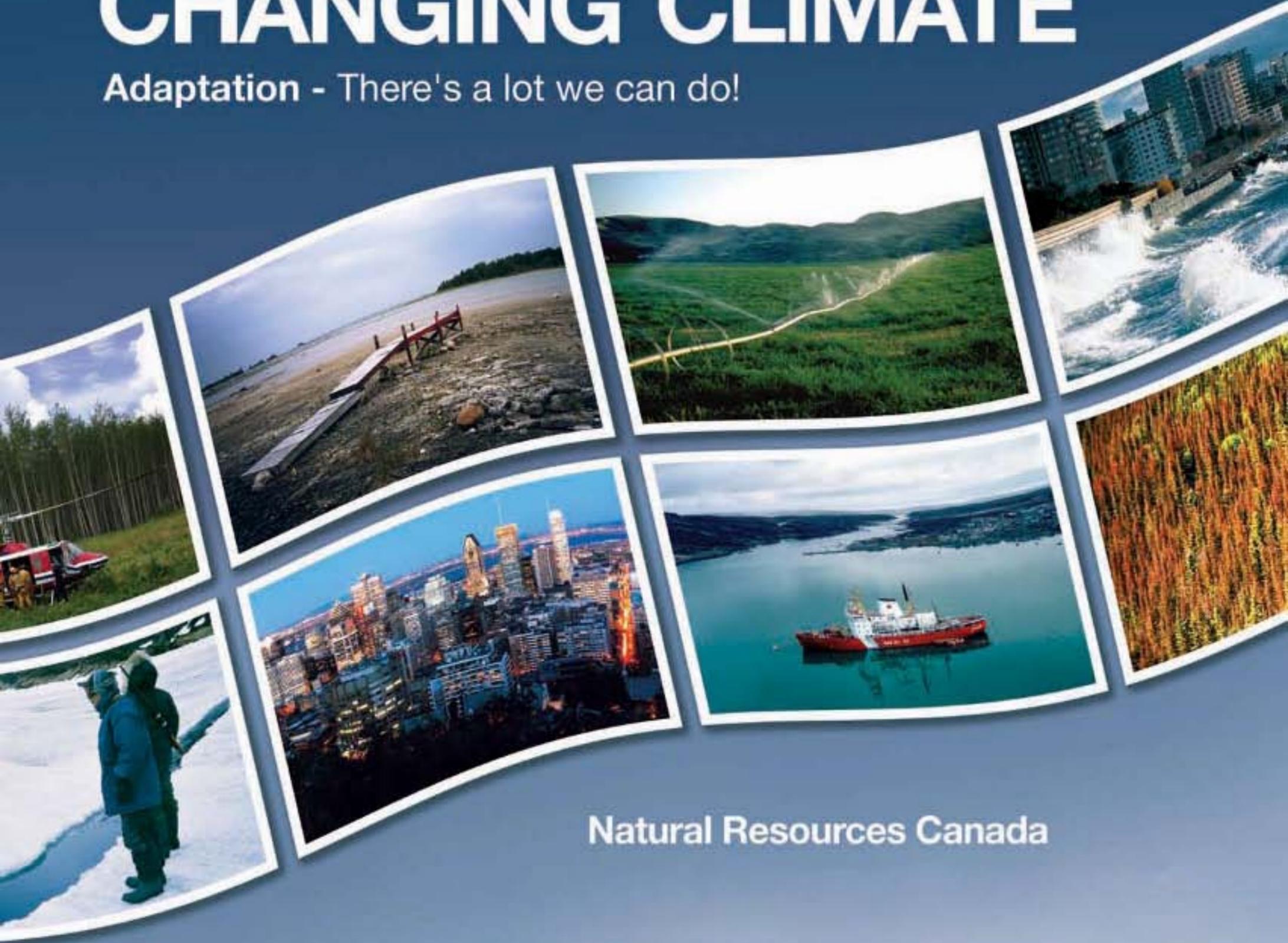




CANADA in a CHANGING CLIMATE

Adaptation - There's a lot we can do!



Natural Resources Canada

INTRODUCTION

The economic, social, and general well-being of Canadians is linked, both directly and indirectly, to climate. Climate influences the crops we grow, the productivity of our forests, the spread of disease, the availability of water, the health of ecosystems, and the stability of our infrastructure. While Canadians have historically adapted well to our climate and its year-to-year variations, future changes will present new challenges.

We are already living in a warmer world. In Canada, average temperature increased by more than 1.3°C since 1948. Parts of the country have warmed more than others, with the greatest temperature increases observed in the western Arctic. We've also seen changes in precipitation patterns, with most of the country becoming wetter, and more of our precipitation falling as rain, rather than snow. In the North, the extent of sea ice has decreased and permafrost has started to melt. Across the country, the hottest days have gotten hotter and more frequent; and, in the winter, we are experiencing fewer days of extreme cold.



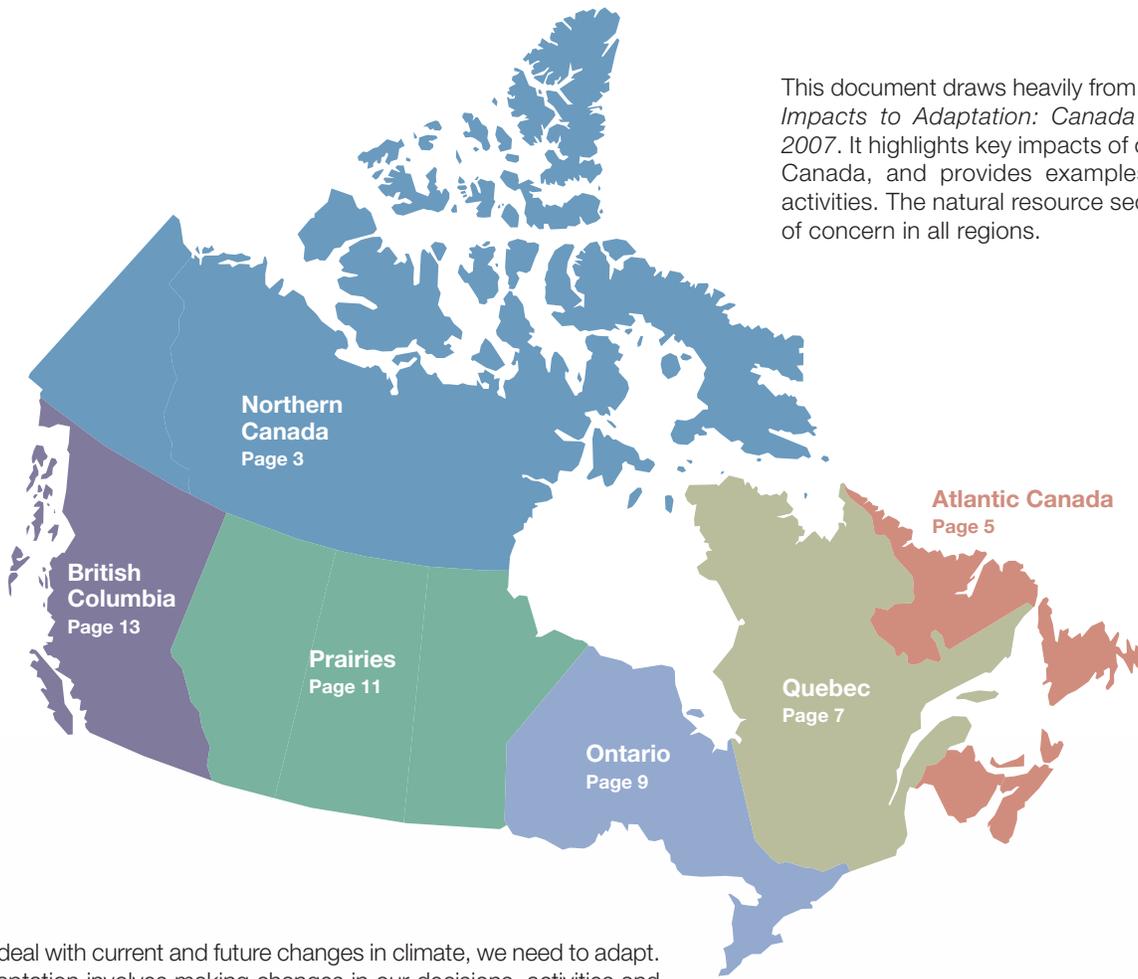
Climate will continue to change — this is inevitable. Although reducing greenhouse gas emissions is vital to limiting the rate and amount of change, it cannot prevent climate change from occurring over at least the next several decades. Climate change includes both gradual changes — increases in temperature, shifts in precipitation patterns, rise in sea level — and sudden changes, such as an increase in extreme weather events. Extreme weather events, including storms, hailstorms, droughts and heat waves, frequently cause natural disasters that can have devastating effects on people, the environment and the economy.

‘Climate change’ refers to any change in climate over time, whether it is the product of natural factors, human activity or both. This usage is the same as that of the Intergovernmental Panel on Climate Change.

Adaptation is a necessary and complementary response to reducing greenhouse gas emissions in meeting the challenges presented by climate change.



This document draws heavily from the scientific report *From Impacts to Adaptation: Canada in a Changing Climate 2007*. It highlights key impacts of concern in each region of Canada, and provides examples of current adaptation activities. The natural resource sectors are important areas of concern in all regions.



To deal with current and future changes in climate, we need to adapt. Adaptation involves making changes in our decisions, activities and thinking in response to observed or expected changes in climate. We adapt to reduce potential harm and to take advantage of new opportunities. Possible adaptation actions are tremendously wide ranging, and may involve utilizing new technologies, adjusting planning and investment practices, and revising regulations.



Northern Canada — Yukon, the Northwest Territories and Nunavut — represents 40% of Canada's landmass. The vast, highly diverse terrain ranges from the boreal forest in the southwest to the tundra landscapes and glacier-covered mountains of the Arctic Archipelago.

Most of northern Canada's 104 000 residents live in the three territorial capitals of Yellowknife, Whitehorse and Iqaluit; the rest are distributed among some 100 other communities with diverse languages and cultures, most with fewer than 500 people. Just over half of northern residents are Aboriginal. Traditional and subsistence activities, including hunting, trapping and fishing, are important to local economies and ways of life for many northerners. Mining, forestry and oil and gas development generate most of the region's revenue, while tourism and public administration are growth industries.

During the past 50 years, the climate of the North has undergone dramatic changes. The western and central Canadian Arctic have warmed by 2 to 3°C, with the largest changes observed in winter and spring. These are among the fastest rates of warming anywhere in the world. Precipitation has increased throughout the entire North — by up to 25% over parts of the tundra.

Temperature and precipitation will continue to rise in the Canadian North throughout this century, with the largest temperature changes occurring at higher latitudes. The extreme northwest may warm by 10°C, or more, by 2080. Sea-ice cover will continue to shrink and, according to some estimates, the Arctic Ocean could be ice-free in summer by 2050. These changes in the north will also have significant impacts on global climate.



Transport truck crossing deteriorating ice road, Liard Ferry crossing near Fort Simpson, Liard River NWT.

Regional Issues

The signs of climate change in northern Canada are everywhere: sea-ice is thinner and breaks up earlier in the spring; glaciers, ice caps and permafrost are melting; migratory birds arrive sooner and depart later than normal. Some native plants and animals are becoming scarcer, some appear less healthy, and a few have disappeared from specific localities. Species never before seen in the North are being reported. Storms are stronger and occur more often, and the weather in general is becoming less predictable.

The Arctic climate is warming at a rate almost twice as fast as that experienced in the rest of Canada.

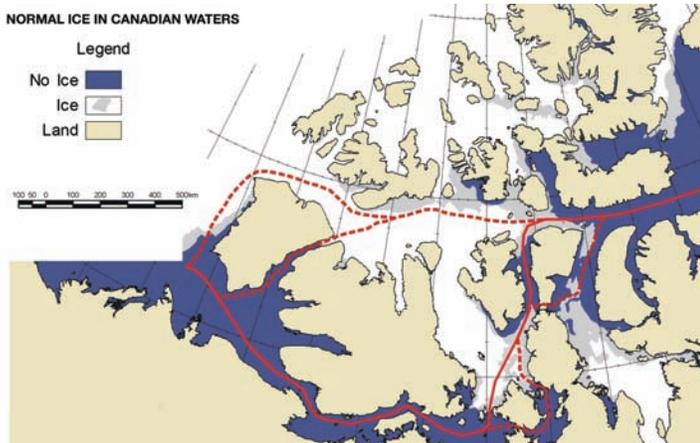
These changes are affecting many aspects of life in the North. Changes in the region's snow and ice cover, and the increasingly unpredictable weather are making travel across land and sea ice riskier, limiting access to traditional hunting and fishing grounds. In combination with ecosystem changes, such as shifts in the distribution of fish and animal species, these alterations impact residents' ability to safely secure country foods, an important source of health and well-being. These changes also have important implications for the protection and management of wildlife, fisheries and forests. For Aboriginal people, climate change is having irreversible impacts on their culture and traditional ways of life.



Northern infrastructure is also being impacted by changes in climate. In many areas, reduced sea-ice cover, combined with sea-level rise, has led to increased coastal erosion that threatens communities and, in some cases, cultural heritage sites. Melting permafrost is undermining buildings and infrastructure and weakening retention ponds that contain mining wastes. The viability of winter roads, which are critical for supplying many remote communities and industrial sites, is being threatened by warmer winters.

The shipping season in the North may increase by 10 days by 2020 and 20 to 30 days by 2080.

More navigable marine waters, due to diminishing sea ice and longer summer shipping seasons, will have a profound impact on northern Canada. They will present new opportunities for economic growth related to natural resource development, transportation and tourism. However, increases in Arctic shipping also present environmental risks, increased demands on search-and-rescue services and security concerns. The economic and cultural impacts on Arctic communities and individual well-being will be far reaching.



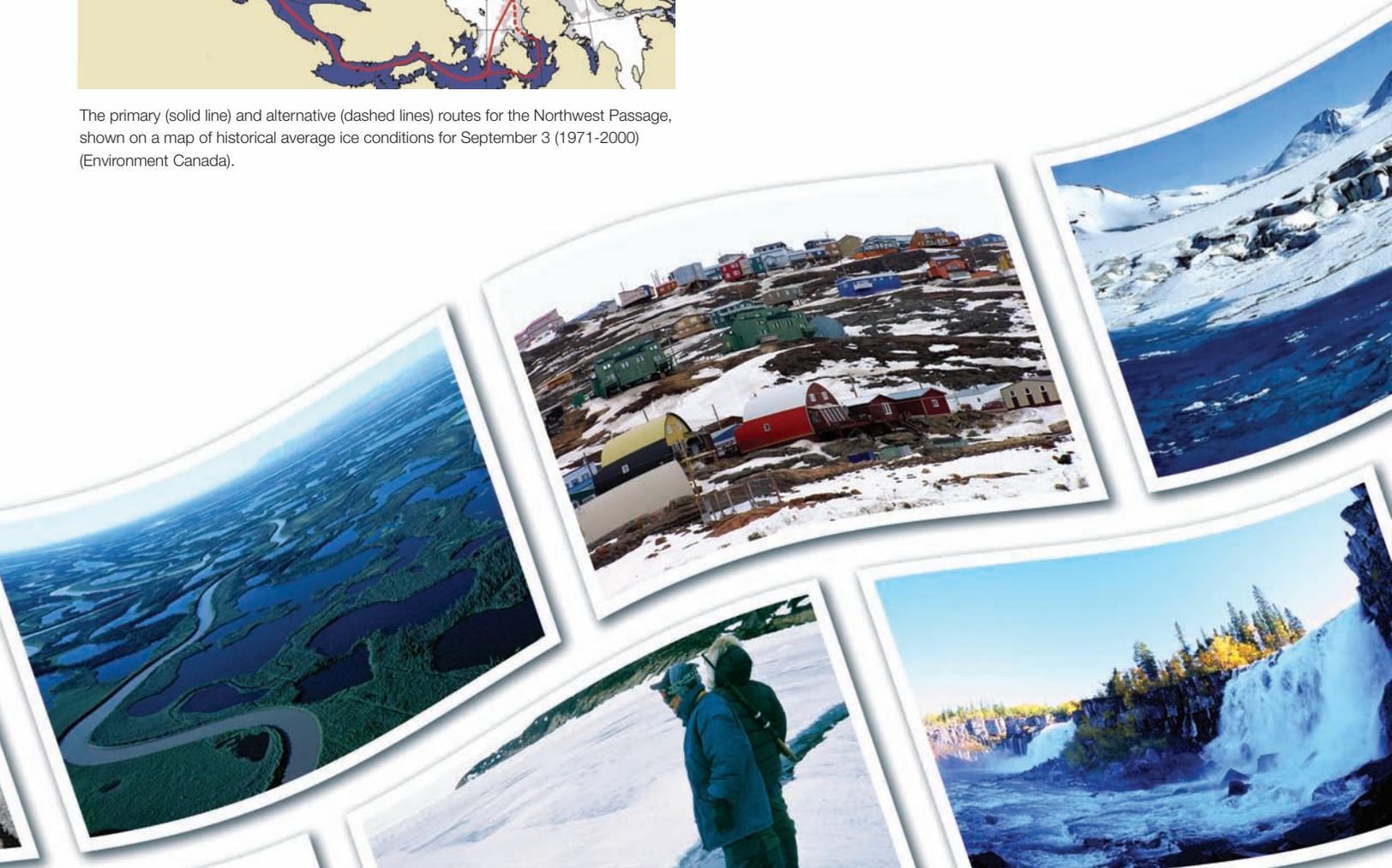
The primary (solid line) and alternative (dashed lines) routes for the Northwest Passage, shown on a map of historical average ice conditions for September 3 (1971-2000) (Environment Canada).

What's Being Done?

Many northern communities are drawing upon a wealth of traditional knowledge, western science and extensive local experience to better cope with a changing climate. Climate change is an urgent issue, and numerous workshops and community meetings have been held across the North to discuss possible solutions. Examples of proposed measures include moving parts or all of some coastline communities, reinforcing vulnerable coastlines, setting up networks for inter-community trade to ensure country food access, and establishing communal freezer programs. However, barriers can sometimes limit the ability of individuals and communities to implement adaptations.

Examples of current adaptations in northern Canada include the following:

- Climate change is now being considered in the design of most major projects in the North, such as pipelines, mines, roads and containment structures.
- Forest managers are adapting their practices to promote sustainability, particularly in response to the spruce bark beetle infestation in the southwestern Yukon.
- People travelling or working on the land and sea ice are taking extra precautions, such as carrying additional supplies and clothing on trips, purchasing all-terrain vehicles, and using global positioning systems for navigation and satellite phones for emergency communication, when going far from the community.



Atlantic Canada encompasses the three Maritime Provinces of New Brunswick, Nova Scotia and Prince Edward Island, as well as Newfoundland and Labrador. While the provinces are diverse in size and characteristics, they all share the strong influence of the coastal environment on their economies, cultures, landscapes and climate.

As such, rising sea level and more intense coastal storms are key climate change concerns for the region. Atlantic Canada is also projected to see hotter and drier summers, warmer winters and more precipitation falling as rain, rather than snow. Mean annual temperature in the region is projected to increase by 2°C to 4°C by 2050, with most of the change happening in the summer months and in interior, rather than coastal, areas. More extreme weather, including more frequent droughts and more intense rainfall events, is also a concern.

These changes will present both challenges and opportunities to Atlantic Canadians. Of the region's population of 2.3 million people, more than half live in rural communities. In these rural communities, natural resources, such as fisheries, contribute greatly, both economically and culturally. The natural environment is also extremely important to the many Aboriginal communities in the region. In each province, urban centers are growing, with a shift towards a service- and knowledge-based economy.



Hurricane Juan made landfall in Nova Scotia on September 29, 2003 as a Category 2 storm. The hurricane caused widespread tree blow-downs, massive power outages and severe damage to buildings and infrastructure.

Regional Issues

Impacts on coastal communities will result from increased coastal erosion and flooding caused by sea level rise, more intense storms, high winds, more powerful storm surges and changing ice conditions.

Infrastructure, such as roadways and bridges, and industries, including fisheries and tourism, will be impacted. Sea level rise will also result in the intrusion of saltwater into coastal aquifers, affecting groundwater supplies for both communities and agriculture.

Rising sea level will result in flooding of higher, previously immune areas, and more frequent flooding of low-lying areas.

Marine fisheries will also be affected by changing ocean conditions (e.g., temperature, salinity and currents). These factors affect the abundance, health and availability of different fish species for harvesting.

Aboriginal communities are concerned about the impacts of climate change on their health, culture and traditional ways of life. The loss of valuable coastal land, including productive salt marshes, and shifts in the distribution and abundance of country foods are impacts of concern.

While agriculture and forestry will benefit from longer and warmer growing seasons, they also face less predictable and more extreme weather conditions, new threats from pests and pathogens and, in some areas, water shortages.

Weather extremes, such as prolonged droughts, more intense storms and heat waves, will affect the region's water resources, and consequently residents' health and well-being. Heavy rains, for example, could result in contamination of drinking water supplies. Summer dry periods would affect municipal water supplies and present challenges for agriculture, fisheries, tourism and the energy sector.

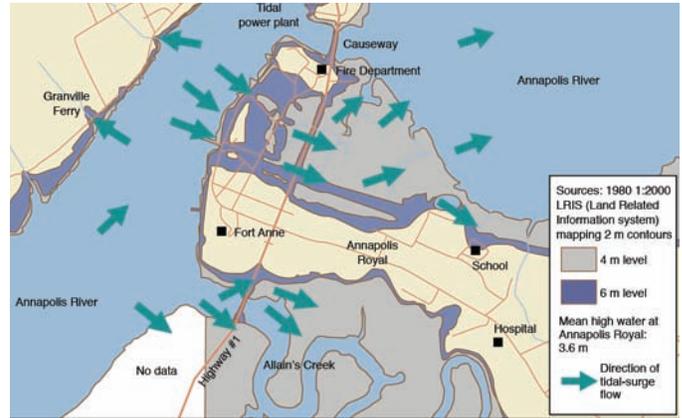
In the southern Gulf of St. Lawrence a storm surge of 3.6 m above present sea level now occurs about once every 40 years. With rising sea levels, this could become an annual event by 2100.

What's Being Done

Adaptation to sea level rise and increased coastal erosion is ongoing in many coastal communities. Traditional approaches, such as restricting development and elevating buildings, as well as innovative initiatives are being used. In Annapolis Royal, the citizens have mapped flood-prone areas and assessed the potential impacts of tidal-surge flows in their region. They enacted mock disaster scenarios and drew up step-by-step procedures for responding to emergencies.

Farmers in the region are shifting to more drought- and pest-resistant crops, and developing best-practices for protecting soil and conserving water. Aboriginal communities are finding less exposed areas for planting sweetgrass, an important plant used in traditional ceremonies.

Halifax Regional Municipality's Climate SMART (Sustainable Mitigation and Adaptation Risk Toolkit) program, a joint venture between the public and private sector, has taken a fully integrated approach to addressing climate change at the municipal level.

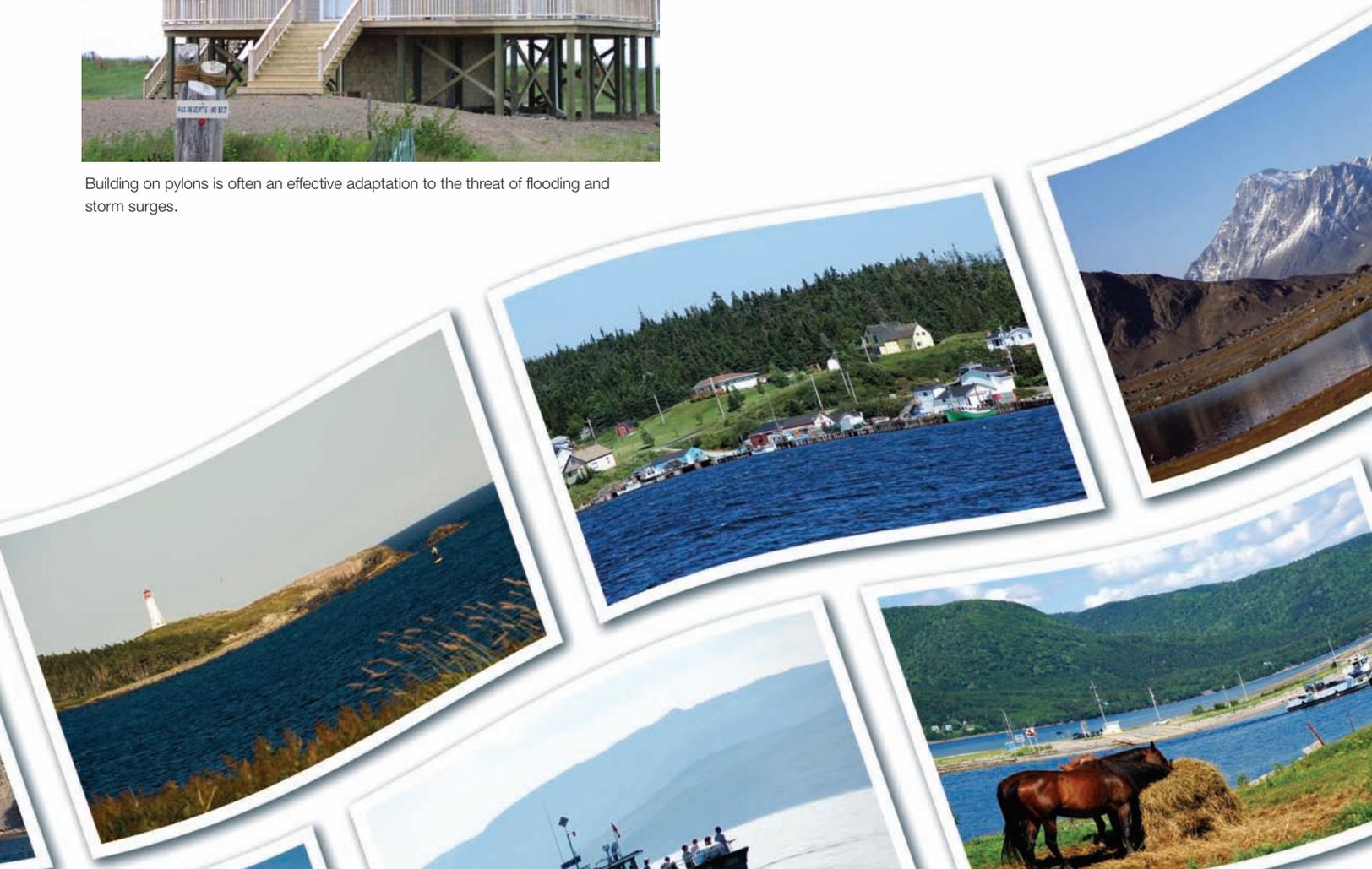


Potential areas at risk from storm-surge flooding in Annapolis Royal, NS (after Belbin and Clyburn).



Building on pylons is often an effective adaptation to the threat of flooding and storm surges.

An important aspect of any adaptation strategy is development of an understanding among residents of the key issues facing their community. Community-based planning and activities are likely to be the most effective.



With an area of 1.6 million km², Quebec is Canada's largest province and the second-most populated. The region extends from southern Quebec, which is home to most of the people, infrastructure and economic-agricultural activity in the province, to the rugged maritime coasts in the east and the sparsely populated land rich with natural resources in the Canadian Shield area.

Quebec has a growing and increasingly diversified economy based on the service sector, which generates 70% of the province's annual GDP of \$275 billion (in 2005). The primary sector (agriculture, forestry, hunting and fishing) now accounts for only 2.3% of the GDP. Other important industries include tourism, aluminum smelting, mining and maritime transport.

Climate change will bring milder, wetter winters and hotter, more humid summers to southern Quebec. More extreme weather, including heat waves, summer droughts, winter storms and heavy rainfalls, is a significant concern. The greatest temperature increases in the province are projected for northern Quebec, a region that has also seen the fastest rise in temperature over recent years. In the maritime regions, declining sea-ice cover, changing storm patterns and intensities and sea level rise are key issues.



In 1989, a major ice break-up on the Saint-François River resulted in winter flooding of several houses situated in the boulevard Allard at Drummondville.

Climate impacts on terrestrial and aquatic ecosystems have already been observed in northern Quebec.

Regional Issues

An increase in extreme weather events poses a serious threat to the aging infrastructure in southern parts of Quebec. Water and energy supply infrastructure, as well as roads and bridges, are at risk. Adaptation measures, including the refurbishment or replacement of some infrastructure, would reduce the magnitude of potential impacts.

Sea level is predicted to rise 18 to 59 cm by 2100. This will result in higher risk of flooding and damaging storm surges, further stressing a population already dealing with downturns in the fishing and forestry industries during the past decade. Sea-level rise, combined with reduced sea-ice cover (projected to be 60% less by 2050) and changes in storminess, will lead to accelerated rates of coastal erosion, thus threatening coastal infrastructure and marine ecosystems.

Sea level may rise up to 14 cm at Quebec City and Rimouski by 2050. This would result in storm surge flooding at Rimouski occurring three times more frequently.

Climate change will impact the security, health and well-being of many residents in northern Quebec due to their isolation and close ties to the natural environment. A key concern is permafrost thawing, which will cause soils to subside and buckle, thus undermining roads, buildings, airport runways and other important infrastructure. Warmer winters will make travel on snow and ice roads riskier, threatening vital supply lines and the safety of hunters and trappers. Disappearing sea ice will cause shifts in the distribution of animals that depend on ice cover for hunting and breeding.

Changes that could have positive economic impacts include warmer winters, which will reduce winter heating costs. Hydroelectricity generation potential in northern Quebec could increase as a result of increased precipitation. A longer, warmer growing season could benefit both agriculture and forestry; however, such extreme weather events as ice storms, torrential rains, extreme heat and drought could negate these benefits. Warmer temperatures will also allow many insect pests and pathogens to thrive, presenting additional challenges to farmers, forest managers and the healthcare system.



What's Being Done?

Quebec is well positioned to adapt to climate change. Indeed, there are several adaptation measures already underway in the province, ranging from research studies to new technologies to policies and programs. Many other adaptation options are currently being evaluated, and will be implemented in the coming years.

To reduce the impacts of climate change on critical infrastructure, vulnerability maps have been developed for use by planners in coastal regions and on permafrost terrain to limit development in vulnerable areas. Improved design standards, which allow for additional safety margins, have been introduced for buildings and for transportation and energy infrastructure.

To address potential health impacts, emergency response plans for heat waves have been established in seven of eight regions of Quebec (as of 2006). Improved environmental monitoring and health surveillance systems have also been introduced.

There has been support for extensive research focused on, for example, coastal erosion in the Gulf of St. Lawrence. Investments have also been made in wind technology, to help diversify the sources of electricity in the province.



The Ouranos Consortium, created in 2002, pools the expertise and disciplines of numerous researchers in order to advance the understanding of climate change impacts and potential adaptation responses. Well over two hundred scientists and adaptation stakeholders are involved in the Ouranos network. Ouranos strives to ensure a better match between research efforts and users' needs.

Classification map of land development potential in Salluit

-  Most recommended
-  Less recommended
-  Least recommended
-  Not recommended



Vulnerability map of Salluit in Nunavik, Quebec, showing suitability of the land for infrastructure construction (from Solomon-Côte).



ONTARIO

Covering more than a million square kilometres, Ontario is Canada's second-largest province by area and the largest by population (12.5 million). The land is diverse, ranging from densely populated cities and highly modified landscapes in the south to sparsely populated, low-lying terrain in the northern areas, some of which are underlain by permafrost. The Great Lakes, which form much of the province's southern boundary, are a critical water source for both Canada and the United States, and are also important for shipping, tourism and recreation, and ecosystem services.

Eighty-five per cent of Ontarians live in urban centres, the majority in the southern third of the province. This is also where most of the province's farms, industry and infrastructure are located. Communities in the central and northern areas of the province are smaller, and largely dependent upon natural resources for their economic base.

In recent years, Ontario has endured a number of weather-related catastrophes, including heat waves, floods and wind damage. Flooding in North Toronto on August 19, 2005, resulted in more than \$500 million in damages and stands as the costliest disaster in the province's history. Such events demonstrate the powerful impact severe weather can have on the province's economy, infrastructure and water supply, as well as on the health and well-being of Ontario residents.



Flood damage in North Toronto as a result of exceptionally heavy rainfall (August 2005).

Climate change will bring more extreme weather to most of Ontario, including an increase in droughts. Temperatures will increase across the province, with the most dramatic changes in temperature occurring in winter. In the summer, warmer nights will increase heat stress during times of maximum heat. Changes in average conditions will also pose challenges for Ontario.

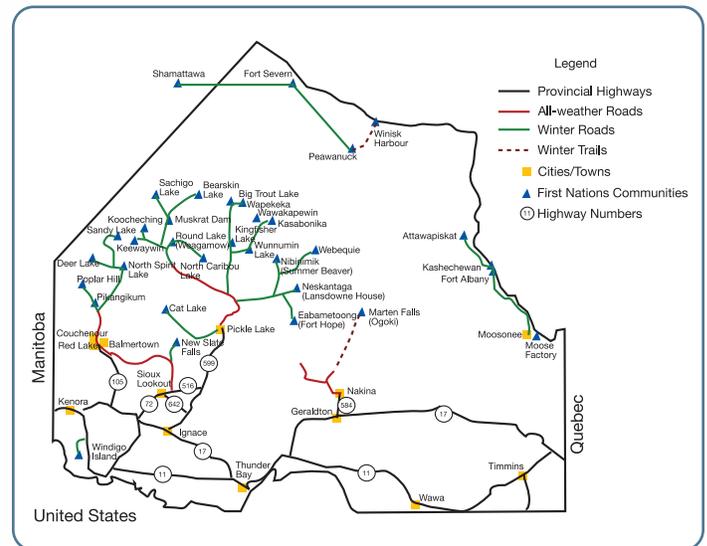
Regional Issues

The impact of climate change on human health is a key issue in Ontario. Across the province, waterborne diseases and those spread by insects and animals are expected to become increasingly common in a warmer and generally more humid climate. Higher summer temperatures, more frequent heat waves and associated air quality issues put vulnerable populations at risk, especially in urban areas. Conversely, warmer winters will bring some health benefits.

Water resources will be affected across Ontario. Increased evaporation, as well as changes in rainfall patterns, will result in generally lower river levels during summer, causing seasonal water shortages.

Climate change is expected to result in even lower water levels that would further compromise Great Lakes shipping and potentially reduce hydroelectricity output by more than 1000 MW by 2050.

Forest fires, pest outbreaks, drought and ice-jam flooding are key climate change concerns for remote and resource-based communities in the province. Communities in the farthest north will be further challenged by shorter operating seasons of winter roads. These roads are vital for the delivery of construction materials, food and fuel to many communities and mine sites.



Communities and winter roads in northern Ontario (Ontario Ministry of Northern Development and Mines).

What's Being Done?

Adaptation to climate change is already underway in many areas and sectors. Examples include the following:

- Several Ontario cities have well-developed weather and smog advisories and heat-health alert systems.
- Some conservation authorities and public health departments are factoring climate change into their long-term plans.
- Farmers and foresters are adopting advanced technologies and management practices to ensure the survival of crops and forests in the face of climate change. For example, foresters are planting hardier species and moving other species up to 100 km north of their current ranges during reforestation.



Toronto's Hot Weather Response Plan is a coordinated outreach and response program designed to alert and assist those most at risk of heat-related illness and death to hot weather conditions. An initial alert system was introduced in 1999, and the summer of 2001 saw the launch of an improved alert system based on local weather conditions, which incorporated information on the impacts of past heat waves. A Hot Weather Response Committee meets three times a year to monitor, evaluate and update the Hot Weather Response Plan. This is an example of how adaptation is an ongoing process that will often involve more than a single action.

Opportunities exist for rapidly mainstreaming adaptation to climate change into decision-making.



PRAIRIES

The Prairie Provinces of Alberta, Saskatchewan and Manitoba extend from the glacier-clad peaks of the continental divide, across the agricultural heartland of Canada and vast regions of boreal forest, to the tundra coastline of Hudson Bay. With over 37 million hectares of land under cultivation — 80% of Canada’s farmland — the Prairies are Canada’s agricultural powerhouse. The primary resource sector (oil and gas production, farming, forestry and mining) is the largest contributor to the region’s economy, but service industries are the fastest-growing sector and provide most of the employment.

All regions of Canada can experience seasonal dry spells, but only in the Prairie Provinces can precipitation cease for a month, surface water disappear for entire seasons, and drought persist for a decade or more.

Seventy-five per cent of the region’s 5.5 million people live in cities. The population is expected to grow 30% in the next 25 years, with 40% of that growth taking place in Alberta.

The Prairies have one of the world’s most variable climates. Summers are typically hot and dry, and winters can be bitterly cold. Total rainfall can vary enormously from season to season and from year to year.

In the future, the Prairies’ climate is expected to become more variable. More extreme weather, including heat waves, intense storms, torrential rains, hail and floods is likely. Droughts may become more frequent and pronounced. More precipitation will fall as rain rather than snow, and there will be less rainfall in the summer growing season, when it is needed most.

The most costly natural disasters in Canadian history have been droughts on the Prairies. The drought of 2001–2002, which was felt across Canada but concentrated on the Prairies, cost the regional economy \$3.6 billion in lost agricultural production and 41 000 jobs.

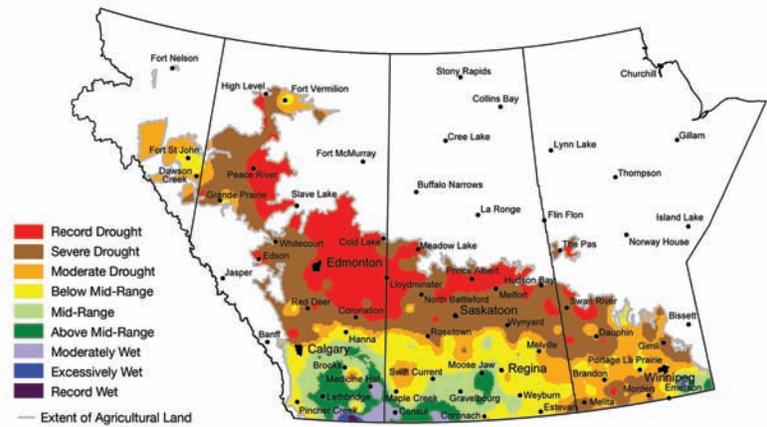
Regional Issues

Water shortages and increased aridity are the key climate change concerns on the Prairies, with implications for most aspects of prairie life. Reduced availability of water could constrain production in several important economic sectors, such as agriculture, forestry and energy, encouraging continued migration from rural areas to urban centres. Many other sectors, including recreation, tourism and public health, will also be challenged by a drier future.

Climate change will also be associated with periods of too much water. Flooding, resulting from high-intensity rainfalls and/or rapid snow melt, is also expected to become more common. Flood control will be a significant issue, particularly in urban areas. Standing waters following flood periods, in association with warmer temperatures, could foster the spread of vector- and water-borne diseases, such as West Nile virus.

Climate change means that the Prairies are losing many of the advantages of cold winters. A great deal of resource exploration, forestry operations and transportation in the northern parts of the region rely on solidly frozen ground and a network of seasonal ice roads. Cold winters are also extremely important in controlling the spread of many pests and diseases.

Major ecosystem shifts are expected as the distribution of plant and animal species change with climate warming and drying. Changes in terrestrial ecosystems will be most visible near sharp ecological gradients, such as in the mountains, in island forests and along the margins of the northern and western coniferous forests. Non-native plants and animals will likely benefit from changing climate, challenging current species. Lower water levels and higher water temperatures will impact aquatic ecosystems, affecting fish and waterfowl.



Drought conditions on the Prairies (August 2002) based on precipitation compared to historical distribution (Agriculture and Agri-Food Canada).

http://www.agr.gc.ca/pfra/drought/drought02sum_e.htm



What's Being Done?

The history of culture on the Prairies is one of continuous adaptation to changing conditions. Sophisticated methods of irrigation, water resource management and soil conservation are widely practiced to deal with water shortages and drought. Numerous programs have been put in place to help producers cope with an unpredictable climate and volatile markets.

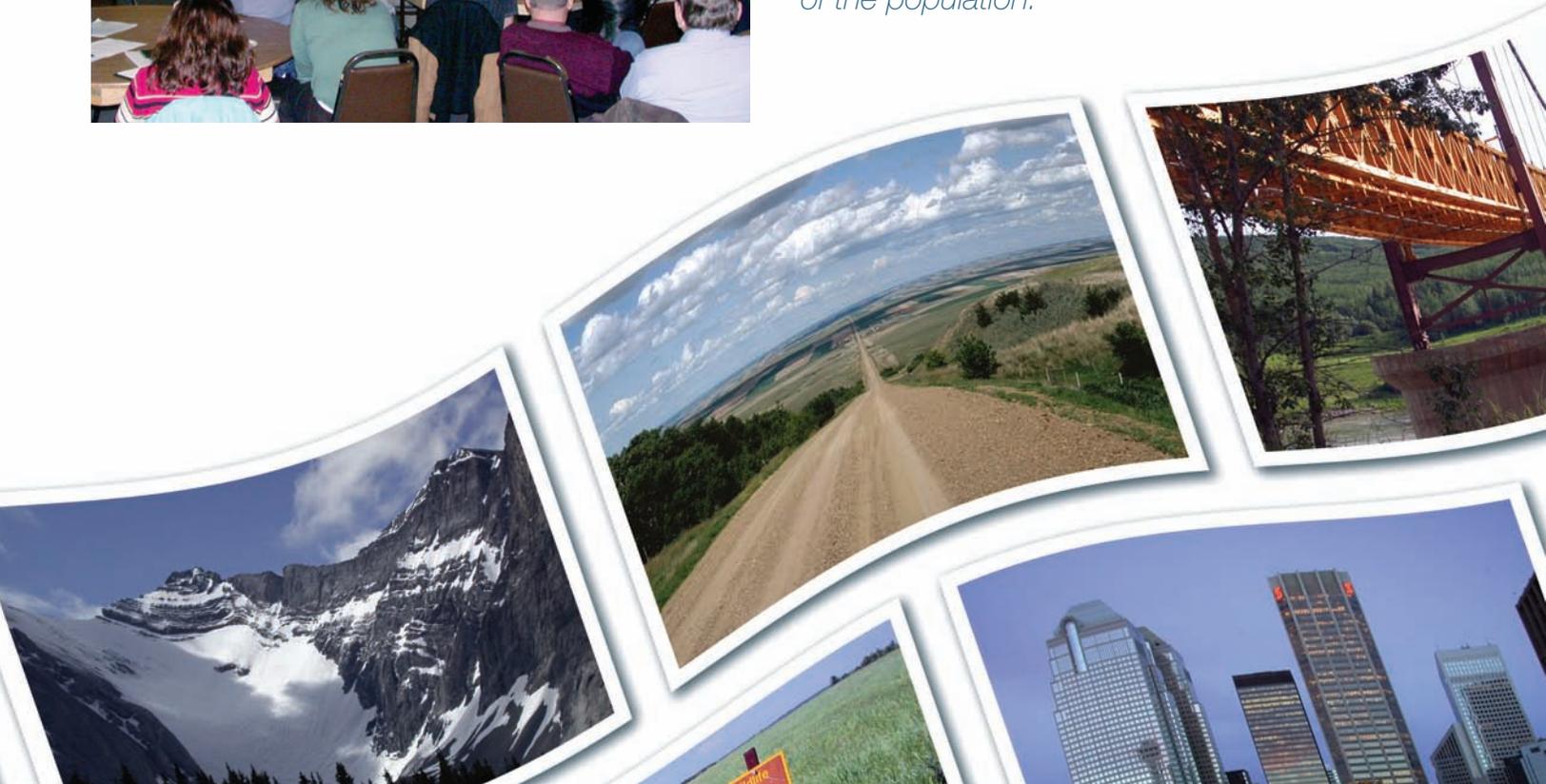
Adaptations in the region range from decisions made by individuals, such as crop selection and purchasing of crop insurance, to major initiatives, such as re-engineering of the Red River Floodway. In response to recent climate impacts, all-weather roads and river crossings are being developed to access many communities formerly reliant on winter roads, while forest companies are using high-floatation tires on logging equipment to deal with wet soil conditions. Water and energy conservation plans of individuals, communities and regions all assist in increasing our ability to cope with changing climate.

The Prairie Provinces, as a whole, have the resources and capacity needed to successfully adapt to climate change, but this ability needs to be applied. There are significant differences within populations and between cities and rural areas. Urban areas tend to benefit from greater access to financial resources, advanced technologies and services, whereas hard-won experience and robust community support networks are strengths for adaptation in rural areas.

Alberta's Water For Life Strategy aims to use economic instruments, best management practices and watershed management plans to increase the efficiency of water use by 30%. Flood risk maps, early warning systems and emergency response measures are also in the works.



In a small town, even a modest climate event can be locally disastrous, simply because it is likely to affect a greater proportion of the population.



Containing a rich variety of landscapes — including forests, grasslands, mountains, meadows, coastal wetlands, innumerable rivers and lakes, tidal zones and the only temperate rain forest in the country — British Columbia is the most physically and biologically diverse region in Canada.

Most of BC's population of about 4.3 million (2006) clusters in the province's southwest corner, in and around the cities of Vancouver and Victoria. Many smaller cities and towns and Aboriginal communities are dispersed along the coast and in the province's interior.

The extraction, processing and export of natural resources remain a mainstay of BC's \$150 billion economy. But, service sector activities, including communications, film-making, tourism and high-tech, are dominant in the cities.

British Columbia's climate has warmed significantly in recent decades, with the most dramatic changes observed in southern BC and in the north-central coast. As climate change continues, much of the province will get warmer and wetter, particularly in winter and spring. Summers will become drier, especially in the south-central valleys. Extreme weather, including heat waves, powerful storms and intense precipitation, will occur more frequently.

Most of BC's alpine glaciers are retreating rapidly and many may disappear altogether in the next 100 years.

Regional Issues

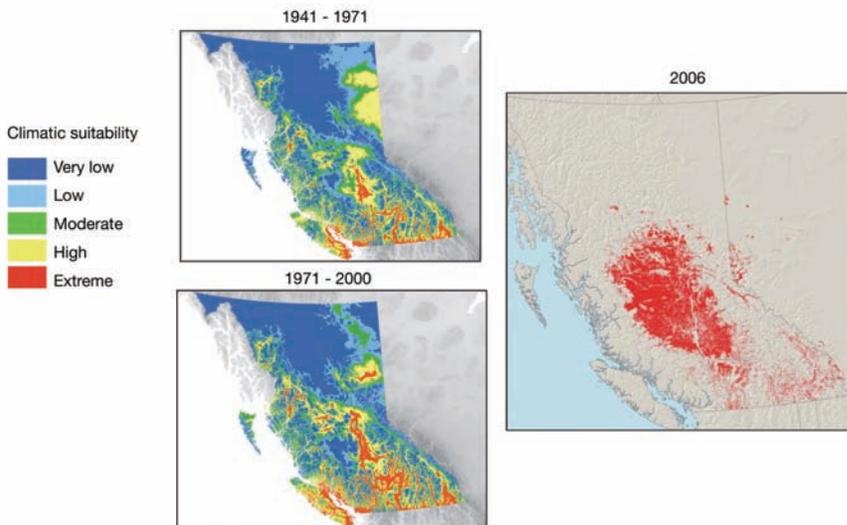
Mountain pine beetle (MPB) already affects about 14.5 million ha (2008) of BC's forests. This massive outbreak is linked to both past management practices and recent climate warming. Continued warming will encourage the MPB to continue its spread, farther north and east. The economic and environmental impacts are huge, with long-term implications for the forest industry, forest-dependent communities and forest ecosystems.

Water shortages will become increasingly common in some urban centres and other areas of the province, due to shifting precipitation patterns, higher evaporation rates and shrinking mountain snowpacks and glaciers. This will impact all water users, including municipalities, agriculture, industry, fisheries, forestry, power generation, tourism and aquatic ecosystems. Hydroelectric power generation provides British Columbia with nearly 90% of its power supply.

Windstorms, forest fires, storm surges, coastal erosion, landslides, snowstorms, hail, droughts and floods already have major impacts on BC's communities, industries and environment. The province will face more of these events in the future, threatening critical infrastructure, such as roads, ports and water treatment facilities, as well as human health and well-being.

Although warmer and longer growing seasons may bring some benefits and new opportunities for agriculture in the province, water shortages and increased pest infestations could strain the ability of producers to profit from climate change.

Fisheries will also be challenged; warmer sea surface and stream temperatures are a special concern for Pacific salmon. Salmon are a crucial economic and cultural keystone species in the province.



British Columbia could warm by 2-7°C by 2080.

Left: Historical distributions of climatically suitable habitats for the mountain pine beetle (MPB) in British Columbia (adapted from Carroll et al.). Areas with 'very low' suitability are unsuitable for MPB, where as 'extreme' areas are those considered climatically optimal. *Right:* Total area affected by mountain pine beetle in British Columbia in 2006 (Natural Resources Canada).



What's Being Done?

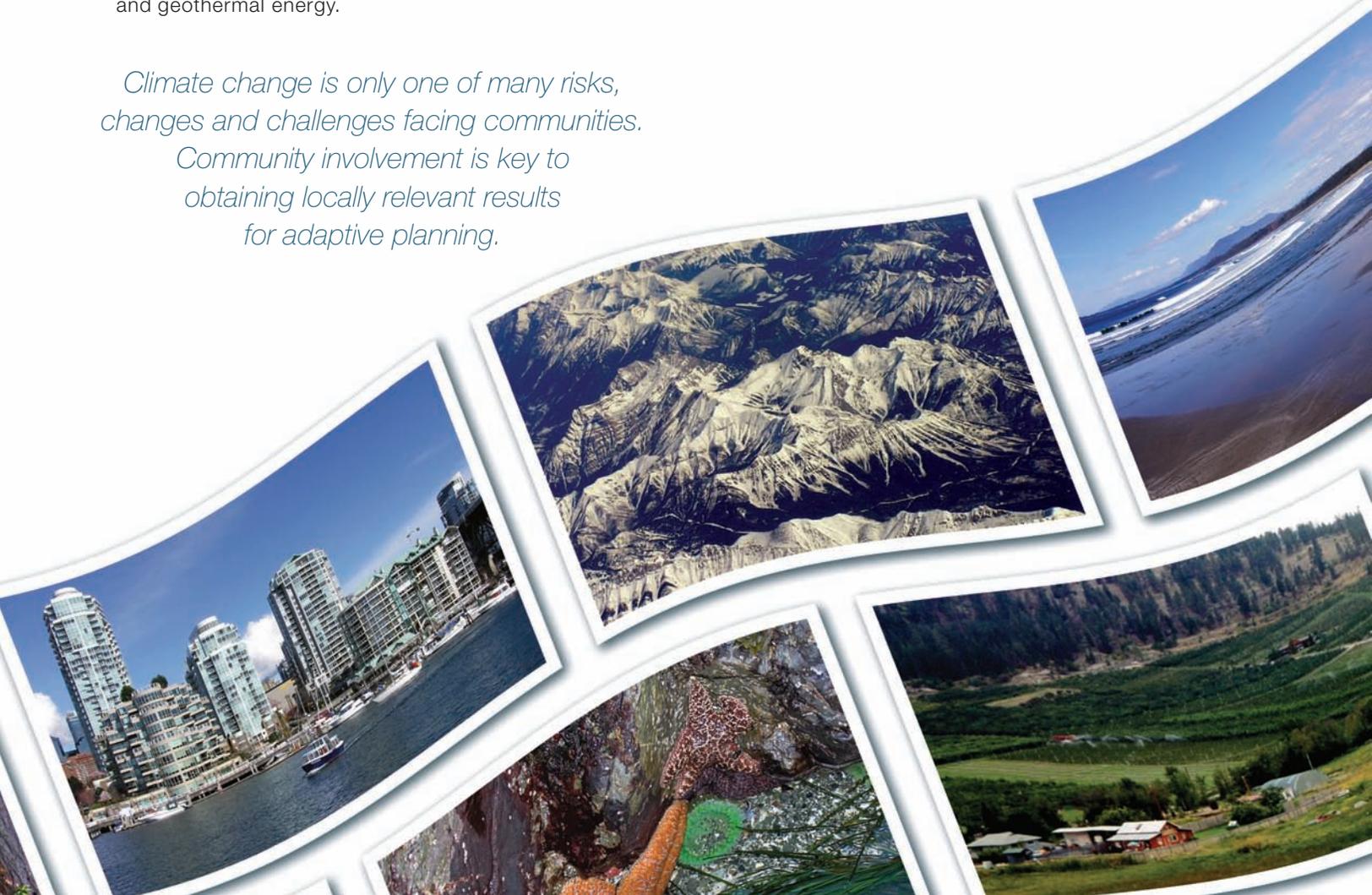
Individuals, governments and industry in British Columbia are beginning to act to address climate change impacts. For example:

- Many residents of remote coastal communities are making additional preparations to deal with shortages of power and food caused by severe weather events;
- Metro Vancouver has adopted an integrated storm water management strategy that includes consideration of projected climate change;
- Drought-prone regions, such as the Okanagan Valley and the Victoria Capital Regional District, have instituted aggressive restrictions on water use and various financial incentives for improving water use efficiency;
- Climate change is explicitly recognized as a priority concern in the Trepanier Landscape Unit Water Management Plan (Okanagan Valley);
- The BC Ministry of Forests and Range is integrating climate change considerations into its long-term planning and forest management practices; and
- In response to increasing demands for electricity and expected decreases in hydropower production as a result of changing river flows, BC Hydro has set the goal of meeting at least 50% of new power demand by using renewable sources, such as biomass, wind and geothermal energy.

More than 110 communities in British Columbia are economically reliant on the forest industry. Research is examining the social and economic impacts of mountain pine beetle on Vanderhoof, in north-central BC, with a specific goal of being able to plan adaptation to climate change. Residents are concerned about the long-term implications of environmental changes for the community and future generations. Changes in annual harvest levels necessitated by the MPB outbreak mean that the local economy will go through great changes during the next decade. The challenge is to manage this transition to ensure long-term sustainability.

Climate change is only one of many risks, changes and challenges facing communities.

Community involvement is key to obtaining locally relevant results for adaptive planning.



Higher temperatures, sea-level rise, heavy rainfall, intense storms, severe floods and droughts, and more heat waves are just some of the climate impacts being observed around the world. Worldwide economic losses due to severe weather disasters, adjusted for inflation, grew from US\$4 billion in 1975 to more than US\$200 billion in 2005. Such impacts are expected to intensify in the future due to climate change.

Climate change is already affecting the residents, economies and environments of all regions of the world...

The impacts of climate change and the adaptation measures that other countries take to respond to them will affect Canadians.

Trade Dynamics

Being part of a global market means that the impacts of climate change elsewhere will have significant consequences for the Canadian economy. For example, climate warming could increase forest productivity in Canada, but increased forest productivity in other countries could result in lower prices for Canadian wood products.



Northern Security

Declining Arctic sea ice will allow more international marine traffic to pass through Canada's North. This will increase demands for surveillance, monitoring, maintenance of navigation signals, search-and-rescue services and environmental protection. Activities to address these needs will assert Canada's sovereignty over these marine passageways, while protecting ecosystems and indigenous cultures from potentially negative impacts related to increased shipping and other economic activities.

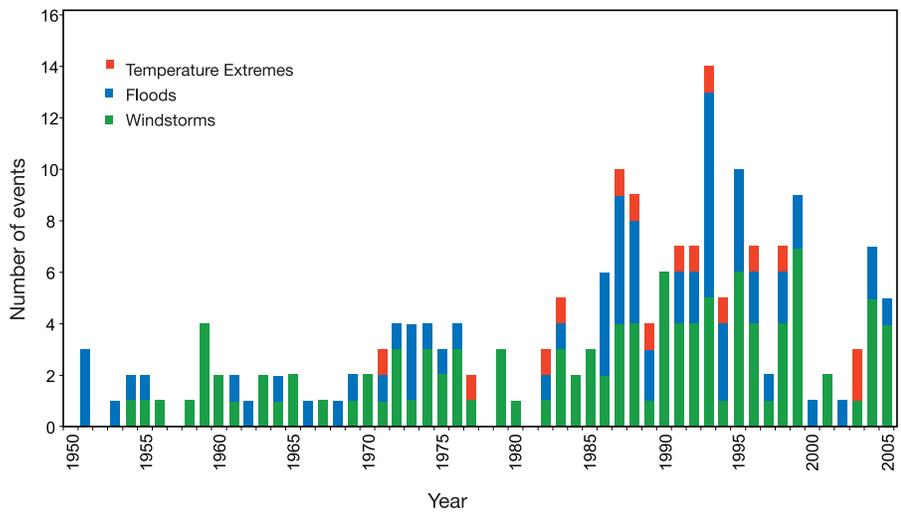
Water Resources

Canada's transborder water agreements with the United States were forged before climate change became an important issue. Rising temperatures and melting mountain snowpacks are affecting the quantity and quality of water in many rivers and lakes that straddle the Canada-United States border. These impacts will affect the sustainable management of water resources in both countries.

International Development

Each year, as the climate warms and the global population grows, more people are impacted by severe weather-related disasters, such as floods, landslides and droughts. Such disasters, and associated impacts on food and water supplies, can lead to serious health problems and, in poorer countries, can compromise the achievement of development goals. Impacts associated with gradual climate changes, such as rising sea level, are also a significant threat to many low-lying developing countries that have limited ability to deal with such problems. Such impacts have potential implications for Canadian activities related to international aid, peace-keeping and immigration.

Canada is involved in international initiatives to promote sustainable development and reduce poverty in developing countries. These activities help those who are most vulnerable to the impacts of climate change and enhance Canada's climate change expertise, adaptation skills and practices.



The number of global climate-related natural disasters, by event, from 1950 to 2006 (data from Munich Reinsurance), <http://www.munichre.com/publications/302-04772_en.pdf>.

Research, much of which was supported in part by Natural Resources Canada, has given us a clearer picture of the current and future risks and opportunities that climate change presents to Canada, and a better understanding of how adaptation occurs and the barriers that can limit implementation.

The report *From Impacts to Adaptation: Canada in a Changing Climate* identifies some key conclusions that apply to Canada broadly. These include:

- The impacts of changing climate are already evident in all regions of the country. Higher temperatures, declining sea and lake ice, diminishing glaciers, more heat waves and increased coastal erosion are just some of the changes being observed.
- The impacts of many recent severe weather events, including heavy rains leading to flooding and landslides, wind and ice storms, and storm surges, demonstrate that Canadian communities and critical infrastructure are vulnerable to climate change. Many of the most severe and costly impacts of climate change will be associated with increases in the frequency and magnitude of extreme weather events.
- Some of the most pervasive impacts in Canada will be related to water resources, with seasonal water shortages and health concerns related to water quality being experienced in every region of Canada. Demands on water resources for agriculture,

energy production, communities and recreation will have to be managed in consideration of ecosystem needs.

- Climate change affects all regions of the world. Impacts on other countries, and the steps taken to address these, will affect Canadian consumers, the competitiveness of some Canadian industries, and Canadian activities related to international development, aid and peace-keeping.
- In Canada, we have the knowledge, technology and resources to cope with changing climate — our adaptive capacity is high. However, not all regions and populations are equally well positioned. Resource-dependent and Aboriginal communities, for example, are particularly vulnerable to climate change. This vulnerability is magnified in the Arctic.
- Adaptation is beginning to occur across the country. For example, communities are developing emergency response plans for heat waves and flooding, and water meters are being installed in several cities to reduce water demands.
 - There is much more to be done. Integrating climate change into existing planning processes, often using risk management methods, is an effective approach to adaptation.
 - Although further research will address specific knowledge gaps and adaptation planning needs, we have the knowledge necessary to start undertaking adaptation activities in most situations now. In many cases, however, there is still a need to raise awareness of the value of adaptation, and also to ensure that the information and tools needed to make adaptation decisions are widely available.



CONCLUSION

Canada's climate is changing and impacts are being felt across the country. As climate change continues, current climate risks will intensify and a range of new challenges and opportunities will be presented. As highlighted throughout this report, key impacts will vary across Canada, although all regions will face issues concerning water availability (too little or too much), health and well-being, and extreme weather events.

Adaptation is necessary now and in the future. Many examples of current adaptation initiatives have been highlighted in the previous pages. These examples are promising indications of the interest and ability of Canadians to adapt their behaviour, activities and thinking to meet the challenge of climate change. They also demonstrate that adaptation encompasses

a wide range of possible responses and that individuals, community groups, the private sector and governments can all play important roles in building a more resilient Canada.

We are only starting to address the challenges of climate change. The path forward on adaptation will build upon current successes. Improving access to information, help and advice, maintaining and strengthening the knowledge base, and overcoming barriers to action are just some of the ways to facilitate adaptation.

As a country, we have the skills, knowledge and resources (social, economic and institutional) to adapt to climate change; the challenge lies in using them effectively.

