind permission to reprint the article ‘Flood mapping in Canada Q&A’. This article was originally published in the Spring 2019 issue of HazNet (Vol. 12, No. 1). See www.haznet.ca.

Floods are the most costly and frequent natural disasters in Canada, causing over $1B in damage to homes, property, and infrastructure annually (IBC, 2018*).

Accurate and updated flood maps are critical tools for flood risk identification and mitigation. Currently, many existing flood maps in Canada are out-of-date and lack consideration of rapid urban development or the impacts of climate change.

A key requirement in flood mapping is good quality foundational elevation data to properly map flood risk. Natural Resources Canada (NRCan) provides leadership and advice to the flood mapping community and focuses on acquiring and sharing high-resolution spatial data to support flood mapping in a sample set of high-risk areas of Canada as well as strengthening the Federal Flood Mapping Guidelines Series.

Canada elevation map

Flood maps identify the areas covered by water on normally dry land during actual or potential flood events. They can identify the specific risk of flooding on structures, people and assets. The following are the types of flood maps used in Canada.

**Inundation Maps:** Maps that show the floodwater extent of real or potential flood events. They aid in the management of emergency preparedness plans for communities situated within floodplains. For example, NRCan’s Emergency Geomatics Service, a division of the Canada Centre for Mapping and Earth Observation, relies on satellite imagery acquired during natural disasters to extract flood extent information and disseminate inundation maps in near real-time (< 4 hours).

![Inundation Map by the Toronto and Region Conservation Authority](image)

**Flood Hazard Maps:** Engineering maps that display the results of hydrologic and hydraulic investigations and show areas that could be flooded under different scenarios. These maps are used for regulatory planning purposes related to land use planning and flood mitigation.
Flood Risk Maps: Maps that indicate the potential adverse consequences associated with floods, including social, economic, environmental and cultural consequences to communities during a specific potential flood scenario.
Flood Awareness Maps: Communication maps that serve to inform members of the public regarding the history of flooding in their communities, as well as the potential for future flooding and the risks that such flooding would pose to residential properties, businesses, cultural assets, infrastructure, and human life. These interactive web maps or printed poster-style maps include a range of additional content types, such as photographs, descriptive text, and graphics.

Flood Awareness Map by the Grand River Conservation Authority
Question 2: Why are flood maps important?

Flood maps serve as critical decision-making tools in flood mitigation, land use planning, emergency management, and public awareness. They offer the following advantages to communities in all aspects of the emergency management cycle.

**Preparedness** – They empower citizens and property owners with information that allows them to make informed decisions related to flood risks.

**Mitigation** – They provide a cornerstone for land use planning such as restricting development within flood zones and other structural flood mitigation strategies.

**Response** – They are useful to first responders, citizens and emergency management officials during a flood event by showing evacuations routes, evacuation centres, and the population at risk.

**Recovery** – They inform recovery practices by promoting knowledge of potential risk to infrastructure and properties; thus enabling communities to “build back better.”
Question 3: Are flood maps available?

Currently provinces and territories set their own standards for flood mapping, and different data sources are used across Canada. NRCan considers the use of consistent and authoritative geospatial data supporting the production of flood maps to be essential for evidence-based decision-making.

Access to accurate flood maps by Canadians varies by municipality nation-wide; however, in many parts of Canada, flood maps are out-of-date. NRCan has been working to improve knowledge of the current state of flood mapping in the country through recent and ongoing activities.
NRCan has developed a Flood Mapping Framework that captures all components of the flood mitigation process, from flood hazard identification to the implementation of flood mitigation efforts. The following flow chart illustrates the relationship between these components and links them to the relevant *Federal Flood Mapping Guidelines Series* document.

NRCan also developed the *Federal Flood Mapping Guidelines Series* to champion common flood modelling techniques in Canada and to encourage geospatial data dissemination and sharing. This series of documents provide details on technical aspects of the following flood mapping-related activities:

- Hydrologic and hydraulic investigation;
- Flood mapping;
- Flood risk assessment;
- Estimating the effects of climate change forecasting on flood modelling;
- LiDAR data acquisition; and
- Land use planning.
All documents in the Series are evergreen and will adapt as new technological and scientific developments emerge. Published guidelines are available on the Public Safety website. For more information on current initiatives to promote flood mapping contact: geoinfo@canada.ca.
1% Annual Chance Flood: A flood that has a 1% chance of being equalled or exceeded in any given year; also known as a 100-year flood (1:100). Similarly, 200-year flood (1:200) means a 0.5% chance of flooding in any year.

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

Avulsion: Abandonment of an old river channel and the creation of a new one.

Bathymetric: The study of underwater depth of lake or ocean floors.

Climate change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Digital elevation model (DEM): A file with terrain elevations recorded for the intersection of a finegrained grid and organized by quadrangle as the digital equivalent of the elevation data on a topographic base map.

Disaster: Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Exposure: The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

Flood: A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters or (2) the unusual and rapid accumulation or runoff of surface waters from any source.

Flood fringe: A plain bordering a river and subject to flooding.
**Floodway:** An area of fastest, deepest flowing waters.

**Flood hazard:** A flood hazard is the threat to life, health, property or the environment as a result of flooding.

**Flood-proofing:** Strategies to protect the built or natural environment from flooding events.

**Fluvial mapping:** Mapping of rivers and streams and how they change in different conditions.

**Freeboard:** A vertical distance added to the actual calculated flood level to accommodate uncertainties in flood levels. Such uncertainties include hydraulic and hydrological variables, potential for waves, surges and other natural phenomena.

**Geomorphic hazards:** Hazards related to landforms including floods, landslides, snow avalanches and soil erosion.

**Hazard:** The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

**Hydrological analysis:** An engineering analysis of a flooding source carried out to establish peak flood discharges and their frequencies of occurrence.

**Hydraulic model:** A computer program that uses flood discharge values and floodplain characteristic data to simulate flow conditions and determine flood elevations.

**Hydrometric:** The monitoring of the components of the hydrological cycle including rainfall, groundwater characteristics, as well as water quality and flow characteristics of surface waters.

**Resilience:** The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
**Return period:** An estimate of the average time interval between occurrences of an event (e.g., flood or extreme rainfall) of (or below/above) a defined size or intensity.

**Riverine flooding:** The overbank flooding of rivers and streams.

**Vulnerability:** The propensity or predisposition to be adversely affected.

**Source:** Floodplain Mapping Backgrounder to the BC Real Estate Association, *Floodplain Mapping Funding Guidebook for BC Local Governments* (April 2014). Thanks to Tamsin Lyle of Ebbwater Consulting for her gracious permission to reprint this glossary.