

# **CLIMATE CHANGE ADAPTATION PLANNING TOOLKIT**

**FOR INDIGENOUS COMMUNITIES**

## **APPENDICES**

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### **GUIDANCE BOOK**

**RESOURCES FOR  
WINTER ROADS, WILDFIRES,  
FLOODING, & COASTAL EROSION**

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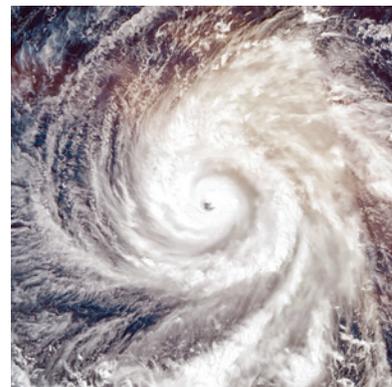
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# APPENDIX 1

## GLOSSARY OF TERMS

### Glossary of Key Terms:

- **Adaptation:** Adaptation is how we respond or prepare for climate change and weather variability (INAC, 2010). It is the process by which people and natural systems respond to actual or anticipated climate, either to minimize or avoid harm or take advantage of new opportunities (IPCC, 2014).
  - **Proactive Adaptation:** adaptation that occurs before a climate change impact is observed or felt.
- **Adaptive Capacity:** Adaptive capacity is the ability to adjust to changing circumstances. It includes the ability of systems, institutions, humans, and other animals and plants to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC, 2013).
- **Climate Change:** a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels (Oxford Dictionary, 2019).
- **Climate Model:** Computer driven representations of potential future climate conditions, including changes in temperature, precipitation, and other physical characteristics of the climate system (Hayhoe, 2017)
- **Climate Projection:** A climate projection is an estimation of future climate, determined by a climate model (IPCC, 2013).
- **Climate Resilience:** Resilience can be thought of as the ability of the community to prevent, respond to, or recover from a disturbance (e.g. a climate change impact) (US Government, 2020).
- **Climate Scenario:** A climate scenario is a possible picture of what future climate could look like. Climate scenarios are developed and used to investigate and understand the potential impacts of human induced climate change (IPCC, 2001).
- **Community-Based Monitoring:** a process where citizens, community groups, government agencies, industry, members of the academic community, and/or local institutions work together “to monitor, track, and respond to issues of common community concern” (EMAN and CNF, 2003).
  - **Indigenous Guardians Program:** many communities have implemented an Indigenous Guardians program, where guardians monitor ecological health, maintain cultural sites, and protect sensitive areas and species (ILI, 2019). Guardians serve as the “eyes on the ground” in Indigenous territories (ILI, 2019). To learn more, visit the [Indigenous Guardians Pilot Program \(https://www.canada.ca/en/environment-climate-change/services/environmental-funding/indigenous-guardians-pilot-program.html\)](https://www.canada.ca/en/environment-climate-change/services/environmental-funding/indigenous-guardians-pilot-program.html), [Indigenous Leadership Initiative \(https://www.ilinationhood.ca/our-work/guardians/\)](https://www.ilinationhood.ca/our-work/guardians/), and [Indigenous Guardians Toolkit \(https://www.indigenousguardianstoolkit.ca\)](https://www.indigenousguardianstoolkit.ca).
- **Consequence or Impact:** The effect of extreme weather, climate events and climate change on natural and human systems (IPCC, 2014).
- **Critical Infrastructure:** The physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society (UN-ISDR, 2017)



- **Consequence or Impact:** The effect of extreme weather, climate events and climate change on natural and human systems (IPCC, 2014).
- **Critical Infrastructure:** The physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society (UN-ISDR, 2017)
- **Exposure:** The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets that could be negatively affected by a climate impact (IPCC, 2013).



- **Flooding:** Flooding is the overflowing of water onto land that is normally dry (Lyle, 2017).
  - **Coastal Flooding:** Coastal flooding occurs along the coast of a sea, ocean, or other large body of open water. The likelihood and intensity of coastal flooding is increased by severe weather and sea level rise (Maddox, 2014).
  - **Inland Flooding:** There are two types of inland floods - fluvial flooding and pluvial flooding. Fluvial or *riverine* floods occur in areas along rivers, lakes, and other bodies of water and may result from rainfall, snow and ice melt, and ice jams. Pluvial flooding can happen without being near an open/flowing bodies of water. They are a result from excessive rainfall and often accompanied by high groundwater levels (Maddox, 2014).
- **Geospatial:** relating to data that is associated with a particular location.



- **Hazard:** a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation (UN-ISDR, 2017)
  - **Climate Hazard:** a physical process or event that can cause harm to human health, livelihoods, or the natural environment (The World Bank, 2019). Examples of climate hazards include thunderstorms, drought, rain, hail, snow, lightning, fog, wind, temperature extremes, air pollution, and climate change (Hobbs, 1987).
- **Hazard Assessment:** The process to determine the extent, intensity, frequency, or likelihood of a hazard occurring.



- **Hydrology:** the branch of science concerned with the properties of the earth's water, and especially its movement in relation to land.



- **Indigenous Knowledge:** A holistic system of knowledge acquired over time through experience or observation and is tied to the cultural, linguistic, spiritual and subsistence ways of Indigenous peoples (CIER and UBC, 2011).
- **Resilience:** Resilience is the ability/capacity of a system to absorb disturbance and reorganize while undergoing change in order to maintain essentially the same function, structure, identity, and feedbacks (Walker et al., 2004).
- **Risk:** Risk is a measurement of the potential impacts of a hazard over time. Risk is the probability of an event occurring multiplied by its negative consequences if they occur (Ebbwater Consulting, 2016).



- **Risk Assessment:** The process to determine risk levels.
- **Vulnerability:** The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UN-ISDR, 2017).

- **Sustainable Development:** Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987).



- Deborah McGregor (2006) offers an additional perspective on the concept of sustainable development and Indigenous Knowledge/ Traditional Ecological Knowledge (TEK): "...many environmental professionals believe that science and technology, at least on their own, cannot extricate us from our current crises. Other approaches are desperately needed and, thus...TEK has come to be viewed as a current, relevant, and viable system for understanding the situation and providing a basis from which to work toward solutions..." (p. 2).
- "The relationship with Creation and its beings was meant to be maintained and enhanced, and the knowledge required for this to occur was passed on for generations and over thousands of years. The responsibilities that one assumed were part of ensuring the continuation of Creation—what academics, scientists, and environmentalists might today call "sustainability." (McGregor, 2006, p.3)
- "...all of Creation is important, all must be respected. If we lose or disrespect even the tiniest and seemingly most insignificant being, our own survival becomes threatened." (McGregor, 2006, p. 3)

- **Winter Roads:** Winter roads are carved from the ice and snow to provide temporary access to isolated regions where building conventional year-round roads is too expensive because there are too many river crossings and large boggy areas to traverse (Northern Policy Institute, 2015).



# APPENDIX 2

## WINTER ROADS PLANNING RESOURCES

### Nunavut Climate Change Centre

**Developed by:** Government of Nunavut Department of Environment

**Source:** <http://climatechangenunavut.ca/en>

**Region:** North

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Nunavut Climate Change Centre hosts a resource page full of informative websites, many of which provide climate change information related to the Canadian north. The site contains an interactive climate change map, a permafrost databank, vulnerability maps for land development purposes, a literature review map of Nunavut, a resource page for research, links to Traditional Knowledge sites, databases, reports, and news. Several projects from the Nunavut Climate Change Centre integrate Indigenous Traditional Knowledge and provide documents in four languages (English, French, Inuktitut, and Innuinaqtun).

### Climate Change Adaptation Resource Guide: Nunavut Emergency Planning and Extreme Weather

**Developed by:** Government of Nunavut, Nunavut Climate Change Centre

**Source:** <http://climatechangenunavut.ca/en>

**Region:** North

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Climate Change Adaptation Resource Guide is intended for policymakers and practitioners within the emergency preparedness and management sector in Nunavut. The objective of this document is to provide an overview of information and resources designed to assist readers in incorporating adaptation-based activities and policies into environmental planning, recognizing climate-related vulnerabilities, and evaluating risk.

## **SmartICE: Sea-ice Monitoring and Real-Time Information for Coastal Environments**

**Developed by:** ArcticNet

**Source:** <https://www.smartice.org/>

**Regions:** Nunatsiavut; Labrador; coastal communities

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 6: Monitoring Progress and Change

SmartICE (Sea-ice Monitoring and Real-Time Information for Coastal Environments) is a climate change adaptation tool and technological innovation of ArcticNet's Nunatsiavut Nuluak project, which is addressing concerns surrounding impacts of climate change and modernization on communities in Northern Labrador. SmartICE is a community-university-industry collaboration that integrates technology, remote sensing, and Inuit Knowledge to promote safe travel for all stakeholders in northern coastal environments. Through a network of in situ sensors, the system generates daily observations of changing sea ice conditions at hazardous travel locations, particularly during freeze-up and break-up. This is combined with user-based satellite image classifications of sea ice state and sea-level rise, as well as Traditional Inuit knowledge of safe winter traveling paths. SmartICE has partnered with C-CORE to deliver remote sensing expertise and the Canadian Ice Service. Repeat satellite imagery is produced and used to map sea-ice surface conditions (e.g., concentration, roughness, water content) using user-defined classification systems.

## **Winter Roads Draft Technical Binder**

**Developed by:** IBI Group, Hemson Consulting Ltd.

**Source:** <https://nomts.ca/>

**Region:** North

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action

The Winter Roads Draft Technical Binder was prepared for the Ontario Ministry of Transportation and Ministry of Northern Development and Mines to assist them in developing the Northern Ontario Multimodal Strategy. This document provides information on programs and policies, winter road usage, construction and maintenance, and operations. A jurisdictional comparison of winter road guidelines and road management approaches in Manitoba and the Northwest Territories is also included. Climate change adaptation plan strategies for winter roads are described, including specific construction methods and improved water crossings. The Winter Roads Draft Technical Binder also addresses funding challenges for communities, safety concerns of road users, and consideration of all-season road development in remote communities.

## **Guidelines for Safe Ice Construction**

**Developed by:** Northwest Territories Department of Transportation

**Source:** <https://www.inf.gov.nt.ca/en>

**Region:** North

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action

The Guidelines for Safe Ice Construction document was developed by the Northwest Territories Department of Transportation to provide guidance to individuals involved in the construction and maintenance of winter roads. The document includes a glossary of ice-related and winter road operation terminology, and an explanation of ice behaviour under various loading regimes. Ice hazards, winter road inspection, and end-of-season guidelines are also discussed.

## **Guidelines for Safe Ice Construction**

**Developed by:** International Institute for Sustainable Development

**Source:** <https://www.iisd.org/library/economic-implications-climate-change-transportation-assets-analysis-framework>

**Region:** North/National

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Conclusions and recommendations

While economic analysis methods such as cost-benefit and economic impact assessments are well established, their application to climate change impacts on transportation infrastructure is less developed. This guide focuses on aiding practitioners to better understand how to reveal the economic implications of both ongoing damages to transport infrastructure and the benefits of investing to improve infrastructure resiliency. The guide includes: a taxonomy of economic benefits from transportation infrastructure, relating these benefits to costs as climate change alters infrastructure services and triggers additional costs; an exploration of the economic toolkit; a step-by-step approach to conducting a climate risk assessment; and some further thoughts on the process.

# APPENDIX 3

## WILDFIRES PLANNING RESOURCES

### **FireSmart – Protecting your Community from Wildfire**

**Developed by:** Partners in Protection

**Source:** <http://www.firesmartcanada.ca/>

**Region:** National

**Resource type:**

- Step 1: Starting Planning Process
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

This tool was produced by Partners in Protection, an Alberta-based coalition of professionals representing national, provincial, and municipal associations and government departments responsible for emergency services, land-use planning, and forest and resource research and management.

Primary topics include a description of interface issues, evaluation of interface hazards, mitigation strategies and techniques, emergency response for agencies and individuals, training for interface firefighters, community education programs, and regional planning solutions. Some tools found within this document include:

- Chapter Two: Wildfire Hazard Assessment System provides users with a structured and practical approach for assessing hazards posed by wildfires to homes, facilities, and communities.
- Chapter Three: Solutions and Mitigation provides users with solutions or mitigation options to reduce the hazard posed by interface fire to communities.

In addition, all readers should consider reading the ***FireSmart Homeowner's Manual***, a guide on reducing fire risk around the home. This updated guide is well designed, easy to read, and user friendly. Also view the eight-page ***FireSmart Homeowner's Assessment*** to evaluate and reduce house fire risk.

\*FireSmart communities have completed the 8-step FireSmart Canada Community Recognition Program. Learn more about **FireSmart Canada Community Recognition Program** and other FireSmart services.

## **Daily Wildfire Situation Map**

**Developed by:** Government of Saskatchewan

**Source:** <http://environment.gov.sk.ca/firefiles/firestodate.pdf>

**Region:** Saskatchewan

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability

Daily Wildfire Situation Map contains an up-to-date map, identifying current active wildfires (and a tally of all wildfires to date) in Saskatchewan including fires located on/near First Nation reserve lands.

## **Canadian Interagency Forest Fire Centre**

**Developed by:** Federal, Provincial, and Territorial non-profit organization

**Source:** <https://www.cifffc.ca/index.php>

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Conclusions and recommendations

The Canadian Interagency Forest Fire Centre (CIFFC) is a not-for-profit corporation owned and operated by the federal, provincial and territorial wildland fire management agencies to coordinate resource sharing, mutual aid, and information sharing. In addition, CIFFC also serves as a collective focus and facilitator of wildland fire cooperation and coordination nationally and internationally in long-range fire management planning, program delivery and human resource strategies.

## **Logan Lake FireSmart Project**

**Developed by:** Logan Lake BC

**Source:** <https://www.youtube.com/watch?v=vG5RFiD5Elg>

**Region:** British Columbia

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action

This video documentary tells the story of Logan Lake's development of a wildfire protection plan. In the summer of 2003, a series of wildfires in the BC interior devoured 265,000 hectares of forest and 334 homes. Although their community was spared, the fires were a wake-up call for the District of Logan Lake, BC. The community worked to produce a plan, incorporating several innovative ideas. These included teaming up with the local high school, whose students worked to reduce the amount of debris and forest fuels accumulated on the forest floor. For small BC communities working to develop their own protection plans, this program serves as a video blueprint.

## **First Nation Emergency Services Society of British Columbia**

**Developed by:** First Nation Emergency Services Society of British Columbia (FNESS)

**Source:** <http://fness.bc.ca/#>

**Region:** British Columbia

**Resource type:**

- Step 1: Starting Planning Process
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action
- Step 6: Monitoring Progress and Change

The First Nations Emergency Services Society (FNESS) assists British Columbia First Nations in developing emergency plans. To access Emergency Preparedness Training, a written request must be sent to FNESS from your community's Chief and Council or Band Administrator. This site offers free pdf templates to help communities develop their own emergency plans, a financial assistance guide book, emergency preparedness training, and prevention tools.

# APPENDIX 4

## INLAND FLOODING PLANNING RESOURCES

### CANWET – Canadian Watershed Evaluation Tool

**Developed by:** Greenland Technologies Group

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 6: Monitoring Progress and Change

CANWET is a GIS-based software designed to inform individuals working in river basin and watershed management, water supply and wastewater treatment infrastructure, food security, and climate change adaptation. The software is easy to use, has an open source GIS environment, and uses commonly available spatial data.

Greenland International Consulting offers training sessions to support use of this software. CANWET has been used in assimilative capacity studies, watershed and sub-watershed studies, master drainage plans, infrastructure planning, and source water protection studies.

*CANWET can be highly technical, it is recommended that a consultant, working group in the community, or person with an environmental background is hired in the community. This type of work can become complex and require a lot of time, which some chiefs and councils may be limited because they are dealing with competing interests. The consultant, working group, or “environmental champion” that is hired must be able to relay information back to the community and decision-makers in ways that are easily understood to get support for important decisions. They should also have some authority in decision-making.*

*Clynt King, Environmental Technician,  
Six Nations Council Environment Office  
May, 2018*

## **Flood Hazard Map Application**

**Developed by:** Alberta Environment and Parks

**Region:** Alberta

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 6: Monitoring Progress and Change

This application uses GIS technology to prepare flood hazard maps for Alberta communities. A high-speed internet connection is required in addition to the following computer specifications:

- Internet Explorer 9 or higher, Safari 3 or higher, Microsoft Edge, Firefox, Chrome; and,
- JavaScript must be enabled in your browser settings.

Users can search their community by name, or by address, and view the following areas: floodway, flood fringe, overland flow, and under review. It is important to note that flood hazards have not been identified in all communities and may exist in areas without flood hazard mapping.

## **Federal Flood Mapping Guidelines Series**

**Developed by:** Government of Canada

**Source:** <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/dsstr-prvntn-mtgtn/ndmp/fldpln-mppng-en.aspx>

**Region:** National

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability

In Canada, overland flooding costs the Canadian economy more than any other hazard we face, and is the single largest draw on the Disaster Financial Assistance Arrangements (DFAA). Flood mapping identifies the boundaries of a potential flood event and is critical to support informed decisions and investments to reduce the impacts of flooding in communities across Canada. In consultation with provincial and territorial partners and key stakeholders, the federal government has developed new documents in the Federal Flood Mapping Guidelines Series. These are a series of evergreen guidelines that will help advance flood mapping activities across Canada. The publication of these documents will contribute to better addressing overland flooding – Canada's costliest hazard – by strengthening flood mapping across the country.

## **Tools for Climate Change Vulnerability Assessments for Watersheds**

**Developed by:** ESSA Technologies Ltd.

**Region:** National/coastal

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

This compendium of tools was designed for technical experts, decision makers, adaptation planners, and resource managers to support the development of climate change vulnerability assessments for water quantity and quality at a watershed scale (Nelitz et al, 2013, p.1). This document serves to help readers understand the purpose of each tool type and inform effective adaptation actions. To achieve this, basic concepts surrounding vulnerability are introduced and several international case studies demonstrating tool applications are shared.

## **FloodSmart Canada**

**Developed by:** Partners for Action

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

FloodSmart Canada is an online platform that provides information on flooding risks, preparation, and mitigation. This site houses a toolkit of resources, case studies, and outreach materials. Specific checklists have been developed for homeowners, First Nation communities, organizations, and businesses.

## **Far North Major River Systems Map**

**Developed by:** Government of Ontario

**Region:** northern Ontario

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 4: Identifying Solutions

These maps exhibit major river systems in the Far North Region. Rivers included in this map series are: Albany, Winisk, Severn, Moose, Ekwana and Attawapiskat Rivers. The maps display gauging systems such as, cost share agreement gauges, Water Survey of Canada gauging stations and Meteorological Survey of Canada Climate stations, as well as dams and their jurisdictional owners and Far North First Nations communities.

## **Flood Protection Resources**

**Developed by:** Intact Centre on Climate Adaptation

**Source:** [https://www.intactcentreclimateadaptation.ca/programs/home\\_flood\\_protect/resources/](https://www.intactcentreclimateadaptation.ca/programs/home_flood_protect/resources/)

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Intact Centre on Climate Adaptation (Intact Centre) is an applied research centre with a national focus located at the University of Waterloo. The Intact Centre helps homeowners, communities, governments, and businesses to identify, and reduce, risks associated with climate change and extreme weather events, such as flooding. The Intact Centre on Climate Adaptation offers a number of resources to help residents to reduce their risk of experiencing a basement flood. Additionally, many municipalities and insurance providers offer subsidies or discounts to residents who take actions to reduce their flood risk. Reach out to your municipality or insurance provider for additional information.

## **Infrastructure Adaptation Program**

**Developed by:** Intact Centre on Climate Adaptation

**Source:** <https://www.intactcentreclimateadaptation.ca/programs/infrastructure-adaptation-program/>

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Intact Centre on Climate Adaptation (Intact Centre) is an applied research centre with a national focus located at the University of Waterloo. The Intact Centre helps homeowners, communities, governments, and businesses to identify, and reduce, risks associated with climate change and extreme weather events, such as flooding. The Infrastructure Adaptation Program helps communities across Canada to reduce their risk of flooding through two main areas of focus: 1) Flood Resilient Communities; and 2) Natural Infrastructure Preservation.

# APPENDIX 5

## SEA-LEVEL RISE & COASTAL EROSION

### PLANNING RESOURCES

#### Sea Level Rise Adaptation Primer – A Toolkit to Build Adaptive Capacity on Canada’s South Coasts

**Developed by:** The Arlington Group, EBA, DE Jardine Consulting, Sustainability Solutions Group

**Source:** <https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/resources/slr-primer.pdf>

**Region:** Atlantic and Pacific Coasts

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action
- Step 6: Monitoring Progress and Change

The *Primer* describes past and future sea levels and provides an overview of four different adaptation strategies, a recommended framework for decision making, and 21 adaptation tools to support local adaptation action. An analysis of each adaptation tool includes a description of the tool, a discussion of implementation methods, advantages and disadvantages, and identification of enabling legislation, where applicable.

The B.C. Ministry of the Environment commissioned the preparation of the *Sea Level Rise Adaptation Primer* for Canada’s Atlantic and Pacific coasts. Although this Primer was prepared in B.C., legislative provisions, policies, and local government applications discussed in this Primer include those in B.C., southern Quebec, and the Atlantic coasts of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Coastal communities along Hudson Bay and in the Arctic face a different set of vulnerabilities and were not considered within the specific context of this research.

## **CanCoast**

**Developed by:** Natural Resources Canada

**Source:** <http://www.nrcan.gc.ca/environment/science/indicators-change/coastlines/10999>

**Region:** All coastal

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability
- Step 6: Monitoring Progress and Change

CanCoast is a tool designed to assess climate change sensitivity, help facilitate adaptation planning in coastal areas, and contribute to a national assessment of coastal vulnerability to climate change. It is an ArcGIS-based geospatial database that enables coastal data to be collated, archived, and analyzed. The CanCoast database contains digital-elevation data, projections of sea-level change for 2050, ground-ice conditions for coastal permafrost areas, and information on surficial materials, landforms, tidal range, wave height, and recent trends in sea-ice concentrations (Lemmen et al, 2016, p.33). Potential applications for CanCoast include hazard mapping and impact assessment, adaptation planning, and analysis of data and knowledge gaps (Lemmen et al, 2016, p.33).

## **Canada's Marine Coasts in a Changing Climate**

**Developed by:** Government of Canada

**Source:** [http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/files/pdf/NRCAN\\_fullBook%20%20accessible.pdf](http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/files/pdf/NRCAN_fullBook%20%20accessible.pdf)

**Region:** National/Coastal

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

This document is designed to help Canada's coastal communities recognize, manage, and adapt to climate change. Readers from Canada's coastal regions will gain a deeper understanding of the risks, impacts, opportunities, and adaptation actions associated with sea-level rise, sea-ice melt, and storm surge flooding. *Canada's Marine Coasts in a Changing Climate* provides regional climate data, case studies, comprehensive reviews on adaptation strategies, answers to frequently asked questions, and a list of resources. Readers will learn about ecosystem health, climate change, and adaptation as it relates to coastal environments. This document describes the impacts of climate change on infrastructure and articulates the goals of climate change adaptation. Indigenous perspectives, impacts on culture, education, and subsistence harvesting are all addressed.

## **Simulating the Effects of Sea Level Rise and Climate Change on Fraser River Flood Scenarios**

**Developed by:** BC Ministry of Forests, Lands, and Nature Resource Operations

**Source:** [http://www.env.gov.bc.ca/wsd/public\\_safety/flood/pdfs\\_word/Simulating\\_Effects\\_of\\_Sea\\_Level\\_Rise\\_and\\_Climate\\_Change\\_on\\_Fraser\\_Flood\\_Scenarios\\_Final\\_Report\\_May-2014.pdf](http://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/Simulating_Effects_of_Sea_Level_Rise_and_Climate_Change_on_Fraser_Flood_Scenarios_Final_Report_May-2014.pdf)

**Region:** British Columbia

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability

This project report provides a series of flood level-profiles that can be used as planning tools. The report displays estimates of future water levels in the Fraser River as the result of climate change effects such as sea-level rise. The project area includes the 170 km long reach of the Lower Fraser River, from Hope to the Fraser River mouth (North Arm, Middle Arm and South Arm) and major tributaries affected by backwater from Fraser River Freshet flooding. These tributaries include the Coquitlam River, Pitt River, Sumas/Vedder Rivers, and Harrison River/Lake. The study was prompted by ongoing development and growth in the floodplain areas of the Fraser Valley and Metro Vancouver region, and the increased potential for major flood damage which has raised questions over the adequacy of existing dikes and historic flood protection standards. This document is a non-visual simulation, containing several data tables and using scientific language.

## **Turn Back the Tide**

**Developed by:** Government of Newfoundland and Labrador, Department of Municipal Affairs and Environment

**Source:** <http://www.turnbackthetide.ca/tools-and-resources.shtml>

**Region:** Newfoundland and Labrador, Nunatsiavut, Arctic

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Turn Back the Tide project was initiated by the Government of Newfoundland and Labrador to increase climate change awareness. There are interactive tools, calculators, action-list items, and guides for energy efficiency.

The website provides the following tools, information, and resources:

- Climate Data Information Portal
- Intensity-Duration Frequency Curves
- Temperature Projections
- Precipitation Projections
- Flooding: Flood alert system updates and flood risk mapping studies
- Climate Monitoring Report
- Climate Projection Study
- Coastal Erosion Monitoring
- 7 Steps to Assess Climate Change Vulnerability in Your Community

## **Atlantic Climate Adaptation Solutions Association – Coastal Community Adaptation Toolkit**

**Developed by:** Governments of Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and New Brunswick

**Source:** <https://atlanticadaptation.ca/en>

**Region:** Atlantic Coast

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Atlantic Climate Adaptation Solutions (ACASA) Project is a partnership between the provincial governments of Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and New Brunswick, and regional stakeholders including non-profits, tribal governments, and industry. The website houses a Community Adaptation Toolkit, which includes a decision tree, a community profile for increasing adaptation capacity, a guidance document, and the Climate Change Coastal Primer (user account required). The ACASA website provides information on:

- Climate Change (adaptation, glossary, and mitigation)
- Adaptation Approaches (policy planning, vulnerability assessment, adaptation options, and community examples)
- Projects by province
- Publications (documents, images, case studies, maps, presentations, and reports)

# APPENDIX 6

## HOLISTIC PLANNING RESOURCES

Appendix 1: Holistic Planning Resources provides additional detail for tools & resources that can be used for more than one impact area, including hazard and risk assessment-type tools.

### **Communities Adapting to Climate Change - Adaptation Resource Kit & Discovery Tool**

**Developed by:** Columbia Basin Trust

**Region:** Columbia Basin

**Resource type:**

- Step 1: Starting the Planning Process
- Step 2: Climate Change Impacts in the Community

The Adaptation Resource Kit is designed to help communities in the Canadian Columbia Basin to become more resilient to climate change impacts and weather variability by providing tools and resources to develop or complete adaptation strategies. The Adaptation Resource Kit has checklists and action items that vary in level of detail and complexity, allowing communities to decide how comprehensive they want their adaptation plans to be. The Kit is based on the experiences and learnings of fourteen communities that engaged with climate adaptation planning as part of Columbia Basin Trust's Communities Adapting to Climate Change Initiative (CACCI) from 2008-2014.

### **CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods)**

**Developed by:** International Institute for Sustainable Development (IISD), International Union for Conservation of Nature (IUCN), Helvetas, and Stockholm Environment Institute (SEI)

**Region:** International

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability

The Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL) is designed to support communities characterized by climate-sensitive and/or natural resource-dependent livelihoods. CRiSTAL is designed for use by project planners and managers working at the local or community level. The tool relies on information collected from desk-based review and stakeholder consultations at the local level to help users understand which livelihood resources are most affected by current climate change hazards; how project activities affect access to, or availability of, these critical livelihood resources; what project adjustments (revision of existing activities and/or design of new activities) can be made to support climate change adaptation and reduce climate risk; and to what extent the project contributes to climate change adaptation.

CRiSTAL is a desktop application compatible with Microsoft Windows 7 operating systems and greater versions. The CRiSTAL tool, User's Manual and other documents are free to download on the site.

## **Managing the Risks of Climate Change: A Guide for Arctic and Northern Communities**

**Developed by:** Centre for Indigenous Environmental Resources (CIER)

**Region:** National

**Resource Type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 6: Monitoring Progress and Change

This online Risk Management Guide is designed to help communities to identify and address climate change priorities. The risk management process outlined on the website is a simple, practical, and highly effective approach for identifying risks, ranking them, and providing methods to reduce risks. It provides a clear picture of the complexity of an issue and helps to produce well thought-out recommendations. The guide provides six downloadable and printable worksheets for recording information. These worksheets are physical tools that can be shared to bolster project success. The final document produced throughout this process will help to build a persuasive business case for action, suitable for submission to decision makers and leadership.

The six simple steps included in this process are:

1. Getting started: Identify all stakeholders and draft a work plan.
2. Preliminary analysis: Identify potential, current, and future climate change risks posed to your community.
3. Risk estimation: Analyze the risks from step 2. And consider stakeholder perceptions.
4. Risk evaluation: Rank these risks from extreme to minor.
5. Risk controls and adaptation decisions: Decide on a strategy to reduce extreme risks.
6. Implementation and monitoring: Develop a solid action plan and a plan to monitor your progress.

## **Atlantic Climate Adaptation Solutions Association - Community Vulnerability Assessment Tool: 7 Steps to Assessing Vulnerability in Your Community**

**Developed by:** Natural Resources Canada, Government of Newfoundland and Labrador, Memorial University of Newfoundland

**Region:** Atlantic/coastal

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

*7 Steps to Assessing Vulnerability in Your Community* is designed for communities with limited resources and its use does not require any technical expertise. This tool can serve as a guide for community leaders and decision makers, providing a means for quick analysis of local climate change impacts and possible adaptation options.

## **Climate Change Atlas for Canada**

**Developed by:** The Prairie Climate Centre

**Region:** National

**Tool type:**

- Step 2: Climate Change Impacts in the Community
- Step 4: Identifying Solutions

The Climate Change Atlas for Canada is an interactive site designed to allow users to learn about climate change through mapping, climate science and data, and climate-related news, stories, and video documentaries. Information is presented using simple language and personal, on the ground climate change impacts are described.

## **Public Infrastructure Engineering Vulnerability Committee (PIEVC): The Engineering Protocol**

**Developed by:** Engineers Canada

**Region:** National

**Resource type:**

- Step 3: Risk Assessment and Community Sustainability

The Public Infrastructure Engineering Vulnerability Committee has developed a step-by-step guide called the “Engineering Protocol”. The Protocol is used to evaluate vulnerability risks to buildings or other public infrastructure systems due to climate change impacts. The five-step process includes:

- Step 1: Project definition;
- Step 2: Data gathering and sufficiency;
- Step 3: Risk assessment;
- Step 4: Engineering analysis (optional); and,
- Step 5: Conclusions and recommendations.

A Project Manager can use the protocol to systematically review historical climate information and project the nature, severity, and probability of future climate changes and events. It also establishes the adaptive capacity of specific infrastructure as determined by its design, operation, and maintenance. It estimates the severity of climate impacts on various infrastructure components (i.e. deterioration, damage or destruction) to identify high risk components and the nature of climate change threats. This information can be used to make informed decisions regarding which infrastructure components require design adjustments, or changes to operational or maintenance procedures.

Engineers Canada encourages use of the Protocol for all types of infrastructure going forward. It is available for use at no financial charge through a license agreement with Engineers Canada. Users of the Protocol are required to sign a non-disclosure agreement. PIEVC also offers various training workshops.

## **Adaptation Library**

**Developed by:** Natural Resources Canada

**Region:** National

**Resource Type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Adaptation Library is a user-friendly database for community-based climate change adaptation resources. Users can search the database by region or by selecting relevant climate issues to find tools, guidebooks, research, and speciality tools for community decision makers. Users can also add filters to narrow searches to fit their climate change adaptation goals. The library contains the following sections:

- Permafrost melt
- Changes to lake and river levels
- Changes to water temperature
- Sea ice melt
- Freeze-thaw processes
- Snowpack

Users of the site can create a login and save resources to their own personal library.

## **Canadian Centre for Climate Services (CCCS)**

**Developed by:** Government of Canada

**Region:** National

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 6: Monitoring Progress and Change

The CCCS is an initiative of the Government of Canada that provides access to all things climate, from climate basics to data and resources supporting adaptation decision-making. The site is designed to facilitate access to climate data and tools through features such as the Library of Climate Resources, interactive climate data viewer, and extraction tool. For the first time, Canadians can access Environment and Climate Change Canada's climate data through an interactive map, download relevant climate data subsets, and use the library to access climate datasets and resources consolidated across federal, provincial, and territorial governments, national professional organizations, climate consortia, and established international organizations.

The CCCS has also launched their Climate Services Support Desk which is staffed by climate experts ready to help users understand and use climate information to support adaptation decision-making. A video describing their services is available [here](#).

## **Emergency Preparedness Guide for Muskego Cree Families and James Bay First Nation Communities**

**Developed by:** Canadian Red Cross

**Region:** Northern Ontario

**Resource type:**

- Step 2: Climate Change Impacts in the Community

The Canadian Red Cross developed this emergency preparedness guide for James Bay and Moose Cree Communities in northern Ontario. The Emergency Preparedness Guide can be used to address the following emergencies: floods, forest fires, power outages, severe winter weather (e.g. blizzards, ice storms, extreme cold, etc.), and severe summer weather (e.g. thunderstorms, windstorms, hail, etc.). The guides have been translated into two Cree dialects to meet the specific and unique needs of these remote northern First Nation communities.

## **A Practitioner's Guide to Climate Change Adaptation in Ontario's Ecosystems**

**Developed by:** Ontario Centre for Climate Impacts and Adaptation Resources, Ontario Ministry of Natural Resources – Climate Change Program

**Region:** Ontario

**Resource type:**

- Step 1: Starting the Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions
- Step 5: Taking Adaptive Action
- Step 6: Monitoring Progress and Change

This guide introduces the concepts of climate change adaptation, vulnerability, and risk. It also describes vulnerability and risk assessment tools and techniques, providing a framework and worksheets that can be used to support adaptive management in a rapidly changing climate. Ultimately, this guide seeks to assist natural resource managers in identifying ways in which climate change vulnerabilities and risks can be integrated into decision-making processes, adaptation action plans, strategies, and policies.

## **ReTooling for Climate Change Climate Change Adaptation Community of Practice (CCACoP)**

**Developed by:** Mirarco, OOCAR

**Region:** National

**Resource type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 4: Identifying Solutions

The CCACoP is an online platform and forum where researchers and practitioners share knowledge on climate change adaptation. This interactive community encourages information sharing and mainstreaming of climate change adaptation into decision-making models. Users may access climate change news, forums, webinars, event information, and a library of adaptation platform products. Membership to this online platform is free.

## **Prairie Adaptation Research Collaborative**

**Developed by:** Prairie Adaptation Research Collaborative

**Source:** <http://www.parc.ca/>

**Region:** Alberta/Saskatchewan/Manitoba

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

The Prairie Adaptation Research Collaborative (PARC) is a partnership between the governments of Canada, Alberta, Saskatchewan, and Manitoba. PARC researches current and future climate change impacts and adaptation planning within the prairie climate. In addition to scientific research, PARC also conducts research on political climate modelling, potential policy responses, and partnering projects with Indigenous communities.

For more information and research related to forest fires, visit:

[http://www.parc.ca/research\\_pub\\_forestry.htm](http://www.parc.ca/research_pub_forestry.htm)

## **Ouranos**

**Developed by:** Ouranos

**Source:** <https://www.ouranos.ca/en/>

**Region:** Quebec

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

A non profit organization that develops and coordinates projects by tapping into a network of approximately 450 researchers, experts, practitioners and policy-makers from a variety of disciplines. Ouranos' mission is to acquire and develop knowledge on climate change and its impacts, as well as relevant socio-economic and environmental vulnerabilities, to help policy-makers identify, evaluate, promote and implement national, regional and local adaptation strategies. Ouranos specializes in:

- Co-financing for interdisciplinary and multi-institutional projects that bring together researchers, practitioners and policy-makers to promote and support adaptation to anticipated climate change
- Climate scenarios and services to multiple partners in Quebec, across Canada and around the world
- Production of regional climate simulations using the Canadian Regional Climate Model 5 (CRCM5). The new CRCM5 chosen at Ouranos is developed by UQAM's ESCER centre, in collaboration with Environment and Climate Change Canada.

## **Pacific Climate Impacts Consortium (PCIC)**

**Developed by:** University of Victoria

**Source:** <https://www.pacificclimate.org>

**Region:** Pacific Coast, Yukon

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 5: Conclusions and recommendations
- Step 6: Monitoring Progress and Change

PCIC is a regional climate service centre at the University of Victoria that conducts quantitative studies on the impacts of climate change and climate variability in the Pacific and Yukon region. Results from this work provide regional climate stakeholders with the information they need to develop plans for reducing the risks associated with climate variability and change. In this way, PCIC plays an important bridging function between climate research and the practical application of that knowledge by decision makers.

## **Pacific Institute for Climate Solutions (PICS)**

**Developed by:** University of Victoria, Simon Fraser University, University of British Columbia, and University of Northern British Columbia

**Source:** <https://pics.uvic.ca/about>

**Region:** British Columbia

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 5: Conclusions and recommendations
- Step 6: Monitoring Progress and Change

The Pacific Institute for Climate Solutions (PICS) is a dynamic knowledge network that brings together leading researchers from British Columbia (BC) and around the world to study the impacts of climate change and to develop positive approaches to mitigation and adaptation. PICS pulls together the intellectual capital of the province in applying a multi-disciplinary approach to climate change research. We support research endeavours that focus on solutions and relevance to BC. PICS develops educational tools and engages in outreach activities to inform audiences as diverse as policy makers, industry, educators, students and the general public about climate change issues and solutions. PICS research is solutions-based, with an emphasis on concrete recommendations aimed at BC policy makers and other climate stakeholders.

## **Ontario Centre for Climate Impacts and Adaptation Resources**

**Developed by:** MIRARCO

**Region:** Ontario

**Resource Type:**

- Step 1: Starting Planning Process
- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 4: Identifying Solutions

*Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR)* is a university-based resource hub that supports Ontario communities in developing climate change adaptation strategies through partnerships and by providing resources on climate data, case studies and projects, publications, tools, framework guides, and workshops. OCCIAR has a partner on a project with Ontario First Nation Technical Services Corporation (OFNTSC) that focuses on building capacity within Ontario First Nations, enabling them to address climate change impacts. The project includes: building the technical capacity required for First Nations to participate in economic opportunities associated with Ontario's proposed cap and trade program, developing adaptation strategies for First Nation communities to prepare for effects of climate change, and conducting a Climate Change Impact Study for the north.

## **Northern Climate ExChange**

**Developed by:** Yukon College

**Source:** <https://www.yukoncollege.yk.ca/research/our-research/northern-climate-exchange>

**Region:** Northern

**Resource type:**

- Step 2: Climate Change Impacts in the Community
- Step 3: Risk Assessment and Community Sustainability
- Step 5: Conclusions and recommendations

Established in 2000, the Northern Climate ExChange partners with communities, industry, First Nations, academics and government leaders to explore and respond to climate change impacts on northern communities and their infrastructure. We develop research questions in collaboration with communities and governments, implement research projects, and share our results with organizations across the circumpolar North. Our research has been used across Canada's North to guide adaptation to climate change impacts. We partner with many different organizations across Canada's North. We have supported Government of Yukon's action to mitigate hazards along the territorial highways, the Yukon Energy Corporation in their efforts to ensure hydro-security, and several First Nations in their work to encourage use of traditional knowledge and respond to a changing climate. Our researchers work with government employees to bring conversations about climate change into everyday decision-making. This is done through courses, and working with government to integrate climate change plans into development assessment.











CENTRE FOR INDIGENOUS ENVIRONMENTAL RESOURCES

**Mailing Address**

P.O. Box 26092 RPO Maryland  
Winnipeg, MB R3G 3R3

T: 204.956.0660  
F: 1.866.288.3919

earth@yourcier.org  
**yourcier.org**

