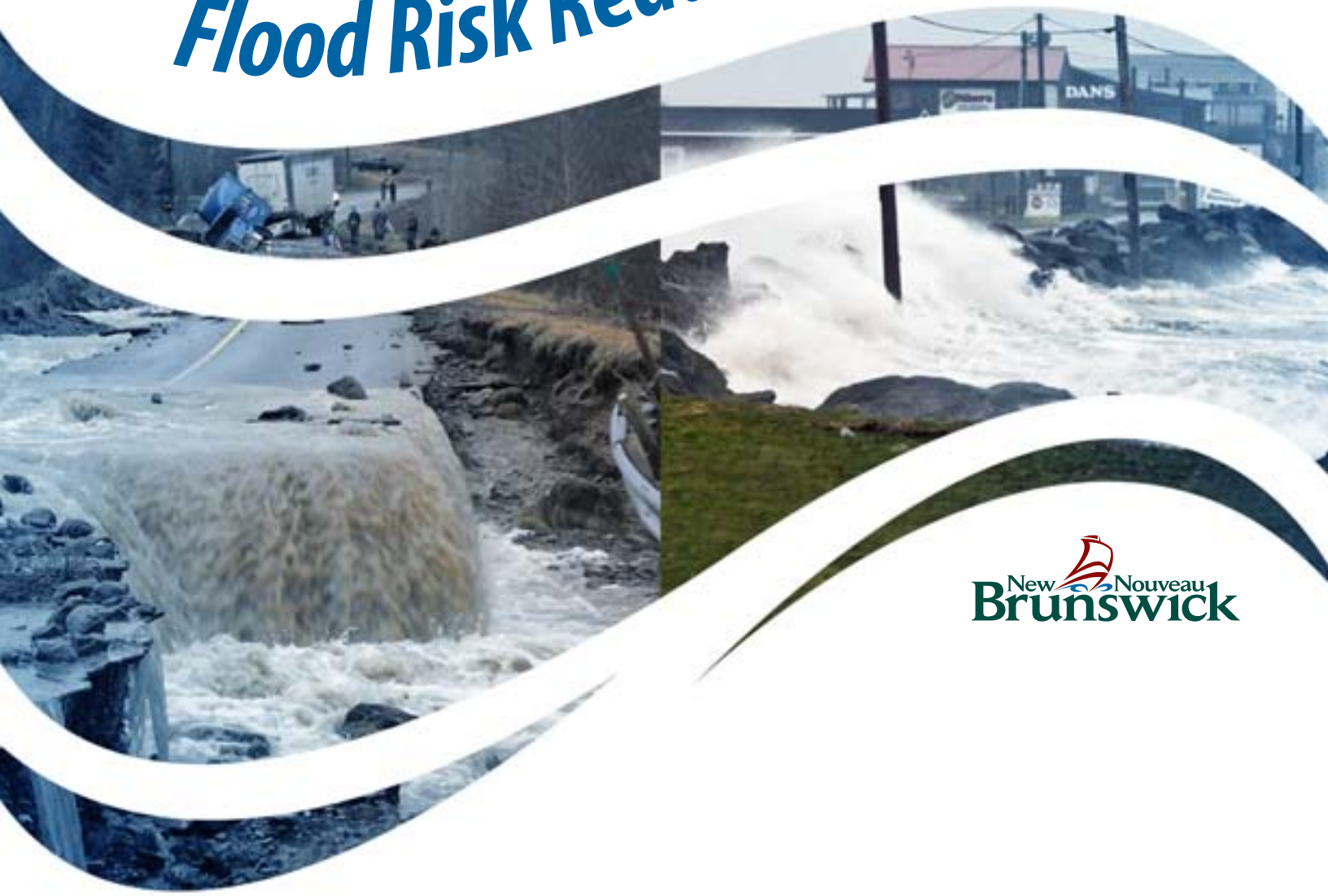
New Brunswick's

Flood Risk Reduction Strategy



New Nouveau Brunswick

New Brunswick's Flood Risk Reduction Strategy

Province of New Brunswick
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Contents

A Message from the Minister

Flooding triggered by heavy precipitation, snow melt, storm surges and jamming of ice, damages properties and livelihoods, and poses risks to human life and the natural environment. We know from experience that flooding has far-reaching social and economic consequences.

New Brunswick's Flood Risk Reduction Strategy is directed toward accurately identifying the locations where flooding occurs, and taking this knowledge into account in our future decisions about where to live, work and build. The strategy also identifies actions that can be taken to protect the people and properties already exposed to flood risk. The benefits include increased public safety, reduced personal hardships, reduced damage to property and the economy, and cost savings for property owners and taxpayers.

The actions described in this strategy can only be achieved by working closely with New Brunswickers across the province. We each have a role in implementing the wide-ranging actions described in this strategy. By working together, we can build a legacy of wise decisions and farsighted actions.

Honourable Danny Soucy
Minister of Environment and Local Government

Executive Summary

The Province of New Brunswick has a long history of flooding, with events of varying severity reported as long ago as 1696.

Grand Barachois, 2010

Over the past five years, New Brunswick has experienced a three-fold increase in the number of disaster financial assistance programs triggered by flooding, compared to the previous five years. The financial burdens borne by individuals, communities and the province are also significant.

Past and ongoing development in flood hazard areas, a lack of available flood insurance for residential properties in Canada, and the increasing frequency and severity of storm events mean that these costs will continue to rise unless risks from flooding are appropriately managed.

Recognizing the above realities, the Government of New Brunswick has made a commitment to begin a collaborative effort to develop a comprehensive flood risk reduction strategy for the benefit of all New Brunswickers. This strategy document is a first step towards meeting this commitment. It describes the specific challenges New Brunswickers face with respect to flood risk and presents 14 responses, organized according to the following objectives:

Objective 1: Accurate Flood Hazard Identification

An improved ability to identify locations where future floods are likely to occur, so that proactive steps can be taken both provincially and locally, to avoid additional exposure to flooding and mitigate existing flood risk.

Objective 2: Planning for Communities and Infrastructure to Avoid Flood Risk

A local planning framework that incorporates flood risk, leading to better decisions about proposed structures, facilities and land uses.

Objective 3: Informed Mitigation of Existing Flood Risk

Reduced flood risk for the people, buildings and infrastructure that are already located in flood hazard areas, and an increased capacity of communities, business and individuals to adapt to flooding.

The actions outlined in the strategy are intended as an enabling framework for a series of more detailed activities to follow. There are actions that can be initiated in the short term and others that will take longer to implement. In the future, the Government of New Brunswick intends to develop implementation details to accompany the actions identified in the strategy, including the priority sequence of actions and timelines for commencing activities.

Flooding in New Brunswick

A History of Flooding

Coastal and inland flooding are among the most serious natural hazards facing Canadians today. This is particularly true in New Brunswick, where past and present settlement patterns follow rivers and ocean coasts and many communities have become established in areas subject to periodic flooding. New Brunswick contains approximately 60,000 kilometres of streams and rivers, and about 2,500 lakes and ponds of various sizes. The province is also bounded by thousands of kilometres of ocean coast. It is therefore not surprising that New Brunswick has a long history of flooding impacting on human settlement, with events of varying severity reported as long ago as 1696. The triggers for flood events vary with the season and location. Heavy rainfall is the largest single cause of New Brunswick floods, however snow melt and ice jams are other significant causes and storm surges affect our ocean coast. While some floods are attributable to a single cause, others, such as the 2012 flooding in Perth-Andover are due to a combination of the above processes.

St. John Street, Fredericton, 1936

Perth-Andover, 2012

Flood-Related Costs

There is a growing urgency to address this important issue. Over the past five years, New Brunswick has experienced a three-fold increase in the number of disaster financial assistance programs triggered by flooding compared to the previous five years. From 2008 to 2012 the estimated total cost of flood-related damage in this province exceeded $100 million. The Province has incurred approximately $28 million in provincial infrastructure repair costs as a result of flooding for the period of April 2008 to the summer of 2011. Total claims under the disaster financial assistance program resulting from the 2008 spring and summer flooding along the St. John River amounted to an additional $28 million. It is estimated that the costs to government alone represent only about 50% of the province-wide costs of recovering from a flood event.

Clearly, the material costs of flooding in New Brunswick are significant. The intangible costs of human anxiety and suffering are not considered in these calculations of flood damage and add another dimension to the costs of flooding.

Responding to Flood Risk

Past and on-going development in flood hazard areas, a lack of available flood insurance for residential properties in Canada, and the increasing frequency and severity of storm events, collectively mean that flood-related costs and consequences will continue to grow unless risks from flooding are appropriately managed. Research undertaken in both Canada and the United States has indicated that actions taken to reduce flood risk yield long-term benefits that far exceed their costs.

Recognizing the above realities, the Government of New Brunswick made a commitment in the November 2012 Speech from the Throne to commence the development a comprehensive flood risk reduction strategy for the benefit of all New Brunswickers. This strategy document is a first step toward meeting this commitment.

Scope and Intent

This strategy is intended to be province-wide in its application and respond to both inland and coastal flooding. The collaborative actions it identifies must be supported by sound technical information and analysis.

The actions outlined in the strategy are intended as an enabling framework for a series of more detailed activities to follow. There are actions that can be initiated now and others that will take longer to implement. In the future, the Government of New Brunswick intends to develop implementation details to accompany the actions identified in the strategy, including the priority sequence of actions and timelines for commencing activities.

Goals

The goals of this strategy include:

- **Increased public safety and reduction of personal hardships;**
- **Reduced flood damage to properties, infrastructure and the environment;**
- **Increased community resilience;**
- **Cost savings for taxpayers and property owners; and**
- **Less uncertainty about flood risk, leading to better decisions.**

Objectives, Challenges and Actions

This flood risk reduction strategy describes the challenges New Brunswick faces with respect to flood risk, and presents responses in the form of 14 actions, organized according to the following three objectives, which comprise the core of the strategy:

Objective 1: Accurate Flood Hazard Identification
Objective 2: Planning for Communities and Infrastructure to Avoid Flood Risk
Objective 3: Informed Mitigation of Existing Flood Risk

Engaging New Brunswickers in Flood Risk Reduction

The success of this strategy will depend on the cooperative efforts of all levels of government and the collaborative involvement of a wide cross-section of New Brunswickers including communities, individuals, businesses, professional organizations, and others. The importance of collaborative effort in addressing flood risk has already been clearly demonstrated. For example, joint federal-provincial initiatives such as the Flood Damage Reduction Program (1976-2000) and the multi-partner Environment Canada Sea Level Rise Project (2006) have been instrumental in identifying and mapping flood hazards in New Brunswick. More recently, the Atlantic Regional Adaptation Collaborative (2008-2012) resulted in partnerships involving the federal government, the province, universities, local communities and others that energized several community-based initiatives addressing flood risk in New Brunswick. Implementing this provincial flood risk reduction strategy will provide an opportunity to take advantage of these collaborations and build on the collective experiences and insights of these partners. The Province will incorporate the principles of collaboration and engagement in responding to each of the three Objectives. This will mean working with communities, property owners and others in the implementation of New Brunswick's Flood Risk Reduction Strategy.

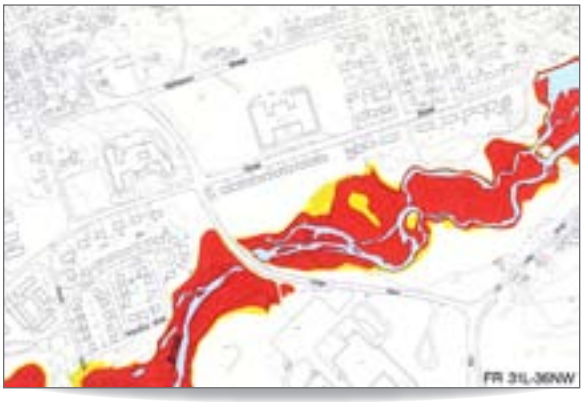
Information, Education and Awareness

Information removes uncertainty, supports collaboration and empowers New Brunswickers to make wise decisions that reduce their vulnerability to flooding. Timely communication and the sharing of information will therefore be another key component of this strategy. The Province will incorporate the principles of communication, education and awareness, in responding to each of the three Objectives. This will include improving and building on existing tools for education and communication regarding flood risk, and providing support, tools and guidance to help communities address flood risk in the future.

Objectives, Challenges and Actions

Objective 1: Accurate Flood Hazard Identification

If we don't know the locations of future floods, we can't avoid or prepare for them. Flood hazard maps are predictive tools that show the location, extent and frequency of flooding. They also show the locations of buildings, properties and infrastructure (roads, water treatment plants, etc.) that will be affected in the event of a flood. These maps are therefore vital for emergency planning and for determining whether or not a specific property is suitable for an intended use. Accurate flood hazard maps coupled with good planning of land use and infrastructure can help prevent flood damage and protect public safety.



Example flood hazard map created under the Flood Damage Reduction Program.

Many flood hazard maps have been produced in New Brunswick over the years. Most are maps of inland flood hazards, created under the joint federal-provincial Flood Damage Reduction program that lasted from 1976 until 2000. Other maps, including those of selected coastal flood hazards, were produced by Environment Canada in 2006 and more recently under the federal-provincial Atlantic Regional Adaptation Collaborative. Despite this previous work, challenges remain.

While most of New Brunswick's coastal flood hazard maps have been prepared within the last 10 years, most of the maps of inland flood hazards were created between 17 and 33 years ago. This means that the locations of more recent roads and buildings are not shown. In addition, some of the physical features that affect flooding (fill placement, new bridges, etc.) are not considered. This information can be updated by superimposing the measured or predicted extent of flooding on newer maps produced using technologies such as LiDAR (high precision topographic data obtained from sensors mounted in aircraft), but this does not address the need for revised predictive flood hazard mapping incorporating up-to-date meteorological and flow data. Recent efforts such as flood mapping along the St. John River in 2008 and 2012 have focused primarily on creating accurate records of historic floods. This information is valuable, but is not sufficient to accurately predict the extent and frequency of future floods. Finally, there are coastal and inland flood hazard areas that have never been mapped.

Many of New Brunswick's flood hazard maps are available in electronic form via the GEO NB website at:
www.snb.ca/geonb1/e/index-E.asp

The above limitations highlight the need to renew and expand our existing flood hazard maps so they will be better tools to effectively manage current and future flood risk. This challenge is not unique to New Brunswick. Jurisdictions across Canada are facing the task of revising outdated flood hazard mapping.

Summary of Current Challenges

Example of flood information available through the GeoNB website.

- Many of New Brunswick's flood hazard maps are decades old, and as a result are based on out-dated stream flow and precipitation records and do not incorporate the latest available climatic and sea level rise predictions. They also don't include the locations of recently constructed buildings and infrastructure.
- The production and calibration of modern, accurate flood hazard mapping requires a variety of information including high precision topographic data (e.g. LiDAR), and environmental data (precipitation, stream flow, tide elevations, etc.).
- Preparing predictive flood hazard mapping is a complex process. It is therefore important that the communities that will make use of these maps are involved in their preparation and have an opportunity to obtain an understanding of how flood hazard maps are produced and how they should be interpreted. Decision-makers must also be convinced of the purpose, value and accuracy of the maps.
- Due to increasing climatic variability and the effects of future changes in land cover and land use, production of updated flood hazard maps is not a one-time activity. The maps will have to be regularly updated.
- There is competition for government resources at all levels. Partnerships that enable the sharing of information and resources are therefore important. This overarching challenge applies to each of the three objectives described in this strategy.

Desired Outcomes

- Accurate, predictive flood hazard maps are available for use by those New Brunswick communities exposed to flood risk.
- New Brunswick flood hazard maps are based on up-to-date technical standards and incorporate the latest available climatic and stream flow information.

Floods that have a high probability of occurrence and have significant consequences for life and property are floods that present the highest risk.

- The required data (topography, precipitation, stream flow, tide levels, etc.) are available to support the expansion and renewal of New Brunswick's flood hazard maps now and into the future.
- New Brunswickers understand how flood hazard maps are produced and support their use in managing flood risk.
- The required resources are available to support the expansion and renewal of the province's flood hazard mapping.

Actions to Achieve the Desired Outcomes for Objective 1

This strategy contains actions that will result in an improved ability to identify locations where future floods are likely to occur, so that proactive steps can be taken both provincially and locally to avoid additional exposure to flooding and mitigate existing flood risk.

The actions include:

1. **Renewing Coastal and Inland Flood Hazard Maps.**

   Initiating the renewal and expansion of New Brunswick's existing set of coastal and inland flood hazard maps in accordance with priority areas, including: a) identifying appropriate technical mapping standards; b) establishing risk-based priorities to determine the areas in most urgent need of flood hazard mapping; c) preparing a cost estimate and building partnerships to ensure that resources are in place to complete the required mapping; d) acquiring the necessary data and LiDAR base mapping; e) preparing the flood hazard maps; and f) identifying a desired renewal cycle to help ensure that the mapping remains accurate into the future.

2. **Engaging New Brunswickers in Flood Hazard Mapping**

   Ensuring that New Brunswickers have the opportunity to become involved in mapping flood hazards (e.g. via working groups, workshops, presentations by experts, educational resources, opportunities for comments on draft maps, and contributing local knowledge for map calibration); and partnering with other jurisdictions and levels of government, educational institutions, the private sector, and local communities to help secure technical expertise, funding arrangements, environmental data and local knowledge in support of this objective.

3. **Increasing Awareness and Education about Flood Hazard Maps**

   Ensuring that the maps are accessible and that New Brunswickers are informed of the value and purpose of the flood hazard maps and are equipped with information on how to use and interpret them.

Objective 2: Planning for Communities and Infrastructure to Avoid Flood Risk

The benefits of investing in flood hazard maps can only be fully realized if planning and development decisions take this mapping into account. The *Community Planning Act* allows communities to regulate development in locations affected by flood hazards within their boundaries, using policies contained in their local plans. They are also able to implement these policies by means of zoning bylaws that regulate land use.

While some New Brunswick communities have used this authority and have taken steps to identify and respond to flood hazards, others have not. Furthermore, when policies addressing flooding are included in local planning documents, corresponding zoning bylaws are not always put in place. As a result, there is no province-wide consistency in responding to flood risk at the community level, and many communities continue to look to the Province for leadership.

Planning to avoid flood risk also involves identifying and applying appropriate design standards for new buildings, roads and other infrastructure, including standards that incorporate the latest information about precipitation frequency and intensity so that drainage systems (e.g. ditches, culverts, etc.) are appropriately designed and sized.

Summary of Current Challenges

- Past approaches to land use planning in New Brunswick, have led to an inconsistent response to flood risk between different communities.
- Some inappropriate development has continued to occur on lands that are subject to flooding.
- It is important that the standards and criteria used to design and size drainage systems (e.g. ditches, culverts, etc.) be reviewed and updated as necessary to incorporate the latest available climate data.

Community planning meeting

Desired Outcomes

- New Brunswick has a consistent, province-wide approach to flood risk reduction while allowing local flexibility regarding specific implementation details.
- New Brunswick communities have the tools necessary to proactively address flood risk in the design, location and construction of new development and infrastructure.
- The Province leads by example, addressing flood risk in the planning, design, funding and approval of new development and infrastructure.

Actions to Achieve the Desired Outcomes for Objective 2

This strategy contains actions that will lead to a local planning framework that incorporates flood risk, leading to better decisions about proposed structures, facilities and land uses.

The actions include:

4. Developing a Provincial Flood Risk Policy

Developing, in partnership with local governments and the residents of New Brunswick, a provincial flood risk policy, setting out general principles and minimum requirements by which local communities can address flood risk (e.g. identification of flood hazard locations in community plans, and implementation of appropriate zoning and development standards) so that new development will not result in increased flood hazard or increased vulnerability to flooding.

5. **Equipping New Brunswick Communities to Follow the Provincial Flood Risk Policy**

   Equipping New Brunswick communities with the information they need to follow the provincial flood risk policy in a manner that responds to local needs, while meeting minimum requirements set by the Province. In addition to the flood hazard mapping described under Objective 1, this information includes model bylaws, best management practices for storm water management and information about social, technical and legal aspects of managing flood risk.

6. **Addressing Flood Vulnerability in Funding Decisions**

   Minimizing flood vulnerability for developments that are financially supported by the Province.

7. **Addressing Flood Risk in Infrastructure Planning and Development Approvals**

   Ensuring that the Province's infrastructure planning mechanisms and development approval processes (e.g. reviews of development proposals under the Environmental Impact Assessment Regulation, *Clean Environment Act*) reduce flood risk where possible and do not result in decisions that increase flood risk.

8. **Leading by Example and Promoting Design and Engineering Standards that Reduce Flood Risk**

   Leading by example by ensuring that design, and engineering standards employed by provincial departments and agencies include methods to reduce run-off (storm water management) and incorporate the latest available information about precipitation frequency and intensity, so that drainage systems (e.g. ditches, culverts, etc.) are appropriately designed. This action will also involve encouraging and promoting the use of these tools by others.

Objective 3: Informed Mitigation of Existing Flood Risk

Over 20,000 New Brunswickers live in known coastal or inland flood hazard areas. Commercial properties and infrastructure such as roads and wastewater treatment plants are also located in these areas. In responding to this existing risk, the focus of potential responses shifts from avoidance to adaptation. Adaptation does not mean waiting until the next flood to act. Instead, it means taking steps now, to reduce the vulnerability of people, buildings and infrastructure that are already exposed to flood hazards. Governments, businesses, local communities and individuals, all have a role to play in adaptation.

Emergency planning coupled with flood forecasting and warning represents a key component of adaptation. The Province currently operates a provincial hydrology centre within the Department of Environment and Local Government that monitors and reports on water resources in the province, and forecasts flows and water levels in the St. John River watershed. These forecasts are used under the River Watch Program to advise the public concerning river conditions and potential flooding and to assist the Department of Public Safety's Emergency

New Brunswick's River Watch website is a hub for information about warnings and other flood-related information: *www.gnb.riverwatch*

Measures Organization (NB EMO) in recommending safety precautions in response to anticipated flooding. NB EMO is engaged at the provincial, regional and municipal levels to ensure that emergency plans and planning are current; including "all hazard" emergency plans and flood contingency plans for regions and municipalities at risk. Storm surge warnings for coastal areas are provided by Environment Canada. These are issued when abnormally high water levels and waves (storm surges) are anticipated, which have the potential to cause coastal flooding.

River Watch website

Flood proofing is another important part of adaptation and refers to a range of techniques that can be employed to reduce flood damage potential for buildings and infrastructure located in flood hazard areas. Such measures will not provide complete protection from future flood events however they can significantly reduce potential damage to facilities, buildings and their contents.

Summary of Current Challenges:

- Development has already taken place along rivers and coastlines in areas that are subject to periodic flooding. People, buildings and infrastructure in these areas are at risk due to the likelihood of future flooding.
- Some New Brunswickers may not be fully aware of the location of their properties in relation to flood hazards, or fully understand the risks involved in living and working within these areas.
- While Environment Canada provides province-wide storm surge warnings for coastal areas, there is no province-wide flood forecasting system for rivers. Current provincial efforts are focused on the St. John River basin.

Desired Outcomes

- Individuals, businesses and communities have the tools they need to make informed decisions about how best to protect private and public property from the effects of flooding.
- Public and private financial liability is reduced.
- Flood-related risks to safety and property are reduced.
- Community and individual resilience is increased.
- New Brunswickers accept that they have both a responsibility and an opportunity to reduce personal and community vulnerability to flooding in advance of a flood event.

Actions to Achieve the Desired Outcomes for Objective 3

This strategy contains actions that will reduce flood risk for the people, buildings and infrastructure that are already located in flood hazard areas, and increase the capacity of communities, business and individuals to adapt to flooding.

The actions include:

9. Enabling Community-based Flood Risk Reduction

Enabling community-based flood risk reduction by equipping communities with the tools and guidance needed to: a) assess their vulnerability to flood risk; b) identify adaptation options; and c) prepare adaptation plans.

10. Supporting Emergency Management

Enhancing and building on existing tools that support emergency management efforts in response to flood events, including: a) engaging regions and municipalities to ensure that emergency contingency and evacuation plans are prepared and exercised; and b) investigating enhanced flood forecasting and warning tools to assist in emergency planning (e.g. more detailed and integrated flood evacuation plans).

Spring 2008 flooding

11. Providing Guidance for Flood Risk Mitigation

Providing guidance on implementing both traditional and innovative mitigation measures for public and private buildings and infrastructure, such as flood proofing, including: a) estimates of the costs of implementing these measures; and b) criteria to assist in identifying the locations where and when mitigation measures are appropriate.

12. Investigating Expanded Flood Forecasting

Investigating the feasibility of extending inland flood forecasting into locations beyond the St. John River watershed.

13. Addressing Flood Vulnerability in Infrastructure Renewal

Including vulnerability to flooding as one of the criteria used for determining priorities for maintenance, repair and replacement of provincial assets and infrastructure.

14. Finding Better Ways to Communicate Flood Risk

Identifying ways to consolidate and improve the utility of existing flood risk communication tools for New Brunswickers.

Implementing this Strategy

The Government of New Brunswick has made a commitment to begin a collaborative effort to develop a comprehensive flood risk reduction strategy for the benefit of all New Brunswickers. This strategy document is a first step toward meeting this commitment. The actions it contains are intended as an enabling framework for a series of more detailed activities to follow.

Public engagement

Some actions can be initiated in the short term but others will take longer to implement. In the future, the Government of New Brunswick intends to develop implementation details to accompany the actions identified in the strategy, including the priority sequence of actions and timelines for commencing activities.

As indicated throughout the strategy, the success of any efforts to reduce flood risk will depend on the cooperative efforts of all levels of government and the collaborative involvement of a wide cross-section of New Brunswickers including communities, individuals, businesses, professional organizations, academic institutions and others. To this end, New Brunswickers can expect to be included as implementation of the strategy moves forward.

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Glossary

Flood (flooding, flood event) – An event that occurs when ditches, streams, lakes or rivers overflow their banks or channels as a result of one or more of the following: a) prolonged or intense precipitation; b) melting snow, or c) blockage of flow (e.g. by an **Ice jam**). See also **Storm surge**.

Flood adaptation – Measures taken to reduce **flood vulnerability** (e.g. **flood-proofing**, avoiding the creation of living space in basements, moving structures out of flood hazard areas, flood forecasting, emergency planning, etc.). Individuals, businesses, communities and the Province all have a role to play in flood adaptation.

Flood hazard (flood hazard area) – A description of the threat of a flood at a given location, based on the flood's anticipated magnitude (e.g. its depth, horizontal extent, and flow velocity) and its **probability of occurrence**. This information is typically shown on a flood hazard map.

Flood proofing – site grading techniques and temporary or permanent structural features (e.g. raised foundations, higher doors and windows, one-way valves on drainage pipes, raised electrical panels, etc.) that can be employed to reduce or avoid flood damage to buildings or facilities that are located in **flood hazard areas**.

Flood resilience – The capacity of a community, business or individual that is exposed to a **flood hazard** to prepare for, respond to, recover from, and reduce the potential consequences of a flood. Identifying flood hazards is the first step toward resilience. The next step is **flood adaptation**.

Flood risk – The combination of **flood hazard** and **flood vulnerability**. Floods that have a high **probability of occurrence** and have significant consequences for life and property are floods that present the highest risk. A flood that happens frequently but has little or no potential to affect human life and property presents a low flood risk.

Flood risk reduction (prevention, mitigation) – Flood risk can be reduced by reducing the **flood hazard** or reducing **flood vulnerability**, or both. Reducing a flood hazard typically means employing structural measures (dikes, dams, sea walls, drainage controls, etc.) to reduce the severity and/or probability of a flood. Reducing flood vulnerability means implementing **flood adaptation** measures.

Flood vulnerability (flood exposure) – The consequences (e.g. impacts on human life, health and property) that would result from a flood at a given location; in other words, the potential for harm to occur as a result of a **flood**.

Ice jam (ice dam) - An accumulation of floating or grounded, ice causing full or partial blockage of flow, resulting in elevated water levels and potential damage due to moving ice.

LiDAR – An acronym for "light detection and ranging." This technology allows researchers and map makers to accurately measure and record land elevations and other topographic features. LiDAR involves the emission of laser pulses towards the earth's surface from an aircraft and measuring the return time of the pulse, and is a useful technology to assist in creating accurate **flood hazard** maps.

Probability of occurrence (return period, recurrence interval) – An estimate of the average interval of time between flood events of the same magnitude, based on historical records and predictions about future climatic variability. For example a 1:100 year event is expected to occur on average once every

100 years. In other words, it has a 1% chance of occurring in any given year. The longer the return period, the larger the flood.

Regional subsidence – A natural process in which land over a large area gradually decreases in elevation ("sinks") over time. It is a result of on-going readjustments to the earth's crust, following the retreat of glacial ice sheets more than 10,000 years ago. In New Brunswick, this subsidence is accelerating **sea level rise** along the shore line of the Northumberland Strait.

Sea level rise – An increase in the average ocean levels due to a combination of thermal expansion (as oceans get warmer, the water expands) and melting of glaciers and polar ice caps. In New Brunswick, **regional subsidence** is adding to the rate of sea level rise.

Storm surge – An event in which the water level at an ocean coast is higher than normal, due to low atmospheric pressure and strong, on-shore winds. Storm surges, particularly at times of high tide, may lead to damaging waves and coastal flooding.