



MÉTIS NATION CLIMATE CHANGE & HEALTH VULNERABILITY ASSESSMENT

Prepared for the Métis National Council

JF Consulting • June 2020



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JF Consulting is also grateful to have been able to participate in a number of workshops with the Métis Nation, including the Métis Nation National Health Committee (Vancouver), a Climate Change and Health Forum hosted by MNBC (Richmond), Les Femmes Michif Otipemisiwak - Métis Women's Forum (Ottawa) and the MNC National Health Forum (Ottawa). Many of the participants at these events took their time to speak with us about climate change and health and share their perspectives.

We are also grateful to the federal government officials, academic researchers and climate change specialists who took the time from their busy schedules to provide us with their expertise on the subject. Many of the ideas put forward during these interviews are reflected in the knowledge gaps and recommendations section of this report.

This report is a first step in providing the Governing Members with an understanding of the risks to Métis health associated with climate change. The integration of health, environment and social considerations is at the forefront of making meaningful change, especially as investments are made in a post COVID world. The integrating vision that was made possible through the Environment and Health Ministries at the MNC can certainly assist the Métis Nation in moving forward to address upcoming changes within Canada and globally.

If you would like more information about this report or offer suggestions please contact the Métis National Council through Eduardo Vides, Senior Advisor, Health Ministry (eduardov@metisnation.ca) or Erin Myers, Climate Change Advisor, Environment Ministry, (erinm@metisnation.ca).

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Executive Summary

Métis Resiliency

The Métis emerged as a distinct people and nation in the interior of west-central North America during the late eighteenth century. As the fur trade expanded westward many of the trading company employees, who were of European origin, established relationships with local Indigenous women. The offspring of these relations formed the Métis Nation. The Métis developed families and communities and have their own unique culture, traditions and language. Today, the Métis Nation recognize the Métis homeland as the three Prairie provinces and the contiguous regions of north-eastern British Columbia, the Northwest Territories, northwestern Ontario and the northern United States.

Climate Change poses serious risks across the Métis nation; the health and wellbeing of the Métis is amongst the most serious risks. Métis peoples living in western Canada are uniquely sensitive to the impacts of climate change due to their dependence on the land for their identity, culture, livelihoods and resource dependent economies. These impacts will affect their physical, mental and spiritual well-being, as well as increase vulnerability to the associated health risks of climate change.

For the Métis, these factors range from their degree of exposure and dependency upon weather patterns for their livelihoods and food security to varying capacities in adaptation. Their close relationship to the land, which includes physical as well as spiritual, psychological and emotional ties, also play an important component to their exposure, especially if significant changes to ecosystems occur or are lost indefinitely. In addition, the challenges that they face due to poorer economic conditions and related health outcomes, relative to the non-Indigenous population, makes for additional susceptibility to a changing climate.

Over many generations, Métis have found innovative ways to live in their particular environment despite diminished access to land and waters. This resiliency to change, built over generations, may allow the Métis to play an important leadership role in adaptation efforts and environmental sustainability as the climate changes. Their knowledge can support adaptation solutions as they are developed for Indigenous and non-Indigenous populations. The unique environmental knowledge of the Métis Nation and the strength of their communities provides examples of resiliency that can be used in adapting to climate change.

Risks

A number of risks have been identified across the Métis Nation including its Governing Members (GMs) - the Manitoba Metis Federation (MMF), Métis Nation-Saskatchewan (MMS), Métis Nation of Alberta (MNA), Métis Nation British Columbia (MNBC) and Métis Nation of Ontario (MNO). There is limited information for the GMs within federal and provincial government databases or research activities. Developing adaptation programming to limit the health impacts due to

climate change will lead to either program and policy inaction, or maladaptation actions due to incomplete information.

The most common risks to the Métis Nation are identified within each of the governing areas in the Métis homeland. Forest fires, flooding, extreme heat and drought, vector-borne diseases and invasive species are risks that affect all Métis. Landslides and glacial retreat are having impacts in Alberta and British Columbia. Ocean acidification, hypoxia and sea level rise are impacting the coastal waters in British Columbia.

Major Risk	British Columbia	Alberta	Saskatchewan	Manitoba	North West Ontario
Forest Fires	High Risk	High Risk	High Risk	High Risk	High Risk
Flooding	High Risk	High Risk	High Risk	High Risk	High Risk
Landslide	High Risk	High Risk	Minimal Risk	Minimal Risk	Minimal Risk
Extreme Heat and Drought	High Risk	High Risk	High Risk	High Risk	High Risk
Glacial Retreat	High Risk	High Risk	Minimal Risk	Minimal Risk	Minimal Risk
Sea Level Rise	High Risk	Minimal Risk	Minimal Risk	Minimal Risk	Minimal Risk
Ocean Acidification and Hypoxia	High Risk	Minimal Risk	Minimal Risk	Minimal Risk	Minimal Risk
Vector-borne Diseases	High Risk	High Risk	High Risk	High Risk	High Risk
Invasive Species	High Risk	High Risk	High Risk	High Risk	High Risk

Figure 1: Provincial Risk Evaluation

Each one of the above risks is impacting the physical, spiritual, mental and cultural health of Métis people across the homeland. Concerns such as displacement from flooding and forest fires, disruptions to traditional foods and medicines and the resulting loss in food security, and risks to morbidity and mortality from extreme heat events are some of the impacts that are highlighted throughout the report.

Information Gaps

The report has identified a number of health vulnerabilities that the Métis face from climate change. Although there is limited information that exists regarding the impacts of climate change on Métis health, there are many studies that can be drawn from that address how climate change is impacting urban and rural Canadians. Given the integration of Métis people in Canadian

society, it can be implied that many of the risks facing individual Canadians and communities are also impacting Métis health. As such, the risks to the Métis from climate change have been identified through existing research on the subject matter, the incorporation of Métis Traditional Knowledge, perspectives from Métis people, and interviews with government, academics, and consortiums. The combination of this work, coupled with information on Métis health status and other social determinants of health such as income, housing and education, has led to the identification of a number of gaps that exist in current research, data systems and programs for the Métis in order that they can better prepare for and adapt to climate change.

It should also be noted here that there are different levels of capacity and information available within each GM's jurisdiction. During the course of this research, MNBC was able to provide information that it had gathered through a survey of members regarding climate change. In addition, we were able to participate in a workshop that was held in January 2020 on climate change and mental health. MMF was also able to provide information from a series of workshops it held with members on environment and climate change. Both MNBC and MMF information has been used in this report and as such, the vulnerability assessments are more robust. Other GM's should think of replicating and enhancing this work.

Health authorities require information about the current associations between health outcomes and weather or climate, vulnerable populations, projections of future risks and adaptation opportunities. Such information can assist the Métis Nation to take needed protective actions and help in building health systems that meet the needs of Métis people. Numerous studies have indicated that there are significant barriers related to data accessibility, a limited number of climate and health models, uncertainty in climate projections, and a lack of funding and expertise. These challenge health authority efforts to conduct rigorous assessments and apply the findings.

The consensus coming out of this work is that there is very little information available to assist in conducting risk and vulnerability assessments for Métis populations. The following gaps have been identified:

- Reports such as the *Indigenous Peoples Survey*, having made significant improvements in recent years in collecting Métis related information, should improve its methodology to include areas such as harvesting and other cultural activities.
- The *Canadian Institute for Health Information* is currently updating its data information services and is in the process of developing an Indigenous Health Strategy. The inclusion of Métis specific information that is useful for climate change adaptation efforts must be encouraged.
- Métis specific information on health status and health determinants is a useful tool to understand some of the resiliency factors that are in place in the face of climate change.

- Indicators of health status will allow one to identify and monitor priority areas for action, such as chronic disease among adults. It will also allow one to identify areas where Métis are doing well compared to other population groups, and make health inequality comparisons across Provinces.
- While there is general information related to flooding, forest fires, extreme temperatures, changes in migration routes, vector borne disease, among others, there has been no effort to correlate how this information is impacting the Métis population directly. Efforts directed towards more community-based monitoring by and for Métis people, developing correlations and comparisons between local climate change assessments and those of Métis people, and the inclusion of Métis expertise in health and climate change planning processes at the local and regional levels.
- For governments investing in adaptation actions, data collection specific to Métis, community-based monitoring, and understanding the mental, emotional, physical cultural links between the land and Métis people are areas where funding is required. In the development of community-based health and vulnerability assessments the inclusion of Métis people within the process is area for improvement.

The Table below indicates where each governing body could begin to address efforts within their respective jurisdictions.

Region	Major Risks Identified	Key Areas for Action
Métis Nation of Ontario	Forest Fires Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> ● Address information needs related to forest fires, flooding and invasive species. ● Lobby regional health authorities to collect additional information on Métis health status and outcomes especially those related to respiratory issues, food security and mental health.
Manitoba Metis Federation	Forest Fire Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> ● Address information needs related to forest fires, flooding, extreme heat and drought, and vector-borne disease. ● Lobby regional health authorities to collect additional information on Métis health status and outcomes. ● Based upon engagement sessions hosted by MMF, hold workshops to define health and climate change risks especially those related to air

		quality, mental health and food safety.
Métis Nation - Saskatchewan	Forest Fires Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, extreme heat and drought and vector-borne disease. • Lobby regional health authorities to collect additional information on Métis health status and outcomes related to respiratory issues, and mental health.
Métis Nation of Alberta	Forest Fires Flooding Landslides Extreme Heat and Drought Glacial Retreat Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, flooding and invasive species. • Lobby regional health authorities to collect additional information on Métis health status and outcomes. A good starting point would be addressing respiratory and mental health related issues.
Métis Nation British Columbia	Forest Fires Flooding Landslides Extreme Heat and Drought Glacial Retreat Sea Level Rise Ocean Acidification and Hypoxia Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, sea level rise, glacial retreat and invasive species. • Based upon needs collected through MNBC effort should be directed to lobby regional health authorities to collect additional information on Métis health status and outcomes related to respiratory issues and mental health.
Métis National Council		<ul style="list-style-type: none"> • Work with federal agencies and researchers to develop a national Métis and climate change data collection strategy and research agenda. • Work intersectorally with environment and health officials at all levels of government and with Governing Members.

Figure 2: List of Major Risks and Key Areas of Action for each Governing Member

Recommendations

- *Ensure Data Collection Efforts Utilise Métis Registration Information* so that data providers utilise self-identified Métis and those registered with Governing Members are distinguish in their data collection efforts.
- *Gabriel Dumont Institute Climate Change Program* should be created as a course to train the next generation of climate change and health specialists.
- *Capacity Building at the Local Level* must be encouraged through a dedicated fund so that the Métis Nation locals may develop health and climate change adaptation and/or mitigation plans.
- *Develop Health and Climate Change Indicators for Métis* alongside federal and provincial agencies in order to expand data collection efforts to inform adaptation planning among Métis communities.
- *Establish Local Risks for Métis People* through the merging of health and scientific data so that Métis perceptions of risk be included in decision making.
- *Fund a Climate Change and Health Specialist* in each of the Governing Members as well as National specialist. The mandate for this specialist would be to work intersectorally among all ministries to better integrate climate change information.
- *Develop a Youth Interchange Program* with federal agencies such as Indigenous Services Canada and Health Canada to build capacity to understand the linkages between federal programming, climate change and the Métis people.
- *Create a National Métis Climate Change Strategy* to develop and articulate a national approach for the Métis people so as to further its efforts with the federal and provincial governments in gaining long term funding and support.
- *Create a Métis Experts Group on Climate Change and Culture* to understand the nature and degree of climate-related impacts on Métis ways of life in various regions. This would include a *National Métis Youth Advisory Council on Climate Change*.
- *Establish Dedicated Research Grants* with organisations such as the Canadian Institutes for Health Research, academia and research consortia to advance the state of knowledge surrounding climate change and human health impacts on the Métis.
- *The Impacts of Pandemics (COVID 19)* may impact the Métis Nation in addressing climate change especially during evacuations and community gatherings. Further research is required to develop process and virtual tools to transmit information among members.

Chapter 1: Introduction

Climate Change poses serious risks across the Métis nation; the health and wellbeing of the Métis is amongst the most serious risks. Métis people living in western Canada are uniquely sensitive to the impacts of climate change due to their dependence on the land for their identity, culture, livelihoods, and some natural resource driven economies. There is currently a lack of Métis specific research on the climate change impacts on health and wellbeing. Climate and health research can often take a Pan-Indigenous approach which can result in generalizations across diverse Métis, First Nations and Inuit populations. This report provides an overview of the climate impacts and associated health risks specific to the Métis population across the Métis homeland.

Objectives

The report provides an assessment of the climate change risks and related health vulnerabilities facing the Métis Nation. It is designed to give an overview of each Métis region and identify gaps for further research. The report provides recommendations based on its findings to improve the adaptability of the Métis Nation to the negative health impacts of climate change.

On November 6th, 2019, the Métis National Council held its first joint National Health and Environment Committee meeting chaired by Minister Clara Morin Dal Col and Kathy Hodgson Smith. Ministers and technical staff representing all Governing Members participated in an important dialogue about their climate change and health concerns.

The objective of this initial meeting was to strengthen the capacity of the Métis Nation to identify, discuss and constructively look at ways to respond to climate-related health risks and impacts together. Climate change is impacting all aspects of life whether it be housing, environment, health, economic development, etc., and therefore we need to work collaboratively to further understand how climate change is impacting Métis citizens. We also need to include diverse voices such as our Elders, youth, women, traditional knowledge keepers to collaboratively co-develop/support adaptation solutions and provide up-to-date research/tools, and expertise which can support the development of a Métis Nation platform to share best practices and lessons learned.

Bringing together diverse environment and health expertise will ensure that the Métis Nation will be a part of the climate change and health adaptation dialogue both nationally and internationally, as well as contribute to the global effort by Indigenous communities to find solutions and adapt to a changing world. The Métis Nation is working to adapt to climate change and build resilient communities which is inspiring hope for a positive future.

Source: Métis Nation Monthly Newsletter – December 2019

Background

The Métis emerged as a distinct people and nation in the interior of west-central North America during the late eighteenth century. As the fur trade expanded westward many of the trading company employees, who were of European origin, established relationships with local Indigenous women. The offspring of these relations formed the Métis Nation. The Métis developed families and communities and have their own unique culture, traditions and language known as Michif (Métis National Council, n.d.).

The North-West is the birthplace and motherland of the Métis Nation (Teillet, 2019). Today, the Métis Nation recognize the Métis homeland as the three Prairie provinces and the contiguous regions of north-eastern British Columbia, the Northwest Territories, northwestern Ontario and the northern United States (Métis National Council, n.d.). The Métis Nation Homeland includes the distinct Métis communities that developed along the fur trade routes and across the northwest, including wintering settlements, road allowance communities, and many towns and larger cities, such as Winnipeg and Edmonton (Canadian Geographic, 2018).

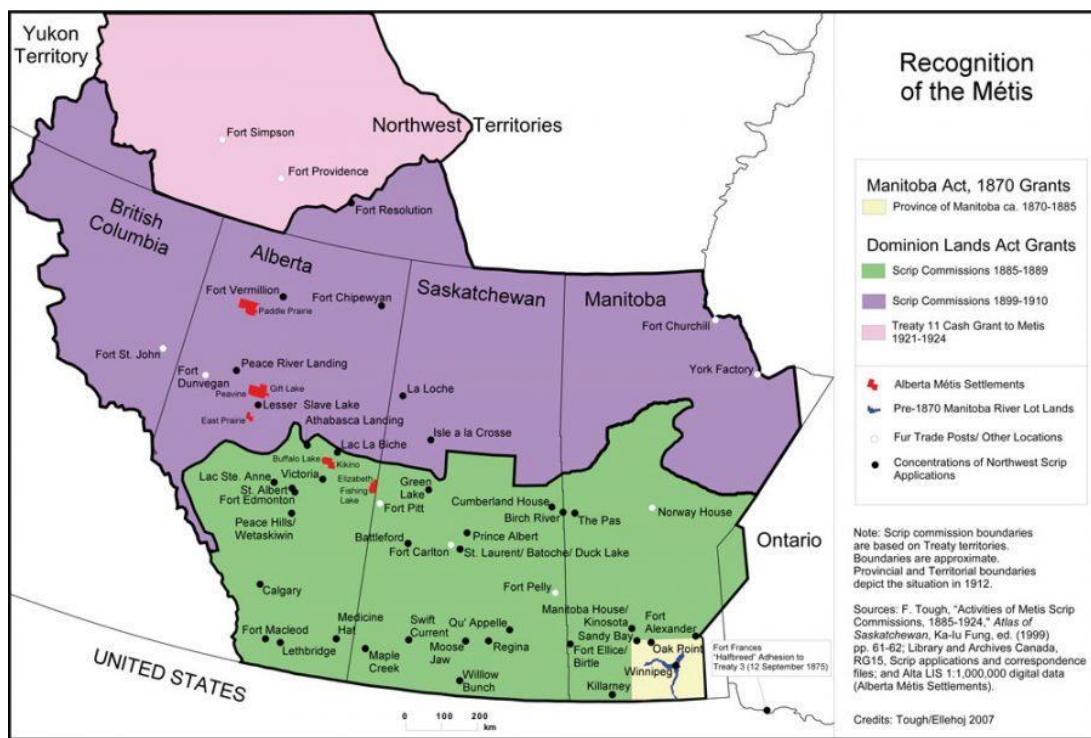


Figure 3: Recognition of Métis Homeland Source: Canadian Geographic, 2018

The Métis National Council (MNC) represents the Métis both at the national and international levels. It receives its mandate from the democratically elected leadership of the five provincial governing members (British Columbia, Alberta, Saskatchewan, Manitoba and Ontario).

This report follows the national definition for Métis adopted by the MNC in 2002: “*Métis*” means a person who self-identifies as Métis, is distinct from other Aboriginal peoples, is of historic Métis Nation Ancestry and who is accepted by the Métis Nation.”

In 2003, the Supreme Court of Canada upheld this definition and confirmed that Métis are a rights-bearing Aboriginal people. The Supreme Court’s judgement in *R. v. Powley* identified Métis rights-holders through self-identification, ancestral connection to the historic Métis community, and community acceptance (*Métis Nation Citizenship*, n.d.).

Between 2006-2016, Statistics Canada reported a 51.2% increase of Métis identification (Statistics Canada, 2016).¹ As of 2016, the Métis population is 587,545. Two main factors have contributed to the growing Métis population: the first is natural growth, which includes increased life expectancy and relatively high fertility rates; the second factor relates to changes in self-reported identification; more people are newly identifying as Métis on the Census.

Statistics Canada’s 2017 Aboriginal People’s Survey (APS) reported that the majority of Métis resided in Ontario and the western provinces (80.3%). Ontario had the largest Métis population in Canada at 120,585, up 64.3% from 2006 and accounting for one-fifth (20.5%) of the total Métis population. Alberta’s Métis population account for 19.5% of the total Métis population. About the same number of Métis lived in Manitoba and British Columbia (15.2%), while Saskatchewan was home to 9.9% of the Métis population (Statistics Canada, 2017).

The majority of Métis (62.6%) resided in a metropolitan area of at least 30,000 people (Statistics Canada, 2017). In 2016, eight metropolitan areas had a population of more than 10,000 Métis: Winnipeg, Edmonton, Vancouver, Calgary, Ottawa–Gatineau, Montréal, Toronto and Saskatoon. Combined, these areas accounted for just over one-third (34.0%) of the entire Métis population. Winnipeg had the largest Métis population at 52,130 in 2016, up 28.0% from a decade earlier. Métis peoples face health inequities relative to the non-Indigenous population that increase their vulnerability to climate change. These inequities will be further discussed in the following chapter.

Method

Critical to the findings in this report is Métis Traditional Knowledge (MTK). Indigenous traditional environmental knowledge is a “way of knowing” the environment and relationships to the

¹ In the 2016 census, Métis identification is simply self-declaration. A person can identify as Métis on the census and not be legally entitled to exercise the Métis Aboriginal right to hunt for food as set out in the *Powley* decision of the Supreme Court of Canada or be accepted as a member of a Métis political organization. It is therefore not clear if the set of people who self-identify as Métis in the census are the same people who are affected by the issues raised and considered in this report. The 2017 Aboriginal Peoples Survey included the question “Do you have a card or certificate issued by a Métis organization that identifies you as Métis?” Nationally, about 45% of those who self-identified as Métis reported having a card or certificate issued by a Métis organization.

environment by Indigenous Peoples worldwide (Aikenhead, 2006). When specifically applied to Métis People, “traditional environmental knowledge becomes contextualized to the history, culture and languages of Métis People, extending the scope beyond a hub of ecological knowledge to a holistic paradigm” (Vizina, 2010). Métis traditional environmental knowledge is built from community practices and form the foundation for Métis’ understanding of and interaction with the natural world (The Métis National Environment Committee, 2011). Métis perspectives of the environment extend beyond western sciences into values and spiritual beliefs resulting in a unique Métis holistic worldview (The Métis National Environment Committee, 2011). Métis Traditional Knowledge continues to have relevance in current times, particularly in adapting to climate change.

The climate and associated health risks identified in this report are derived, in part, from MTK and Métis perspectives. At the Métis Nation British Columbia (MNBC) Climate Change and Mental Health Forum, held in Richmond, BC in February 1-2, 2020, a series of focus groups were conducted according to each MNBC region. Each group discussed questions related to the health impacts of climate change and potential mitigation strategies.² In 2019, the MNBC also sent a post-card questionnaire about climate change to members across British Columbia.³ In total, there were around 250 postcards responses from diverse members including Elders, youth, women, and hunters/ trappers. For this report, the focus group and postcard responses have been used to inform the risk assessment for British Columbia, together with government climate change and health assessments and academic literature.

At the 2020 Women’s Forum of Les Femmes Michif Otipemisiwak, March 3-6, 2020 additional focus groups were utilized to discuss the gender specific health impacts of climate change and potential mitigation strategies. During this session, we heard women’s perspectives from across the nation forming the basis of the gender risk assessment of the report.

This document was also informed by information received from the Manitoba Metis Federation. Over 2019, the Manitoba Metis Federation (MMF) conducted engagement sessions regarding climate change impacts with the Manitoba Metis Community (the Community) throughout the seven MMF regions. The Community discussed changes they have been seeing as well as concerns for the future, with health in a changing climate being a substantial point of discussion. This information has been used to inform the Manitoba portion of this report.

The limited time frame, overextended resources and commitments within Métis Governing Members and the COVID-19 pandemic meant that assessments of Alberta, Saskatchewan and Ontario do not incorporate primary Métis perspective. The assessments for these governing bodies rely on existing Métis government reports, provincial reports and academic literature.

² See appendix for specific questions.

³ See appendix for specific questions.

Organization of the Report

The report will first outline the conceptual framework of the climate change risk assessment in Chapter 2. It will detail the general climate change vulnerabilities and risks across the Métis Nation and will expand upon Métis specific determinants of health that either exacerbate the vulnerability or strengthen the resiliency of the Métis population to the health risks of climate change. Chapter 3 will provide brief provincial assessments of the specific climate change risks and associated health impacts in each region. Chapter 4 will synthesize each provincial assessment to determine national trends and challenges. The final chapter will offer recommendations to improve the adaptability of the Métis Nation to the negative health impacts of climate change and other examples of where the Métis are making progress on climate change.

Chapter 2: Conceptual Framework

Climate Change, Vulnerabilities, and Risks

Climate is the average, or expected, weather and related atmospheric, land, and marine conditions for a particular location. Climate statistics are commonly calculated for 30-year periods. “Climate change” refers to a persistent, long-term change in the state of the climate, measured by changes in the mean state and/or its variability (*Canada’s Changing Climate*, 2019).

Across Canada, it is evident that the climate is changing and that this change is affecting human health. The main areas of concern are:

- Increases in the frequency and intensity of extreme climate events, for example flooding and forest fires
- Changes in food and water supply, which affect food safety and security
- Variations in the distribution of vector -borne diseases
- Sea level rise
- Thinning Glaciers

Each of these concerns come with associated health effects of including; increased respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of food- and waterborne illnesses and other infectious diseases, and threats to mental health.

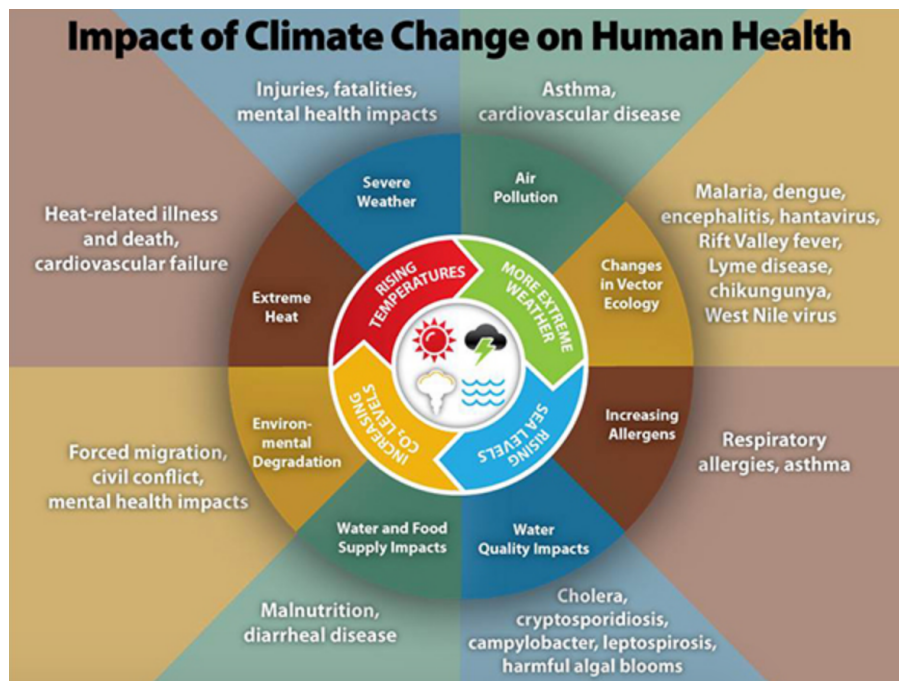


Figure 4: Impact of Climate Change on Human Health **Source:** U.S. Global Change Research Program

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability to climate change as the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate variability and change (IPCC, 2007a). The vulnerability associated with a given population or a specific geographic area is related to all risk and resiliency components that in the end determine if adverse health outcomes will occur. The magnitude and frequency of extreme weather events and the geographical conditions that expose populations to various hazards influence vulnerabilities and ultimate outcomes from climate change. The public health system and the quality of its surveillance and control programs also determine a population's vulnerability. In addition, population characteristics such as the demographic structure of a population, the prevalence of pre-existing medical conditions; acquired factors such as immunity and genetic are important baseline vulnerability conditions which all play a role (Balbus & Malina, 2009).

For the Métis people these factors range from their degree of exposure and dependency upon weather patterns for their livelihoods and food security to varying capacities in adaptation. Their close relationship to the land, which includes physical as well as spiritual, psychological and emotional ties, also play an important component to their exposure, especially if significant changes to ecosystems occur or are lost indefinitely. In addition, the challenges that they face due to poorer economic conditions and related health outcomes, relative to the non-Indigenous population, makes for additional susceptibility to a changing climate.

The Métis' rely on the land for the continued vitality of their physical, spiritual, socio-economic and political life (The Métis National Environment Committee, 2011). Over many generations, Métis have found innovative ways to live in their particular environment despite diminished access to land and waters (The Métis National Environment Committee, 2011). This resiliency to change, built over generations, may allow the Métis play an important role in adaptation efforts, and environmental sustainability as the climate changes. Their knowledge and leadership can support adaptation solutions as they are developed for Indigenous and non-Indigenous populations. The unique environmental knowledge of the Métis Nation and the strength of their communities provides examples of resiliency that can be used in adapting to climate change.

Social Determinants of Métis Health

In Canada, Métis have poorer health outcomes compared to the non-Indigenous population. Health inequalities are influenced, in part, by the social determinants of health, or the conditions in which individuals are born, grown, live, work, and age (World Health Organization, n.d.-b). Social stratifiers, including demographic, social, economic, racial or geographic descriptors, indicate differences in determinants of health and health outcomes (See Figure 5).

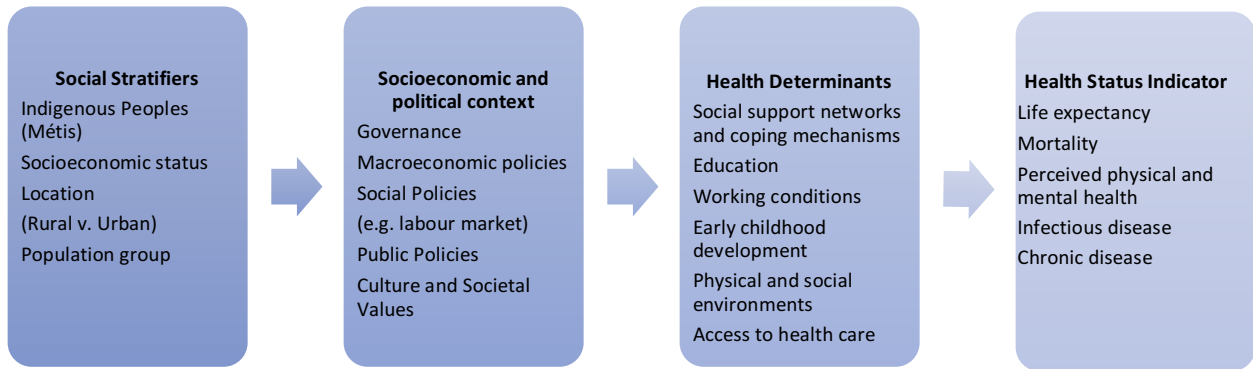


Figure 5: Approach to assessing health inequalities/ vulnerabilities

Source: Adapted from *Key Health Inequalities in Canada: A National Portrait*, 2018.

The health of Métis people in Canada, like all Indigenous peoples, cannot be studied in isolation from historical processes of colonization and forced assimilation. These processes have been largely responsible for weakening determinates of Indigenous health. The National Aboriginal Health Organization (NAHO) established that there are a number of historical factors that impact Métis health and identity including; colonialism, racism, marginalization, lack of Métis rights, lack of Métis land, and loss of culture, Métis knowledge, language, spirituality, and more. Métis health outcomes are also influenced by positive adaptive capacity factors including; resiliency, healing, resurgence, and education (Dyck, 2008).

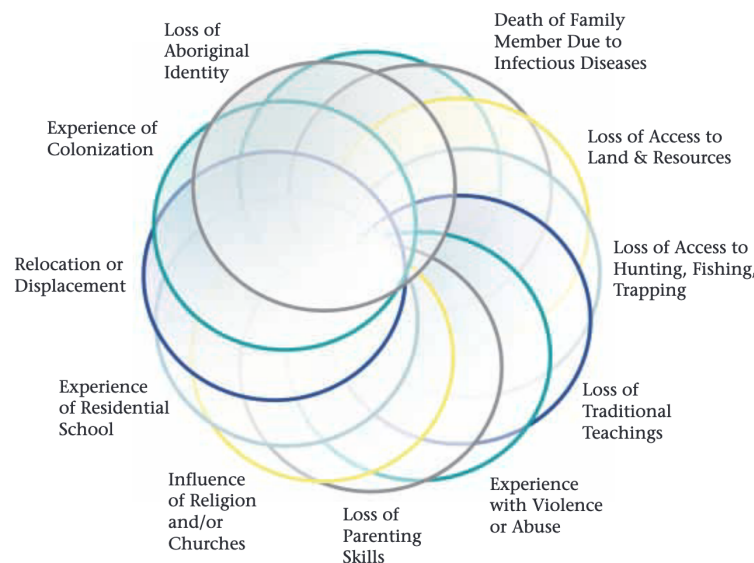


Figure 6: Historical Factors Impacting Métis Health and Identity

Source: National Aboriginal Health Organization. (2008). *In the Words of Our Ancestors: Métis Health and Healing*.

The health indicators and social determinants of health analyzed in the following section are useful to highlight the health inequalities that exist between the Métis and non-Indigenous population and the subsequent increased vulnerabilities Métis face as the climate changes. However, it is worth noting that they do not provide a comprehensive picture of Métis health. The Métis approach to health is holistic rather than individualistic. Health is understood to involve several dimensions which are inter-related, including the spiritual, mental, emotional, cultural and physical (Halseth, 2013). Personal wellness and health are also closely tied to the well-being of others and the extension of family networks (Macdougall, 2017). A Métis determinant specific, community-driven assessment of Métis health will provide a more complete assessment of Métis health. The analyses below identify key social determinants for the Métis population.

Social Stratifiers

Income and Social Status

Statistically, health status improves with higher income and social standing. Income determines living conditions such as safe housing and the ability to buy sufficient nutritious food. Social status refers to the level of respect or power bestowed to people, groups, and organizations in a society. Higher status individuals are usually able to access better health and social services due to improved community standing (Douglas & Vasiliki Douglas Bsn, 2013)

In 2013, the annual median income for Métis people was approximately \$21,000 which is \$6,000 less than what was earned by non-Indigenous Canadians (White & Dyck, 2013). This discrepancy in income has negatively impacted the health and well-being of Métis families. Income earned is related to educational attainment. Within the Métis population, the median income was higher among working-age Métis who had attained at least a bachelor's degree (\$64,304) versus those whose highest level of education was secondary school (\$44,618) - a difference of \$19,686 (Hahmann, Robertson, et al., 2019). When median income is examined by sex, Métis women earn less than Métis men with a \$21,059 income differential (Hahmann, Robertson, et al., 2019). In relation to young people in 2016, 16.1% of non-Indigenous children and youth under 18 years were living in low income households compared to 21.5% of Métis children (Statistics Canada, 2018a).

In terms of social status, government bodies and the Canadian population at large, still do not have a comprehensive understanding of Métis history and identity. Distinctions-based identification and lexicon only entered into government frameworks and in the general population over the last decade. Many Canadians generally regard the Métis as individuals as a mixture of white - primarily French - and First Nations heritage (Statistics Canada, 2018a). By doing so, they ignore the specifics of Métis peoplehood and foster the stereotype that anyone with "mixed blood" is Métis and, therefore, Indigenous (Macdougall, 2017). This lack of understanding has led to policies being developed in the health sector that do not necessarily meet the needs of Métis individuals.

For example, the Canadian Institutes of Health Research indicated that Aboriginal-specific health indicators “are concentrated at the national level, and are either pan-Aboriginal or registered First Nations specific” and why “current Indigenous health indicators has not effectively translated into programming and policies to improve the health of Indigenous peoples” (CIHR, 2013). The previous inability to self-identify as a Métis has led to the generation of databases without ethnic flags, making it very hard, and in some cases impossible, to generate numerators to interpret health status making it difficult to target programs, policies, and appropriate funding for each population. (CIHR, 2013)

Rural and Urban Communities

The ability to dedicate resources to community action to address climate change has a rural/urban divide. Natural Resources Canada indicates that the resources among communities can vary substantially. “Large metropolitan areas may have many planners and policy-makers dedicating at least some of their time directly to adaptation-related issues, whereas a remote hamlet likely will not have any planners.” (Richardson, G. R. A., 2010). Taking action to address climate change and health is dependent upon community understanding of vulnerabilities. Those larger communities may have the luxury of dedicated resources to conduct such assessments and develop action plans. A small community may have difficulties collecting information, limiting their ability to develop a vulnerability assessment and a subsequent action plan.

The difference in the capacity, social dynamics and economies of urban and rural communities are demonstrated in the cultural values, demographic indicators, and economic outcomes in various regions. Access to country foods, access to the land and connection to one’s community may be a core value to rural families, while store bought foods, the access to parks and recreation areas and a connection to local clubs and activities may be a core value to urban families.

For the Métis in general, traditional foods, and the spiritual and cultural characteristics that they bring to the individual are an important source of health and identity. For rural Métis populations there is more access to the land and the ability to participate in traditional harvesting – an important health component. For urban Métis populations traditional harvesting may not be an option and the ability to access healthy foods may be shopping at the grocery store. Access to healthy foods and potential vulnerabilities from climate change would need to be addressed differently in the urban and rural settings. The 2017 Aboriginal Peoples Survey indicates that “Métis in rural areas were consistently more likely to hunt, fish or trap and gather wild plants or berries (51%) than those in urban areas (35%) (Statistics Canada, 2019).”

Sex and Gender Identity

Sex refers to the biological characteristics such as anatomy (e.g. body size and shape) and physiology (e.g. hormonal activity or functioning of organs) of an individual (Public Health Agency

of Canada, 2012). Sex is typically categorized as male, female, or intersex. Sex can be a factor that influences health, for example, men and women may show different symptoms for diseases and conditions. In contrast, gender is associated with socially and culturally constructed roles, relationships, behaviours, relative power and other traits that society ascribes to females, males and people of diverse gender identities (Public Health Agency of Canada, 2012). Gender norms – social expectations of appropriate roles and behaviours for males and females – influence overall health and well-being. Gender norms concerning work roles, the division of paid and unpaid labour and the occupations of males versus females can result in different exposures and vulnerabilities (Public Health Agency of Canada, 2012). Additionally, these norms can form the basis upon which women, transgender, and gender non-conforming persons face discrimination, creating income, employment and education inequities that have impacts on the health of these identities and the type of health care they receive (Halseth, 2013).

Métis woman's educational attainment is higher than their First Nations and Inuit counterparts. However, it is lower than non-Indigenous women; 73% of Métis woman completed high school compared with 80% non-Indigenous woman, and 9.4% Métis woman earned a Bachelor's degree or higher compared with 20.3% non-Indigenous woman (Halseth, 2013). Lower educational attainment is tied to lower income. According to Statistics Canada 2006 Census, Indigenous women have lower median incomes than both Indigenous men and non-Indigenous women (see figure below) (Halseth, 2013). However, the gender gap between the median incomes of Indigenous men and women is narrower than it is for non-Indigenous men and women, suggesting a greater degree of gender income equality (albeit at lower income levels (Halseth, 2013). Poverty is also exacerbated by family status. Indigenous households were more likely to be headed by a single parent compared with non-Indigenous households. According to the 2016 Census, 25.5% Métis children live in lone-parent households headed by the mother (Statistics Canada, 2017). Poverty contributes to poorer health outcomes.

Statistics for Métis 2SLGBTQQIA (Two-Spirit, lesbian, gay, bisexual, transgender, queer, questioning, intersex and asexual) peoples are limited. The social determinants of Indigenous 2SLGBTQQIA peoples' health have received little attention in health reporting due to the compounding of transphobia and homophobia with other forms of structural power inequities (Hunt, 2016). Indigenous 2SLGBTQQIA often face challenges in accessing housing, health care, drop-in centres, sexual health care, counseling and other programs, due to the gendered nature of those services and outright discrimination against gender non-conforming persons. Indeed, many emergency housing shelters in Canada have separate programs for men and women and do not have trans-inclusive policies. Indigenous, and specifically Métis, 2SLGBTQQIA are often "invisible" within health policy discussions which impacts funding priorities, and the design and delivery of Métis health programs. There is a need for research and policy which includes 2SLGBTQQIA Métis peoples' perspectives on public health issues (Hunt, 2016).

A serious threat to the well-being of many Indigenous women and 2SLGBTQQIA people is the violence they experience in Canadian society. For example, Métis women have a distinct experience in colonialism. "There were gendered dimensions to Métis women's use of Scrip, and Métis girls also had different experiences of residential schools, in which some were sent to

residential schools while others were denied any form of schooling entirely. They also had distinct experiences within Métis settlements and towns, road allowances communities, the Sixties Scoop and other failed government interventions” (National Inquiry into Missing and Murdered Indigenous Women and Girls).

Indigenous women are 3.5 times more likely to experience violence compared to their non-Indigenous counterparts, and they are more likely to suffer from severe forms of spousal violence (Halseth, 2013). Métis women and girls have been marginalized and have faced “concerted efforts to separate them from First Nations relatives through the apparatus of the state and the history of colonization has further generated a hierarchy of identity, resulting in conflicts within the Métis community (National Inquiry into Missing and Murdered Indigenous Women and Girls).

The high rates of violence against Indigenous women are related to lower socio-economic status, as well as the legacy of colonial policies like the residential school system, where many experienced sexual, physical and emotional abuse (Halseth, 2013). For some women, a legacy of these abuses has been a “loss of self-esteem, alcohol and drug abuse, post-traumatic stress disorder, impaired impulse management; chronic self-destructive behaviors; episodes of disassociation or depersonalization; alterations in self-perception manifested by a chronic sense of guilt or shame; alterations in relationships with others; and alterations in one’s belief system or the value and meaning of one’s unique life” (Halseth, 2013). These outcomes can increase vulnerability to health risks. Indigenous 2SLGBTQQIA people are often forgotten in discourse about violence, and the lack of distinctions-based data is a significant barrier in recognizing and understanding the scope of violence that they face (National Inquiry into Missing and Murdered Indigenous Women and Girls). Métis governments are making efforts to better represent 2SLGBTQQIA Métis needs. For example, in 2019, the Manitoba Metis Federation created its first Two-Spirit Michif Local to represent and organize 2SLGBTQ Métis citizens and allies to better represent 2SLGBTQ Métis needs while discussing MMF objectives (Monkman, 2019). In future climate change and health work, it is critical to include Métis 2SLGBTQQIA peoples.

	First Nations	Métis	Inuit	Non-Indigenous
High School Graduation	61%	73%	47%	80%
Bachelor’s degree or higher	8.4%	9.4%	4.6%	20.3%

Figure 7: Educational attainment summary of Indigenous women and non-Indigenous women 25 years and older

Source: Halseth, R. (2013). *Aboriginal Women in Canada: Gender, Socio-Economic Determinants of Health, and Initiatives to Close the Wellness Gap*. National Collaborating Centre for Aboriginal Health. Data from 2006 Census.

	Median Income
Indigenous Women	\$15,654
First Nations Women	\$14,490
Métis Women	\$17,520
Inuit Women	\$16,599
Indigenous Men	\$18,714
Non-Indigenous Women	\$20,640
Non-Indigenous Men	\$ 32,639

Figure 8: Median Income, Indigenous women (age 15+) compared with Indigenous men and non-Indigenous men and women

Source: Halseth, R. (2013). *Aboriginal Women in Canada: Gender, Socio-Economic Determinants of Health, and Initiatives to Close the Wellness Gap*. National Collaborating Centre for Aboriginal Health. Data from 2006 Census.

Culture

A person's upbringing, background, traditions, language, customs, and the beliefs of their family or community play a huge role on overall health because it influences how one may think, feel, act, and value. The Canadian government enacted policies designed to assimilate Indigenous peoples, including the devastating Residential School System and Sixties Scoop. These policies separated Métis children from their families and communities. Today, Métis continue to experience trauma, loss, and grief due to Canada's past and ongoing assimilation policies. Cultural practices can bring healing and bolster resilience amongst Métis individuals, families, communities, and nations (National Collaborating Centre for Aboriginal Health, 2016).

For the Métis, the Michif language conveys culture and is used to relay knowledge, skills, and cultural values to the community. The 2016 Census indicates that there are 725 individuals who identify Michif as their first language in Canada with over 89% of these individuals living in the four western provinces. The 2011 Census indicated that 645 individuals spoke Michif as their first language, an increase of over 80 people or 11%. This is important as studies show the revitalization of language and culture can improve health outcomes (National Collaborating Centre for Aboriginal Health, 2016).

Among Métis, in 2017, about one in three (35%) had hunted, fished or trapped (Statistics Canada, 2017). Over a quarter (27%) of Métis gathered wild plants, almost one in ten (8%) Métis made clothing or footwear, and about a quarter (24%) of Métis made carvings, drawings, jewelry or other kinds of art in the past year (Statistics Canada, 2017). These land and culture-based activities are connected to health. They can help to replenish the spirit, reduce stress, and increase physical activity and nutrition. Participating in cultural activities is also shown to build self-confidence, foster cultural identities, and increase opportunities for intergenerational knowledge transmission. Thriving Métis cultural sites and institutions are driving resilience within

the Métis Nation. These include, the Métis Nation Heritage Centre and Louis Riel Institute in Manitoba, Back to Batoche and the Gabriel Dumont Institute in Saskatchewan, Métis Crossing in Alberta, the two publishing houses focused on promoting Métis authors, illustrators, stories and the Michif language (*Michif Is the Official Language of the Métis Nation*, n.d.).

Michif is the Official Language of the Métis Nation

According to Norman Fleury, linguist and Michif language specialist, speaker and traditional storyteller, “Michif” was the “nationality” (ethnicity) and the languages now known as Michif were Métis versions of “Cree” and “French,” despite their differences with standard Cree or French-Canadian French. The old people referred to the language we now call Michif as the “Cree spoken by the Michif.” Michif-French was referred to as the “French spoken by the Michif.”

Spoken mainly in southern and central Saskatchewan and Manitoba and ranging into North Dakota (the area in and around the Turtle Mountain Reservation) and some parts of Montana, Michif is considered to be the true mixed Métis language. It mixes Plains Cree verbs and verb phrases and French nouns and noun phrases along with some Saulteaux and English, depending on the locale and family. Michif-French, spoken in various places in all three Prairie Provinces, is a dialect of Canadian French that sometimes employs an Algonquin syntax. Northern Michif, spoken in northwest Saskatchewan, is a dialect of Plains Cree with a tony number of French loan words.

Michif is the endangered orally-based language of Métis citizens. Perhaps only 5-10% of the Métis Nation population are able to speak the language, with the majority being elders.

Source: Métis Nation Gateway, (n.d.). *Michif is the Official Language of the Métis Nation.*
<https://language.metisportals.ca/>

Health Determinants

The social determinants of health are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies and political systems (World Health Organization, n.d.-b). Climate change can expose underlying vulnerabilities that already exist in society. Those who are particularly

vulnerable could be children, the elderly, people with pre-existing health conditions such as respiratory issues or diabetes. Also, those areas where there is weak health infrastructure will be the least able to cope without assistance to prepare and respond.

Social Support Networks and Coping Skills

Greater support from families, friends and communities is linked to better health (World Health Organization, n.d.-b). Social networks are important for promoting and maintaining health and well-being. Social networks, including family and friendship ties, are sources of emotional, practical and other support that enhance social participation and help combat isolation and loneliness (Ramage-Morin & Bougie, 2017).

For Métis, health is shaped by family and community ties (Ramage-Morin & Bougie, 2017). Métis history is marked by loss of culture and access to lands (Teillet, 2019). Yet, Métis history is also one of resilience, with evidence of the durability of family bonds and social networks (Ramage-Morin & Bougie, 2017). Indeed, in a study examining the importance of social support in promoting thriving health, Métis participants were most likely to report high levels of social support relative to First Nations and Inuit participants (Richmond et al., 2007). In the same study, participants with high levels of social support were more likely to report thriving health. In the context of climate change, the strength of Métis kinship and community ties are positive determinants in overcoming health challenges and adversity.

Most Métis (73%) helped out in their community at least once per month during the past 12 months

- One third (29%) of Métis 15 years or older volunteered with a group or organization at least once per month.
- Two-thirds (68%) of Métis 15 years of age or older reported helping people out on their own, not on behalf of an organization. For example, caring for someone's home, driving someone to an appointment, visiting the elderly, shovelling snow or unpaid babysitting.

Source: (Statistics Canada, 2018c)

Education

Educational attainment is a strong determinant of an individual's health and well-being across their life span. Education provides individuals with the knowledge and skills to solve problems and take control of their life circumstances. It also increases the opportunity for a job, income security, and job satisfaction. Low education levels are linked with poor health, more stress and lower self-confidence (World Health Organization, n.d.-b). Beyond the individual, education provides benefits to community health and well-being through economic development and

growth, enhanced innovation and social cohesion, reduced reliance on social assistance, and positive intergenerational effects (National Collaborating Centre for Aboriginal Health, 2017a).

Métis levels of educational attainment are increasing; between 2006 and 2016, the share of Métis aged 25 - 64 who had completed high school went up roughly 10% (66.8% to 77.4%) (Statistics Canada, 2018b). Similarly, one in four Métis had completed a college diploma in 2016, compared with one in five in 2006 (Statistics Canada, 2018b). Despite these improvements, Métis continue to have lower levels of education than the general population. The National Collaborating Centre for Aboriginal Health determined that the exclusion of Métis peoples' histories, worldviews, languages and cultures from curriculums can mean Métis students are not motivated to perform in formal education settings (National Collaborating Centre for Aboriginal Health, 2017a). Racism and discrimination within schools by classmates and by teachers can also exacerbate the problem of low academic achievement for Indigenous students (Whitley, 2014). Ultimately, socio-economic marginalization is considered to be the primary factor associated with poorer educational attainment (National Collaborating Centre for Aboriginal Health, 2017a). Poverty restricts access to education through the financial costs of school fees, transportation, and books, and the financial obligation to support the household (National Collaborating Centre for Aboriginal Health, 2017a).

The 2012 Aboriginal Peoples Survey asked respondents who dropped out of formal education programs why they left school before completion. The reasons that male Métis dropped out of school included the following: wanted to work (21%), school problems (21%), lack of interest (17%), and had to work/money problems (15%) (Statistics Canada, 2013). One-quarter of female Métis leavers cited pregnancy or the need to care for their own children as the main reason why they dropped out of school (Statistics Canada, 2013). To add to this, Métis have not shared equitably in the allocation of early childhood development resources that the federal government has transferred to the provinces through the Canada Social Transfer (Métis Nation, 2014). The jurisdictional barrier has compounded the problem of social and economic disparities including poverty, poor health, and inadequate housing that produce lower than average education and employment levels for Métis (Métis Nation, 2014). Through improvements in Métis educational attainment, health outcomes in the population are likely to improve also.

Traditional Ecological Knowledge (TEK) refers to the evolving knowledge acquired by Indigenous and local peoples over hundreds or thousands of years through direct contact with the environment. This knowledge is specific to a location and includes the relationships between plants, animals, natural phenomena, landscapes and timing of events that are used for lifeways, including, but not limited to, hunting, fishing, trapping, agriculture, and forestry. TEK is an accumulating body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (human and non-human) with one another and with the environment. It encompasses the world views of Indigenous peoples which includes ecology, spirituality, human and animal relationships, and more. (Berkes, 1993). Within the context of social determinants of health TEK is an important factor for the Métis as it provides community resilience to climate change. It can

also be negatively impacted due to changing environmental conditions and species migration patterns.

Employment and Working Conditions

Employment and working conditions have a direct impact on the health of the individual, as well as the health of the family. Unemployment, stressful or unsafe work are associated with poorer health. People who have more control over their work circumstances and have fewer stress-related demands of the job are healthier and often live longer than those in more stressful or riskier work. Paid employment also provides a sense of purpose, identity, social contacts, and opportunities for personal growth (Douglas & Vasiliki Douglas Bsn, 2013).

Métis experience inequalities in the labour force that are reflected in lower employment and participation rates, higher unemployment rates, and greater vulnerability to economic downturns compared to the non-Indigenous population (Moyser, 2017). According to the 2017 Aboriginal Peoples Survey, among Métis age 25 to 54, 79% were employed. When examining the employment rate by gender, it was significantly higher for Métis men (82%) than women (75%) (Hahmann, Robertson, et al., 2019). Métis women reported a lower employment rate than men across most levels of education, even among those with a university degree. Most Métis are employed in two occupational groups; sales and services (21%) and trades, transport, equipment operators, and related occupations (20%) (Hahmann, Robertson, et al., 2019). Many of these types of jobs are lower income, lower skilled, and more vulnerable to economic downturns, and many carry a greater risk of injury (National Collaborating Centre for Aboriginal Health, 2017c).

There are a number of other labor activities that can contribute to economic well-being that are not captured in The Aboriginal Peoples Survey.

Hunting, fishing and trapping

- Over one third (35%) of Métis said they hunted, fished or trapped in the past year.
- Men were more likely to report hunting, fishing or trapping than women (47% versus 25%).
- These activities were also more common among Métis residing in rural areas than among those residing in large urban population centres (50% versus 24%).
- About 1% did these activities for income or to supplement their income.

Gathering wild plants, for example berries, rice or sweet grass

- Over a quarter (27%) of Métis gathered wild plants in the past year
- Gathering wild plants was more common in rural areas than large urban centres (39% versus 19%)
- About 1% of Métis gathered wild plants for income or to supplement their income.

Making clothing or footwear

- Almost one in ten (8%) Métis made clothing or footwear in the past year.
- Making clothes or footwear was more common among women (13%) than men (2%)
- About 1% did so for income or to supplement income.

Making carvings, drawings, jewellery or other kinds of artwork

- About a quarter (24%) of Métis made carvings, drawings, jewellery or other kinds of art in the past year
- These activities were more common among women than men (30% versus 17%)
- About 2% of Métis did these activities for income or to supplement income.

Source: Statistics Canada, 2017

Child Development

Early childhood, particularly the first 5 years of life, impacts long-term social, cognitive, emotional, and physical development. Positive stimulation early in life improves learning, behavior and health into adulthood.

Children under 5 make up a greater proportion of the Métis population (7%) than they do of the non-Indigenous population in Canada (5%) (Greenwood, 2016). The size, composition and characteristics of families can contribute to poorer health and developmental outcomes for young Métis children (Halseth & Greenwood, 2019). According to the 2016 Census, 25.5% Métis children live in lone-parent households headed by mothers (Statistics Canada, 2017). Young Indigenous children, including Métis, are also significantly more likely to be in foster care compared to non-Indigenous children (Statistics Canada, 2017). In 2016, 1.3% of Métis children under age 5 were in foster care compared to only 0.2% of non-Indigenous children (Statistics Canada, 2017). Children developing in these settings can show poorer health outcomes.

Métis children's health and well-being are influenced by family, community, and the broader societal systems and structures in which they live (Greenwood, 2016). Relationships and family are central to Métis culture, providing additional support to Métis children. Elders, for example, pass on their traditional knowledge and teach life skills that contribute to a child's health and wellbeing (Halseth & Greenwood, 2019). Other factors that influence child development include structural and systemic factors such as child development policies, legislation, and agreements; and the availability of strong, community-focused accessible health, education, child welfare and justice systems that support and enable child well-being (Greenwood, 2016). In March 2019, the federal government and the Métis Nation signed Métis Nation Early Learning and Child Care (ELCC) Accord. The Accord will create and enhance early learning programs and supports for Métis children and their families that is anchored in Métis culture and responsive to the Métis specific needs. This programming can positively impact Métis youth health outcomes.

Physical Environments

The physical environment is the state of the natural world that people live in. Safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute to good health (World Health Organization, n.d.-b). Polluted air, water, food and soil can cause a variety of adverse health effects, including cancer, birth defects, respiratory illness and gastrointestinal ailments (Douglas & Vasiliki Douglas Bsn, 2013).

Housing quality, affordability, location, appropriateness, and accessibility are part of the physical environment determinants of health (National Collaborating Centre for Aboriginal Health, 2017b). Housing conditions for Métis are below Canadian averages, with 14% of Métis homes needing major repairs compared to 7% nationally (Statistics Canada, 2017). Socio-economic conditions such as poor housing and poor air quality have been linked to rates of asthma and chronic obstructive pulmonary disease. Both were nearly two times higher among Métis

compared to non-Indigenous populations, as well as to rates of premature years of life lost (PYLL) that were two times higher for Métis than for non-Indigenous peoples.

Indigenous people, including Métis, are also over-represented in Canada's overall homeless population. The homeless face barriers in accessing health care including: inability to provide proof of insurance coverage; affording prescription medication, and; health essentials such as food (National Collaborating Centre for Aboriginal Health, 2017b). Many homeless people also suffer from mental illness or substance abuse problems, and encounter a health care system that often fails to provide adequate treatment (National Collaborating Centre for Aboriginal Health, 2017b).

According to Statistics Canada (2017), approximately 80% of Métis live in urban centers, which tend to have poorer air quality than rural areas. For example, Edmonton, which has a high number of self-identified Métis residents, has among the poorest air quality of Canadian cities. The World Health Organization's guideline for annual average concentration of fine particulate matter (PM_{2.5}) is 10.0 micrograms per cubic meter. Edmonton often averages above this guideline (Environment Canada, Int). Fine particulates pose a great health risk because of their small size (~1/30th of the average human hair width) which means they can lodge deeply into the lung. Poor air quality can exacerbate the health of those living with respiratory and cardiovascular illness resulting in poorer health outcomes for the Métis. Climate change is a fundamentally altering the physical environment, impacting access to clean air, safe drinking water, sufficient food and secure shelter and ultimately the health outcomes of the population.

Social Environment

The social environment refers to membership in a distinctive group of people. Group membership can contribute to problem solving by allowing individuals to recruit assistance from other members or their group, or even use the collective social status of their group to resolve issues (Douglas & Vasiliki Douglas Bsn, 2013)

Métis Governing Members (GMs) undertake collective action for the mutual benefit of its members. For example, MMF provides health, environment, housing, and education initiatives for its members. Programs to support social and cultural activities, such as streaming of Métis music, provide access to social activities where people can feel connected to each other and to their culture.

The MNA delivers programs and services to Métis youth in Alberta, so they may feel inspired and empowered to move the Nation forward. The MNA's Department of Youth Programs and Services has led many initiatives to address this need and ensure all Métis youth in Alberta feel a sense of belonging to both their community and their Métis roots. Through provincial initiatives such as; Youth and Seniors Gatherings, Alberta Métis Fest, On the Land camps, Headstrong mental health summit, Youth Conferences, and much more, MNA has helped to establish important cultural connections.

Accessibility, Availability, and Acceptance of Health Services

Equitable access to universal health services supports earlier diagnosis, lowers mortality and comorbidity rates, and leads to improved physical, mental, emotional, and social outcomes (National Collaborating Centre for Indigenous Health, 2019). In Canada, Métis and other Indigenous peoples experience barriers to health care, resulting in significant and ongoing health disparities compared to the non-Indigenous population. According to the National Collaborating Centre for Indigenous Health, the accessibility, availability and acceptability of health services for Métis people are impacted by colonialism, geography, health systems, health human resources, jurisdictional issues, communications, cultural safety, and traditional medicines (2019).

Many Métis have experienced racism, discrimination, and a lack of compassion or understanding which have left many suspicious of medical professionals and the mainstream healthcare system. For example, the coercion of Métis women into tubal ligations continues today (National Collaborating Centre for Indigenous Health, 2019). This example, among many others, have resulted in some Métis individuals having a pronounced mistrust of health services, which ultimately impacts their health and well-being (National Collaborating Centre for Indigenous Health, 2019).

For Métis living in rural areas, health care challenges are more severe (National Collaborating Centre for Indigenous Health, 2019). There is a shortage of health professionals within remote communities, many individuals are transported to urban and southern-based hospitals for medical emergencies, hospitalization and appointments. People in these communities, including Métis, may experience financial hardships, loneliness, emotional stress, and elevated anxiety and fear associated with such medical relocations (National Collaborating Centre for Indigenous Health, 2019). Jurisdictional issues also play into health discrepancies between Métis and the non-Indigenous population. While Métis have access to mainstream services, little or no attention has been paid to their specific cultural or geographical needs (Chartrand, 2011). All of these factors can make Métis vulnerable to health risks.

Métis Health Profile

The above health determinants result in Métis having poorer health outcomes than the general population. There is also very little comprehensive data related to understanding Métis health and well-being. Canada's Indigenous health information is hindered by a lack of relevant, consistent, and inclusive Indigenous identity indicators in health data sets; and limited Indigenous leadership and participation in the governance and management of Indigenous health data (World Health Organization, n.d.). Health and census information for the Métis population is particularly limited. Unlike the First Nation and Inuit population, the federal government previously did not have jurisdictional authority for the Métis (Macdougall, 2016). It was only in 1996 that Statistics Canada began a targeted approach to collecting data on Métis people. Consequently, there are significant information gaps for establishing baseline health data, income, and educational statistics related to Métis people. The following section provides a brief overview of the available Métis health data with information from Statistics Canada.

Life expectancy

- In 2017, the life expectancy for the Métis Canadian population was 70 years for men and 80 years for women (Statistics Canada, 2017). This is slightly less than that of the entire Canadian population of 79 for men and 80 for women.

Mortality

- Using Canadian mortality data, Tjepkema, Wilkins, Senécal, Guimond, and Penney (2009) found that the life expectancy for males, who had attained 25 years of age, was 49.5 additional years for Métis, compared to 52.8 additional years for non-Indigenous. For females, additional years of life expectancy past the age of 25 were 53.7 for Métis compared with 59.2 for non-Indigenous (Kosatsky et al., 2012).
- The probability of survival from 25 to 75 years of age for Métis males and females was 56.7% and 63.3%, compared to 64.3% and 79.4% for non-Aboriginals (Kosatsky et al., 2012).
- The most common causes of death for Métis males were circulatory system disorders (32%), cancer (all types 23%), and injury (external causes 18%). Causes of death for Métis females were cancer (all types 33%), circulatory system disorders (29%), respiratory diseases (7%), injuries (6%), and digestive system disorders (6%) (Kosatsky et al., 2012).

Mental Health

- Reporting on findings from the 2017 Aboriginal Peoples' Survey (APS) (Statistics Canada, 2017) indicated that 54% of Métis 12 years and above reported their health status as very good or excellent and 65% reported their mental health status as very good or excellent.
- More than half of Métis aged 45 or older also reported strong family networks. Those with strong family networks were generally more likely to report positive health.
- One in five Métis over 18 (19.6%) reported having ever had suicidal thoughts in the 2012 APS (Statistics Canada, 2016b). Métis women were more likely than Métis men to have had suicidal thoughts (Statistics Canada, 2016b).
- Suicide rates among Métis were significantly higher than the rate among non-Indigenous people. The suicide rate was 14.7 per 100,000 person-years at risk, which was nearly twice as high as the rate among non-Indigenous people (8.0) (Kumar & Tjepkema, 2019).
- The rate among Métis males (22.6) was more than three times higher than the rate among Métis females (7.2). The suicide rate was nearly twice as high among Métis (22.6) use as non-Indigenous males (12.3). The suicide rates for Métis female (7.2) was higher than non-Indigenous females (3.9) (Kumar & Tjepkema, 2019).

Disability

- In 2017, 30% of Métis had one or more disabilities that limited them in their daily activities (Hahmann, Badets, et al., 2019).
- Métis disability rates were higher for women than for men, increasing with age for both men and women.
- Pain-related disabilities were most prevalent among Métis.

Chronic and Infectious Disease

- Rates of chronic and infectious disease are higher among Métis population (see below).
- In Manitoba, 27.9% of Métis have hypertension, 12.2% of Métis have Ischemic Heart disease, 3.6 per 1000 Métis in Manitoba experience strokes, and 5.4 Métis per 1000 suffer acute myocardial infarction.
- In Alberta, in 2009, 3.1% of Métis had heart disease, 13% had high blood pressure and 0.5% had experienced a stroke.
- In Ontario, between 2006 and 2009 out of 100 people 1.94 Métis people suffered from an acute coronary syndrome, 1.79 experienced congestive heart failure and 0.5 had a stroke.
- In terms of diabetes, 11.8% of Métis in Manitoba were diagnosed with diabetes, significantly more diagnosis than the 8.8% of all other Manitobans.
- In Alberta, 6.8% of Métis had been diagnosed with diabetes or 1.8 times more Métis have diabetes compared to other Albertans.
- In Ontario, 8.13% of Métis have been diagnosed with diabetes. The number of Métis with diabetes was 26% higher than all other people in Ontario.

These statistics were outlined in a report *Métis Public Health: Keeping Our Communities Strong* by The Métis Nation British Columbia (MNBC). Statistics for British Columbia and Saskatchewan were not provided.

Vulnerabilities and Risk

The determinants of health result in poorer health outcomes of the Métis highlighted above. These health conditions are exacerbated in climate change and climate related emergencies. The following chapter will highlight climate risks and the associated health impacts for each province.

Chapter 3: Climate Risks

Western Canada experiences some similar climate risks and some that are unique to each region. British Columbia, for example, experiences sea level rise and ocean acidification and hypoxia (low oxygen levels). For the prairie provinces, heat waves and drought are a significant problem. Within each region, climate risks can differ or vary in frequency and severity. Proximity to the coast or to lakes, elevation, and land cover all affect local climate and, to some extent, changes to local climate (*Canada's Changing Climate*, 2019). Urbanization, in particular, can have a substantial effect on local climate because of the widespread changes to land cover like the conversion of natural landscapes to roadways and rooftops, which typically absorb more solar radiation and hence increase local temperature (*Canada's Changing Climate*, 2019). The following chapter will provide an overview of the common climate risks of Western Canada and the associated impacts of each risk to Métis health. It will then offer a picture of risks to the Métis population in each province. **Further research is required to develop a comprehensive study of climate related health risks within each province.**

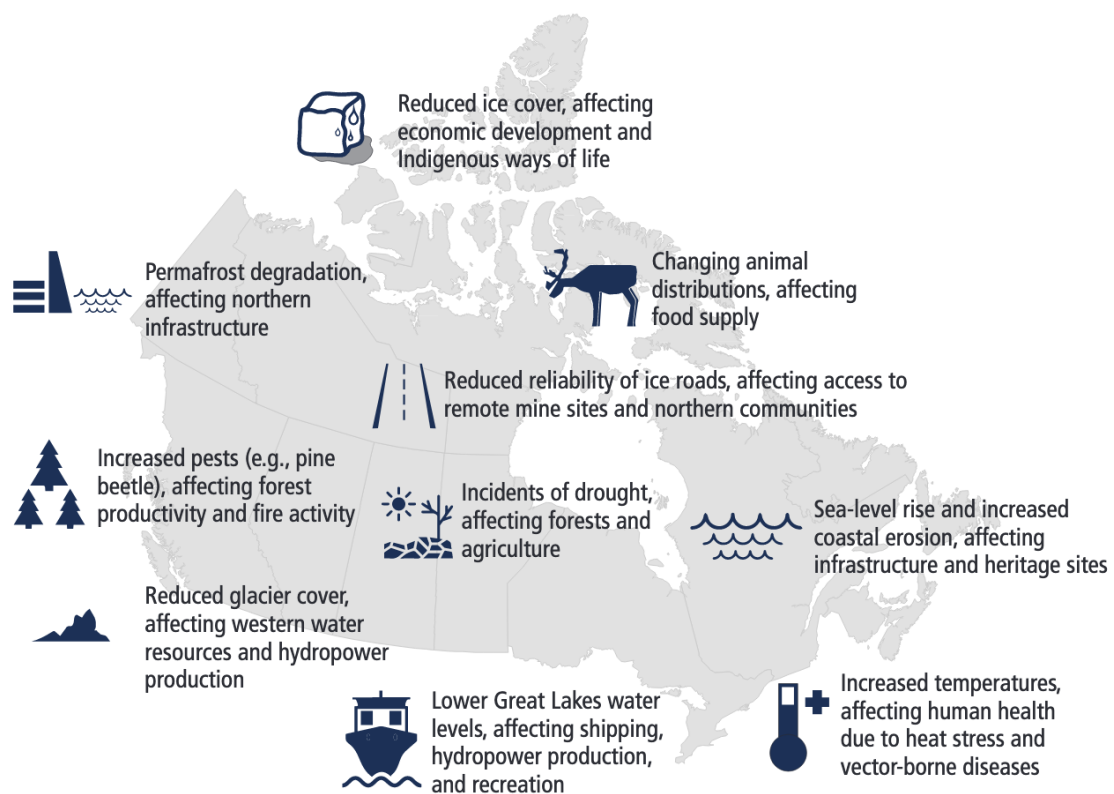


Figure 9: Climate Risks across Canada

Source: The Council of Canadian Academies, 2019

Major Risk	British Columbia	Alberta	Saskatchewan	Manitoba	North West Ontario
Forest Fires	High Risk	High Risk	High Risk	High Risk	High Risk
Flooding	High Risk	High Risk	High Risk	High Risk	High Risk
Landslide	High Risk	High Risk	Minimal Risk	Minimal Risk	Minimal Risk
Extreme Heat and Drought	High Risk	High Risk	High Risk	High Risk	High Risk
Glacial Retreat	High Risk	High Risk	Minimal Risk	Minimal Risk	Minimal Risk
Sea Level Rise	High Risk	Minimal Risk	Minimal Risk	Minimal Risk	Minimal Risk
Ocean Acidification and Hypoxia	High Risk	Minimal Risk	Minimal Risk	Minimal Risk	Minimal Risk
Vector-borne Diseases	High Risk	High Risk	High Risk	High Risk	High Risk
Invasive Species	High Risk	High Risk	High Risk	High Risk	High Risk

Figure 10: Common Risks across the North-West

The red box indicates that the risk is significant in that province. The blue box indicates that the risk is minimal.

Health Impact	Impact
Physical	<ul style="list-style-type: none"> • Mortality • Morbidity • Injury • Decreased physical activities
Emotional and Spiritual	<ul style="list-style-type: none"> • Solastalgia • Ecoanxiety • Ecogrief • Ecoparalysis
Psychological	<ul style="list-style-type: none"> • Anxiety disorders • Stress • PTSD • Depression • Suicide and Suicidal Ideation • Violent behaviours • Substance abuse
Cultural	<ul style="list-style-type: none"> • Disruption of cultural activities and community gatherings

Figure 11: Health Risks associated with Climate Change

This report examines the impacts of climate change on health and well-being, with health conceptualized as encompassing physical, emotional and spiritual, psychological and cultural components. While some health issues, such as respiratory illness due to poor air quality, are not exclusive to climate change, there are definite linkages to how these climate changes are further impacting many existing health concerns.

Physical

The physical impacts of climate emergencies include; mortality, morbidity, injury and decreased physical activities. Mortality refers to direct death caused by climate emergencies, while morbidity refers to illness and disease. Injury and decreased physical activity due to unstable travel conditions and unpredictable weather patterns are also impacts of climate emergencies.

Emotional and Spiritual

Climate change can also impact emotional and spiritual health and well-being. Several terms have emerged in climate-health research and literature to describe emotional responses to climate change including solastalgia, ecoanxiety, ecogrief, and ecoparalysis.

- **Solastalgia** refers to the sense of unease and dislocation that may arise from observing major changes in one's home territory (Albrecht et al., 2007).
- **Ecological grief** is the grief felt in relation to experienced or anticipated ecological losses, including the loss of species, ecosystems and meaningful landscapes due to acute or chronic environmental change (Cunsolo & Ellis, 2018).
- **Eco-anxiety** is a specific form of anxiety relating to stress or distress caused by environmental changes and our knowledge of them. There is no specific diagnosis of 'Eco-anxiety'. Self-reported presentations may include panic attacks, insomnia, obsessive thinking, and/or appetite changes caused by environmental concerns (Usher et al., 2019).
- **Eco-paralysis** is the feeling you can't do anything about any of it. This appears as apathy, complacency or disengagement.

Métis spiritual health is difficult to define. Métis communities are very diverse in their spiritual beliefs. Many Métis follow traditional Indigenous spiritualism, while others are adherents of Roman Catholicism and various Protestant denominations; and some blend Christianity with Indigenous spiritualism (Préfontaine et al., n.d.). The Métis' Indigenous spiritual system is an extension of Anishinabe (Ojibwa) and Nehiy(n)awuk (Cree) traditions (Préfontaine et al., n.d.). At the basis of this system is "Kitchi Manitou" or the "Great Spirit" or "Creator" who created the universe, the spirit world, the land, plants, animals, and humans. The traditional Métis worldview promoted living with the land. In Indigenous languages, there is no such thing as inanimate objects – all things have spirits. Flora, fauna, and humans were provided with spirits, emotions, minds, and bodies, which made them equals and therefore worthy of respect

(Préfontaine et al., n.d.). Climate change, and the damage it causes to the land, is harmful to Métis spiritual health.

Psychological

Research finds that climate change can impact mental health. Extreme weather events can trigger post-traumatic stress disorder (PTSD), major depressive disorder (MDD), anxiety, depression, grief, substance abuse, and suicidal ideation (Hayes et al., 2018). Incremental climate changes, such as rising temperatures and rising sea levels can change natural landscapes, disrupt food and water resources and security, change agricultural conditions, leading to an increase financial and relationship stress, increase risks of violence and aggression, and displacement of entire communities (Hayes et al., 2018).

Cultural

Cultural well-being is tied to Métis connections to their identity, language, history, traditions, and ancestors. Participating in cultural activities and Métis community events are important for cultural health and wellbeing. Climate change, resulting in unstable travel conditions, unpredictable weather patterns, and extreme events such as flooding and wildland fires can disrupt Métis cultural way of life. For example, the loss of a trap line, passed down from generations, due to a forest fire can have a significant impact on a person's ability to connect to their way of life.

Resiliency

Resilience is the ability to psychologically “bounce back” from times of high distress. With climate change, the challenges are large in scale, long-term, and complex (Davenport & Susteren, 2017). However, this report will highlight risks as well as Métis resiliency.

Forest Fires

Wildfires are a natural hazard that typically occur in forested and grassland regions of Canada. The regions with the highest wildfire occurrence in the Métis Nation is British Columbia, and the Boreal forest zones of Ontario and the Prairie provinces.

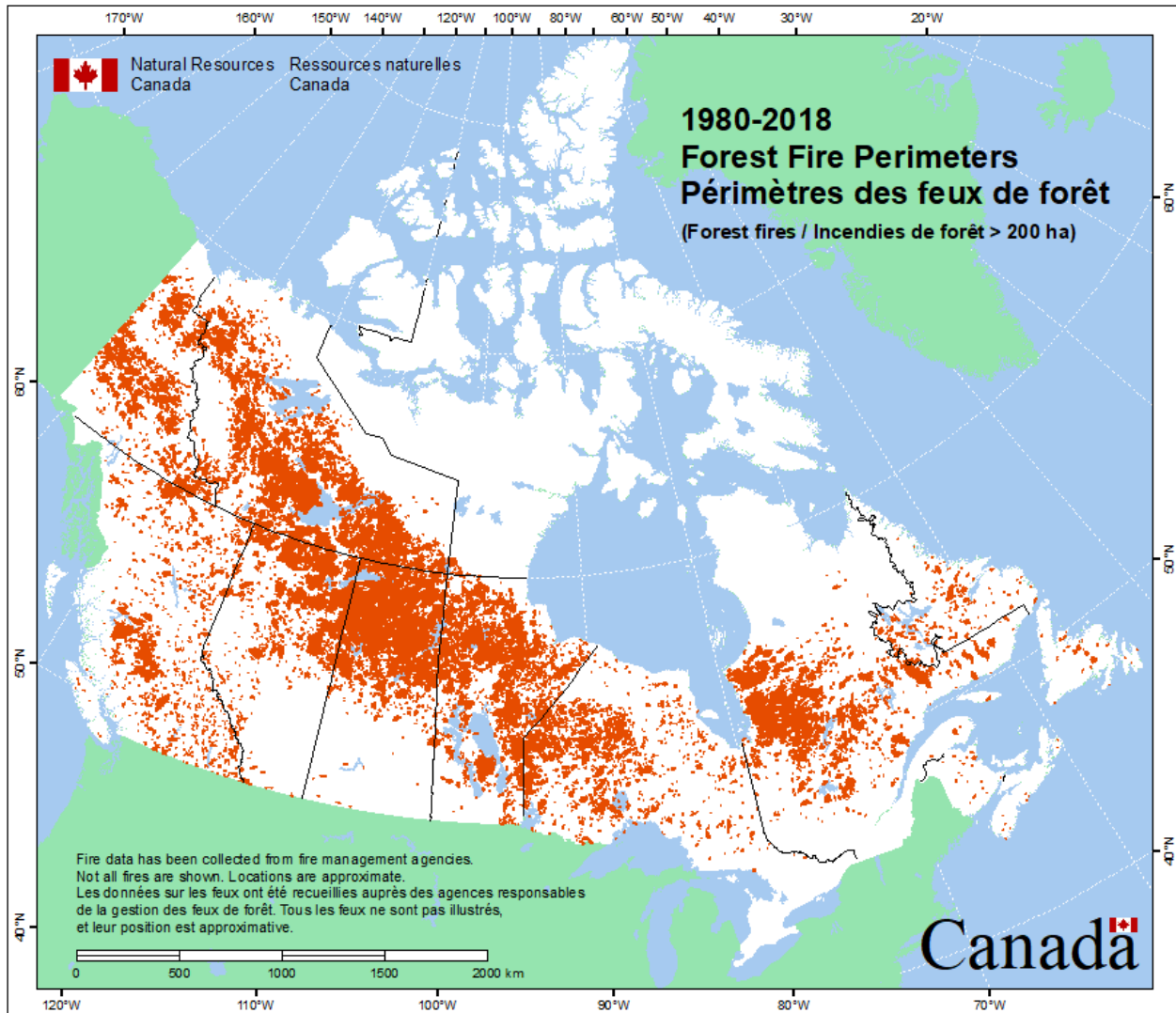


Figure 12: Incidence of Forest Fires in Canada

Source: Canadian National Fire Database (Natural Resources Canada, 2019)

Fire activity is strongly influenced by four factors: fuels, climate–weather, ignition agents and people. Temperature is the most important variable affecting wildland fire, with warmer temperatures leading to increased frequency, timing, and severity of wildfires. Warmer temperatures increase evapotranspiration, lowering the water table position and decreasing fuel moisture (Flannigan et al., 2009). 45% of all fires are ignited by lightning, while 55% are caused by humans. Lightning ignited fires tend to occur in remote locations and often in clusters, and

consequently represent 81% of total area burned. Increased temperatures result in increased lightning activity that generally leads to increased ignitions (Flannigan et al., 2009).

Physical

Mortality

Wildfires can cause loss of life if individuals are caught in affected areas, or indirect loss of life in the aftermath due to limited medical or emergency care or exposure to harmful smoke inhalation. Currently, on average, Canada sees about two deaths each year related to wildland fire (Sankey, 2018). With increased intensity of wildfires and more housing development in fire prone areas, mortality rates are likely to increase, particularly if fires occur closer to the wildland-urban interface. More deaths may also occur if emergency services do not have sufficient time or support to ensure everyone is evacuated or if evacuation routes are cut off. Remote communities could face a disproportionate burden of health emergencies due to a lack of emergency medical services.

Respiratory Problems

Wildland fires release many pollutants into the atmosphere that are shown to have adverse health effects (Liu et al., 2015). In particular, elevated levels of particulate matter $<2.5\mu\text{m}$ (PM_{2.5}) are correlated with respiratory problems, pneumonia, chronic obstructive pulmonary disease (COPD), heart disease, stroke, and premature mortality (Flannigan et al., 2009). Children, the elderly and those with heart and/or breathing problems or other health issues are most at risk of adverse effects of air pollution. Therefore, the Métis population is more vulnerable to respiratory problems caused by forest fires since the Métis have a larger population of children compared to the non-Indigenous population, and the Métis experience higher rates of chronic diseases which will only be compounded due to poor air quality.

Spending time outdoors can also increase the risk of respiratory problems. Métis that engage in hunting and trapping are also at higher risk. Moreover, certain outdoor industries like construction, tourism, agriculture and forestry may experience the negative impacts related to wildland forest fires and poor air quality which means that the many Métis that work in and are dependent on these industries are more vulnerable.

Forest fires can have a significant impact on local air quality, visibility, and human health. Emissions from forest fires can travel large distances and produce harmful effects far away from the fire location. These forest fire emissions include, particulate matter, carbon monoxide, atmospheric mercury, ozone-forming chemicals and volatile organic compounds – all of which are harmful to human health.

Emotional and Spiritual

Fire can play an important role in the health and re-establishment of some ecosystems. However, a severe fire season causes extensive damage to forests and forest ecosystems. Wildfires destroy wildlife habitat, displacing animals and causing health problems due to burns and smoke inhalation. Old growth forest can take decades to recover from major disruptions. In some cases, new species and ecosystems may move in after the event, resulting in ecological transformations. Additionally, the soil erosion, ash, and debris washed into waterways can degrade water quality, causing damage to habitat for fish and aquatic life. With major changes in their physical surroundings, people can experience existential challenges to their identities. Given Métis connection the land, these changes in the ecosystem are prone to solastalgia. Elders are likely to be disproportionately burdened by some of the changes they are witnessing.

Psychological

Studies show links between wildfire smoke and anxiety, depression, PTSD and other mental health challenges (Prairie Climate Centre, 2019). Those with a history of mental or behavioral issues are particularly at risk. Severe wildfires often lead to evacuations. Between 2013 to 2019, close to 40,000 First Nations were evacuated from forest fires, with over 800 people displaced for a period of more than 2 months (*Wildland Fire and Flood Evacuation Statistics*, 2019). Métis specific statistics for evacuations are limited. However, just last year (2019), approximately 800 people living in Paddle Prairie Métis Settlement were forced to evacuate due to fires (Pearson, 2019). Displacement due to wildfires, along with loss of possessions and livelihoods, can cause extreme psychological distress. Mental health and duress resulting from leaving one's home has been identified as a key element of duress during evacuations (Centre for Indigenous Environmental Resources, 2019).

“Participants also commented on the effects of the evacuation on mental health, particularly after they returned home and attempted to resume regular routines and ‘get back to normal’. The results of this study also clearly show that the effects of the evacuation on mental health do not end once people return to their homes. For many, the fear of another evacuation looms.”

Source: Cardinal Christianson, A., McGee, T.K., Whitefish Lake First Nation 459, 2019. Wildfire evacuation experiences of band members of Whitefish Lake First Nation 459, Alberta, Canada, *Natural Hazards* 98:9–29

For Métis people, staying in a shelter for prolonged periods of time with people outside their community could add to the stress. Displacement can also trigger historic trauma associated with forced relocations and government interventions into the lives of Indigenous peoples. Displacement can also cause disruptions to employment and education, creating financial

hardship. For individuals working in the front line, for example emergency services, stress is likely intensified.

During periods of poor air quality, some communities are asked to reduce all sources of emissions including wood-burning and exhaust from cars and engines. Some remote communities rely on diesel generators for power and limiting the use of generators during a smoke event means limiting the use of fans and air conditioners indoors (Maguet, 2018). Staying inside for prolonged periods of time, without power, to avoid smoke inhalation can cause significant frustration and anxiety (Maguet, 2018).

Finally, being displaced also leads to potential increase of violence and abuse while evacuated into other communities. Prolonged periods of time in overcrowded housing or in shelters creates the possibility for the introduction of drugs, increased racism and creates overall trauma throughout the entire evacuation process. (CIER, 2019)

Cultural

For Métis communities, displacement due to wildfires can disrupt traditions. For example, wildfires can impact participation in harvesting activities. Fires can influence the appearance and availability of fish species, reduce numbers of caribou and moose, the length of a hunting season, and affect travel and safe access to harvesting areas. Harvesting traditional foods promotes physical activity, is critical to Métis identity, mental health and wellbeing.

“The one thing that makes Métis people different than other people is their culture. Climate change is affecting what people are practicing, how they are using the land. When you are talking about people who their connection to the land is their culture, it is their identity. They have evacuated several Métis communities for wildfire and not everybody returns to their community once its lost. If they don’t return to where their identity is held then it is lost.”

Source: Métis Firefighter, from draft video from the Métis National Council

Disruption in harvesting activities can also lead to food insecurity. Traditional foods are typically high in nutritional value and offer a number of health benefits. Limited access to traditional foods means the Métis may have to rely on more processed foods that are harmful for one’s health. Processed diets, in combination with other limits of healthy choices, increase levels of stress and decrease capacity for self-care which can increase the prevalence of diabetes. Changes in the eco-system due to wildfire can also result in the deterioration of traditional knowledge and land skills related to hunting grounds, wildlife patterns and traditional cooking.

Gift Lake Metis Settlement FireSmart Education Project

Wildfires can have significant impacts on communities affected by them. Preparing for a wildfire is an important step that every community can take to help reduce the possibility and negative consequences of wildfires. The Forest Resource Improvement Association of Alberta (FRIAA) FireSmart program provides funding to communities seeking to reduce the risk of wildfire and mitigate potential damage. Forests are part of many Alberta communities, and the FRIAA FireSmart program helps to protect both our communities and our forests.

In 2011, at the same time as the Slave Lake fire, the Gift Lake Metis Settlement was evacuated because of wildfire. After the fires, the community decided to take action and work towards creating a stronger wildfire mitigation and preparedness plan. As an important part of the plan, they initiated FireSmart education programs, both in schools and in the community with the help of FRIAA FireSmart funding. The multi-faceted project offered in-class programming to children in Gift Lake. The classes learned about fire risk and what they can do to reduce the risk of fire around their community and around their homes.

Source: Forest Resource Improvement Association of Alberta. (2020). *Gift Lake Métis Settlement FireSmart Education Project*. Forest Resource Improves Association of Alberta.

Flooding

There are different forms of flooding including; riverine flooding, coastal flooding, pluvial flooding and ice jams.

Riverine Flooding

Riverine flooding is driven by increased precipitation, more frequent heavy rain events, and greater snowmelt due to increased temperatures. Land cover change, for example urbanization, deforestation, and cultivation, exacerbates flooding by reducing the absorption capacity of the land.

Pluvial Flooding

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Pluvial flooding can occur in any urban area — even higher elevation areas that lie above coastal and river floodplains (Maddox, 2014) Pluvial flooding is often caused by intense rain which saturates urban drainage systems causing water to flow out into streets and nearby structures (Maddox, 2014). Run-off or flowing water from rain falling on

hillsides that are unable to absorb the water. Hillsides with recent forest fires are notorious sources of pluvial floods, as are suburban communities on hillsides.

Coastal flooding

A coastal flood is typically the result of extreme tidal conditions caused by severe weather. A storm surge is the leading cause of coastal flooding; it is produced when high winds from hurricanes and other storms push water onshore. King tides, tides 50 cm to 100 cm higher than regular high tides, can also cause coastal flooding. Sea level rise increases the frequency of coastal flooding.

Ice Jams

Ice jams occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of the river. The ice layer often breaks into large chunks, which float downstream and often pile up near narrow passages other obstructions, such as bridges and dams. Ice jams often cause considerable increases in upstream water-surface elevation, and the flooding often occurs quite rapidly after the jam (Federal Emergency Management Agency, 2018). Riverine ice jams usually occur during the periods of freeze-up and break-up, and sometimes in midwinter because of abrupt warm weather conditions or flow regulation (Lindenschmidt et al., 2016). Climate change will result in the increase of the severity and frequency of ice jams, the shortening of the River ice season, and delayed freeze-up dates of rivers.

Physical

Mortality

Flooding can cause direct loss of life by drowning or acute trauma if people are caught in fast-moving floodwaters. While Canada has a low average death rate per flood in comparison to other countries, approximately one person per flood, the associated morbidity is not quantified (Burton et al., 2016). Limited medical or emergency care or loss of vital services such as power or clean water during and following the event could cause indirect loss of life. This is a particular risk for Métis people living in remote areas with limited access to health services.

Injury

Flooding can cause physical injuries such as lacerations, skin irritations, bruises, wound infections from direct contact with fast-moving flood waters or debris (Berry et al., 2014). Similarly, sprains, strains and orthopedic injuries can result from contact with water-borne debris, attempts to escape from collapsed structures, or attempts to rescue people or possessions, etc. Infection, pulmonary swelling, lung irritation, fungal infection can also occur due to aspiration of water into lungs (Berry et al., 2014). Another risk is electrical injuries due to contact with downed power

cables/lines, circuits and electrical equipment in contact with standing water. In addition to burns (fire-related or chemical) and explosion-related injuries from disturbed propane and natural gas lines, tanks, power lines and chemical storage tanks, and toxic gas emissions, rescue boats are also at risk in coming into contact with power lines.

High blood pressure, heart attacks and strokes can also occur due to the stress and exertion related to flooding. These events can be fatal (Burton et al., 2016). Existing health problems, like chronic diseases, can also be exacerbated during a severe flood since there is likely disruption and decreased availability of emergency and ongoing health services, especially if health infrastructure is affected. For the Métis population, who have a higher prevalence of chronic diseases than the non-Indigenous population, this is a particular concern.

Morbidity

Flooding can lead to water and food contamination through sewage overflows, flooding of agricultural and industrial areas and transport of sediment, fertilizers, pesticides etc. Such contamination can create conditions for water and food-borne diseases such as upset stomach, gastrointestinal problems, and infectious diseases like Norovirus, Rotavirus, Hepatitis A and C (Burton et al., 2016). Children, elders and others with compromised immune functions are particularly vulnerable to acute gastrointestinal infections (AGI) (Burton et al., 2016). Boil water advisories are often put into effect after a flood to decrease the transmission of infectious diseases for the public water supply. Respiratory problems can also occur from living in damp conditions that cultivate contaminants mold, bacteria, and fungal growth. For those who suffer chronic respiratory illness, like asthma, this can exacerbate breathing problems.

Some vector-borne diseases such as West Nile, Valtice fever and lymphatic filariasis have been seen to increase post-flood (Burton et al., 2016). Zoonotic transmitted diseases (including leptospirosis, hookworm infection, rabbit-borne tularemia, and hantavirus pulmonary syndrome) also increase due to contaminated drinking waters and closer contact between animals and humans.

Emotional and Spiritual

Floods can have impacts on aquatic ecosystems by disrupting habitat and destroying spawning grounds. For Métis people, flood destruction can be spiritually and emotionally devastating due to loss of habitat. The connection between the people, the land and the species they live in these areas is fundamental to Métis culture. Jean Tellier describes “the buffalo hunt is what fully established the Métis Nation”. The Métis have a long history of being connected to the land and much of their emotional and spiritual identity comes from that connection. The changes to moose, caribou, elk and deer habitat, loss of whitefish and shellfish from algae blooms, and changes to diverse ecosystems resulting in the destruction of medicinal plants, are all aspects that present negative outcomes from climate change. That being said, such floods may also be

beneficial for some ecosystems by replenishing wetland areas (e.g. flood plains and inland deltas) with river water and sediment (Prowse et al., 2006).

Psychological

Severe floods can cause severe psychological impacts such as PTSD and depression, particularly to those directly affected (e.g., through damage to or loss of property or livelihood, mandatory or voluntary evacuation, loss of family members or friends). In addition, if the transportation systems are significantly affected there may be a shortage of food and services, further increasing stress and anxiety. Studies have found links between flooding and increased alcohol abuse and dependence, particularly among first responders, residents and health care workers with previous psychiatric conditions (Burton et al., 2016). Recovery and cleanup from a flood event can take months, especially for hard-hit communities. For those directly affected by the flood damage (e.g., flooded home, flooded workplace or routes to work), disruptions to daily life can last for extended periods of time. This uncertainty can cause further distress.

Flooding and other community-wide disasters can severely disrupt the functioning of families and may entirely break down the family's structure and access to social supports (Rowe & Liddle, 2008). Close kinship and community networks in the Métis Nation serve as a strength in climate emergencies. These close ties are especially important for young people post-event. With parents, equally or even more affected by the climate emergency, youths' vulnerability to mental health and substance abuse problems is increased not only because of individual risk factors, but also as a result of parents' stress, and family instability and disorganization (Rowe & Liddle, 2008). Without intervention, community-wide disasters have long-lasting, serious effects for many young people. Youth that have pre-existing mental health conditions are especially at risk of their mental health deteriorating during periods of instability.

Cultural

All types of flooding can result in a loss of wildlife habitat, which can impact participation in harvesting activities. The movement and location of fish and their habitat is of particular concern for food-security. Fishing is an important means to provide food among Métis. Traditionally, Métis consumed a diet based on local wild sea and land mammals, fowl, fish, berries and grains (Receveur et al., 1997). Changes in the eco-system due to flooding can put pressure on traditional knowledge and land skills related to hunting and fishing grounds, wildlife patterns and traditional cooking. Displacement due to flooding can also disrupt traditions, including harvesting activities, since Métis may not be able to access traditional hunting and fishing grounds. The decline in use of traditional food-gathering methods result in a decrease in the consumption of these traditional foods and a decline in the health of many Métis (Public Health Agency of Canada, 2011).

Landslides

Heavy precipitation, warming temperatures, and rain-on-snow events can trigger landslides. Landslide risk is largely dependent on underlying geology and physical factors, including hill slope steepness and bedrock deformation. Between 2000 and 2020, there have been 3 major landslides in the Métis homeland, all of which occurred in British Columbia; Passmore, Khyex River, North Vancouver (Canadian Disaster Database, n.d.). The precise effects of climate change on geohazards such as landslides are difficult to isolate due to the intensification of land use and extreme hydrometeorologic and cryospheric events (Slaymaker, 2016).

Physical

Landslides can cause fatalities through trauma and suffocation by entrapment (World Health Organization, n.d.-a). Falling debris can seriously injure the nearby population. Landslides can also severely damage or destroy lifeline systems (for example, water system, hospital, health center, energy and lines of communication). This can exacerbate health implications.

Emotional and Spiritual

Landslides can disrupt transportation routes and result in evacuations. In January 17-31, 2005, a landslide of mud, debris and snow caused by more than 320 mm of rain completely destroyed two homes in North Vancouver. One person died and nearly 100 homes were evacuated. Another landslide on November 4, 2004, severed a natural gas pipeline serving Prince Rupert and closed the only highway link to the city (Cloutier et al., 2017). For Métis people, this can mean that they are unable to travel to visit family and community members (adapted from BC strategic climate risk assessment, ICF, 2019). Separation from one's family and community can cause intense emotional distress. Landslides can also destroy the natural environment, which can be emotionally and spiritually painful for the Métis population (adapted from BC strategic climate risk assessment, ICF, 2019).

Psychological

A landslide resulting in loss of life, property, livestock and crops can cause stress, anxiety and other mental health problems. The 2005 landslide in North Vancouver caused \$4,337,646 of damage (Canadian Disaster Database).

Cultural

Landslides can disrupt transportation routes. For Métis people, this can mean that they are unable to engage in traditional activities, like harvesting or community gatherings (adapted from BC strategic climate risk assessment, ICF, 2019).

Extreme Heat

An extreme heat event is 3 or more days in a row when the maximum temperature is 32°C (89.6°F) or more. As the global average and extreme temperatures increase, heat days (particularly days above 32°C) are projected to become more common in across Canada. Over the next 30 years, the number of extremely hot days in a year is expected to more than double in some parts of Canada (Health Canada). Due to climate change, by 2050, cities across Canada, including Vancouver, Calgary, Ottawa, Toronto, and Quebec City are predicted to experience over four-times the number of very hot days as compared to 2012 (National Collaborative Centre for Environmental Health, n.d.). In British Columbia, an extreme heat wave could be expected to happen about once every 3 to 10 years (ICF, 2019).

People who live in cities are especially vulnerable to illness during an extreme heat event due to the urban heat island effect. Closely packed buildings and paved surfaces in cities amplify and trap heat more effectively than natural ecosystems and rural areas. On a sunny day, paved surfaces can be up to 27-50 °C hotter than the air. At night, heat captured by pavement and buildings during the day continues to warm the city after the sun goes down. Large cities can be as much as 12°C warmer than their surrounding environments in the evening. This inability to cool overnight leads to increased physical duress on individuals as their bodies are unable to adjust during what would normally be cooler evening temperatures.

Physical

Mortality

Extreme heat events have been associated with sudden, short-term increases in mortality, especially among older adults, people who are chronically ill, people on certain medications and the socially disadvantaged (Berry et al., 2014). A 2009 extreme heat event in British Columbia contributed to 156 excess deaths in the province's lower mainland area (Kosatsky et al., 2012).

Canada's cities face a hotter future



Yellowknife

Yellowknife, and other centres in the North, may experience at least one heat wave a year, disrupting a way of life based on deep cold.



Calgary

By 2051-2080, climate models project an average of four heatwaves per year.



Regina

The average number of days per year that hit at least 34° is expected to rise from 3 to over 23 by 2051-2080.



Winnipeg

Heat waves in Winnipeg historically lasted 3-4 days. By 2051-2080, they're expected to persist for longer than seven days.



Montreal

Daytime maximum temperatures are expected to average 33° by 2051-2080. Over 70 people died in a Quebec heat wave in 2018.

© Global News

Source: Prairie Climate Centre

Figure 13: Canada's warming cities **Source:** Prairie Climate Centre

Morbidity

Heat-related illnesses include:

- **Heat rash**, which occurs when the sweat ducts to the skin become blocked or swell, causing discomfort and itching.
- **Heat cramps**, which occurs in muscles after exercise because sweating causes the body to lose water, salt, and minerals (electrolytes).
- **Heat edema** (swelling) in the legs and hands, which can occur when you sit or stand for a long time in a hot environment.
- **Heat tetany** (hyperventilation and heat stress), which is usually caused by short periods of stress in a hot environment.
- **Heat syncope** (fainting), which occurs from low blood pressure when heat causes the blood vessels to expand (dilate) and body fluids move into the legs because of gravity.
- **Heat exhaustion**, which generally develops when a person is working or exercising in hot weather and does not drink enough liquids to replace those lost liquids.
- **Heatstroke** (sunstroke), which occurs when the body fails to regulate its own temperature and body temperature continues to rise, often to 40.6°C (105°F) or higher. Heatstroke is a medical emergency. Even with immediate treatment, it can be life-threatening or cause serious long-term problems.

Source: HealthLink BC, 2019

Respiratory and cardiovascular disorders

Vulnerability to heat related illnesses are related to age, for example young children and elders do not sweat as easily. Obesity and chronic diseases, such as diabetes, heart failure, and cancer can also exacerbate heat-related illnesses since these conditions change the way the body gets rid of heat. Métis with chronic illness are therefore more vulnerable to heat-related illnesses.

Housing characteristics can also increase vulnerability to heat related mortality and morbidity. Studies indicate that air conditioning is an important protective factor for heat-related mortality (Kovats & Hajat, 2008). As mentioned in Chapter 2, housing conditions for Métis are below Canadian averages, with 14% of Métis homes needing major repairs compared to 7% nationally, suggesting some Métis could have increased exposure to extreme heat (Statistics Canada, 2017). Similarly, people who are socially isolated or those with mobility issues may have challenges getting help and moving to cooler locations (Prairie Climate Centre, 2019). Individuals in remote locations who have difficulty accessing or understanding public health information such as heat warnings may be at greater risk as well.

Mental health also affects vulnerability to heat mortality and morbidity. Antidepressants, antipsychotics and other medications that treat mental health can affect the thermoregulatory system and increase risk of heat stroke (Löhmus, 2018).

Emotional and Spiritual

Extreme heat can result in changes in the environment and impact participation in harvesting activities, which can have negative impacts on both emotional and spiritual health. An increase in crime rates also has occurred during extreme heat events. New research is emerging which examines the relationship between domestic crime and violence and extreme heat. This could present risks to vulnerable Métis people such as Elders, women and children.

Psychological

Extreme heat, with elevated night temperatures, can be detrimental for the sleep patterns of individuals who are not acclimatized to hot weather. The potential health effects of sleep-deprivation are likely to increase during heatwaves. Studies indicate that sleep and emotion interact, and that nearly all psychiatric and neurological disorders (i.e., schizophrenia, affective disorders, addictions, dementia, and many more) are associated with sleeping problems (Löhmus, 2018). Sustained disrupted sleep can also contribute to the formation of new mental health problems and to the maintenance of existing ones.

Several studies have provided evidence that heat-exposure impairs cognitive function, disturbs execution of effective behavioral responses, and decreases the capacity of both working and short-term memory (Löhmus, 2018). Moreover, a 2010 study of violence in Cleveland from 1999 to 2004 published in the journal "Weather, Climate and Society" shows that uncomfortably hot temperatures increase irritability, which in turn increases aggressive behavior, including aggressive crime, especially domestic violence and non-aggravated assaults - attacks involving no weapon and no serious injury (Butke & Sheridan, 2010).

Cultural

Persistent heat events can result in drought which results in loss of wildlife habitat and plants, such as wild rice, which can impact participation in harvesting activities. This can lead to an impact on food security in some areas as it affects food availability and prices. This in turn could lead to changes in nutrition as people move away from traditional foods and towards unhealthy diets.

Heatwaves can also make it dangerous for Métis to participate in outdoor activities or travel to community events (adapted from BC strategic climate risk assessment, ICF, 2019). A number of gatherings are often scheduled during the summer months such as Back to Batoche in Saskatchewan. Adaptation measures such as hydration and the setting up of cooling stations can help to mitigate these negative impacts.

Drought

Heat waves are often accompanied by droughts. Droughts are periods of long-lasting and widespread water shortages that can have dramatic environmental and socio-economic impacts. Droughts can cause reduced water quality, wetland loss, soil erosion and degradation, ecological habitat destruction and increased risk of wildfires (Yusa et al., 2015). Many food-borne illnesses, vector-borne diseases, and fungal diseases also spread more quickly during periods of hot and dry weather. These effects can lead to decreased availability of drinking water, higher risk of food shortages, and increased rates of human illness. Drought conditions can decrease air quality, which impacts respiratory health. As soil dries up, it can be picked up by the wind as dust. Dusty conditions lead to coughing, wheezing, and irritation of the eyes, nose, and throat. Drought-like weather also leads to more wildfires. Wildfire smoke particles are much smaller than dust particles, and can become embedded in our lungs, causing severe respiratory and cardiovascular illnesses. (Prairie Climate Centre, 2019). Droughts differ from other disasters (e.g., floods) since they have longer durations and lack easily identified onsets and terminations (Yusa et al., 2015).

Physical

Respiratory Disease

Drought conditions can decrease air quality, which impacts respiratory health (Prairie Climate Centre, 2019). As soil dries up, it can be picked up by the wind as dust. Dusty conditions lead to coughing, wheezing, and irritation of the eyes, nose, and throat.

Disease

As water levels in lakes, rivers, and wetlands decrease and flows stagnate, concentrations of toxins and water-borne diseases increase, like Hepatitis A (Prairie Climate Centre, 2019). Many food-borne illnesses, vector-borne diseases, and fungal diseases also spread more quickly during periods of hot and dry weather (Prairie Climate Centre, 2019). These effects can lead to decreased availability of drinking water, higher risk of food shortages, and increased rates of human illness.

Water plays a key role in maintaining hygiene, which is directly associated with preventing disease. Health care facilities depend heavily on water to protect the health of patients and workers. Studies suggest strong linkages between changes in precipitation, drought and diarrheal disease.

Emotional and Spiritual

An Australian study examined and interviewed Indigenous communities to capture their views of how prolonged drought in rural North South West has affected their social and emotional well-being strategies (Rigby et al., 2011). Although the Australian context is different to Canada, and Métis have unique experiences and perspectives to drought, this study is useful in determining some information on the implication of drought for Indigenous communities before Métis specific studies are conducted.

Three themes emerged from the interviews including *impacts on culture* (for example, harm to traditional family structure, culture and place, and bringing shame to culture); *sociodemographic and economic impacts* (including, skewing of the population profile; loss of livelihood and participation; aggravation of existing socioeconomic disadvantage); and *loss* (Rigby et al., 2011).

The participants stated that drought compromises the availability of wildlife and plant life as many species were no longer widely available during a drought (Rigby et al., 2011). Rivers and land that were traditional meeting places or used as hunting and food gathering grounds were no longer accessible (Rigby et al., 2011). These factors contributed to the decrease of traditional practice and culture and associated source of positive identity, particularly for Elders (Rigby et al., 2011). Participants also stated that drought-related impacts on communities were affecting social and emotional well-being and lowering self-esteem by promoting antisocial behavior (Rigby et al., 2011).

Psychological

Drought can lead to stress and is associated with physical and mental health problems, such as anxiety, emotional and psychological distress, loss and grief due to water usage restrictions, economic hardship, and seasonal loss of livelihood (Yusa et al., 2015). Psychological impacts will be especially prevalent for individuals that have natural-resource dependent livelihoods, such as farmers and fishermen.

Cultural

Drought may increase the difficulty that individuals face in obtaining adequate water. Food security can also be affected through drought-related decreases in harvesting practices, food shortages and higher food prices. Food and water insecurity can result.

Drought can increase the likelihood of disease spread and/or exposure to an accumulation of contaminants in the water for these aquatic organisms. For example, temperature-sensitive species such as salmon may experience heat stress and difficulties migrating due to low water levels. For Métis in British Columbia, for whom fishing is an important tradition, this can be detrimental.

Glacial Retreat

A glacier is a large body of ice that forms on land where the accumulation of snow and its densification into ice exceeds ablation (melting, sublimation and mechanical calving) over many years. Canada has more glacier cover than any other nation and of the estimated 200,000 square kilometres of Canadian glaciers, one quarter is found in western Canada. As the Earth warms at a faster rate, a combination of less snow and a rapid melt is causing glaciers to recede in length and volume. Although there are not detailed estimates of glacier loss, scientists estimate that 25 to 70 percent of glacier melt has occurred over the last six to seven decades (Alam, 2018).

As glaciers recede many rivers in high mountains will be redirected via more hydrologically expedient paths to the sea. In most instances, the redirection will be inconsequential. In other cases, however, the changes might have more significance (Alpine Club of Canada, May 2018).

Physical

As glaciers retreat, the decreased land-surface stability affects the frequency and location of natural hazards (Kääb et al., 2005). Hazards are mainly caused by landslides and rockfall, glacial lake outburst floods, and extreme weather events. These hazards can cause injury and mortality.

Emotional and Spiritual

Glaciers, as dominant features of high mountain landscapes, are amongst the most easily observable consequences of climate change. This stark change can cause intense grief and anxiety (solastalgia) for the Métis population.

Psychological

The loss of a defining feature of one's home, like a glacier, can cause significant anxiety and long-term stress amongst the population.

Cultural

Glacial meltwater feeds many mountain streams and rivers in B.C. and Alberta. Glacier retreat cause changes in the flow timing and temperature of some streams and rivers. These changes will likely have significant impacts on freshwater and estuarine ecosystems and on aquatic species. This can impact fishing activities for the Métis and potentially, food security for the population.

Sea Level Rise

Sea level changes when the overall volume of water in the ocean increases. It can also increase as a result of decreasing land mass due to vertical disappearance from geological processes. Melting glaciers and thermal expansion—when the atmosphere warms, sea water warms and expands in volume—is expected to make the greatest contribution to a rising sea level over the next century (Environmental Reporting BC, n.d.). Historical records indicate that sea levels traditionally have risen by one to two millimetres per year since the mid 19th century. Over the last two - two-and-a-half decades, sea level has been rising at more than double that, in excess of three millimetres per year, with the expectation that this acceleration will continue (Mcclearn, 2018). Of particular concern for Métis is the coastal area of British Columbia. For coastal communities, such as Vancouver, the rise could be as high as a meter by the end of the century.

Physical

Direct physical health impacts from sea level rise will be a result of direct flooding due to storm surges caused during extreme events such as hurricanes. Deaths and injuries during these events are likely to increase. Sea level rise will also increase the frequency of flooding. The health impacts of flooding are addressed above.

Emotional and Spiritual

Rising sea levels may result in flooding of culturally significant spaces for Métis communities, sites of historical significance or family heritage. The loss of these spaces can cause grief and emotional distress. Adaptation options, particularly relocation, may mean moving away from one's community and home.

Psychological

Sea level rise can impact the financial security, job security, and social and economic stability of Métis individuals, families and businesses, which can cause anxiety disorders and stress. Sea level rise damages property value and other resources which contribute to personal and community income and wealth. Sea-level rise may also affect the viability of key industries, such as tourism, thereby impacting employment, which may also affect financial security. Retreat and relocation of the home due to sea level rise can cause further anxiety and stress.

Cultural

Rising sea-levels and increases in the frequency of storm surges may also affect the mobility of coastal Métis residents and their ability to engage in various cultural activities and community engagements.

Métis and Water

“Western science generally sees water as a fundamental component of the ecosystem, an inert entity that interacts with the living world. In Indigenous culture, water symbolizes the element from everything begins, a living force and the centre of life rather than simply a component of it. For Métis, water is integral to cultural and spiritual survival and is a critical link to one’s ancestors.”

Source: Szach, N. J. (2013). *Keepers of the water: Exploring Anishinaabe and Métis women's knowledge of water and participation in water governance in Kenora, Ontario* (Order No. MS25847).

Ocean Acidification and Hypoxia

Acidification

The oceans are a major carbon reservoir and sink. Each year, about one third of the carbon dioxide (CO₂) in fossil fuel emissions dissolves in ocean surface waters, forming carbonic acid and increasing ocean acidity (Allison, 2015). Water acidification impacts marine calcifying species, such as certain plankton groups, clams, snails and corals, by hampering their calcification process (growth) and could even lead to dissolution of their skeleton (Fisheries and Oceans Canada, 2012). The effects of acidification on these calcifying species will have important repercussions on all associated species and the whole food chain.

During the summer months along the BC coast, acidic water from depths of 100 to 200 meters upwells into the ocean surface layer (Fisheries and Oceans Canada, 2012). Over the last century the depth below which the aragonitic shells of shell fish, corals and some plankton dissolve has become shallower by typically 30 - 50 meters.

Hypoxia

Hypoxia occurs in deep ocean waters when oxygen is removed from the water much faster than it is replenished from the atmosphere or by photosynthesis. Microbial respiration due to the decay of organic material in deep water and in sediments contribute to hypoxia.

Along the Pacific Canadian coast, the greatest area of concern for stronger hypoxia is the continental shelf in late summer (Fisheries and Oceans Canada, 2012). Oxygen concentrations in sub-surface waters west of Vancouver Island have dropped in the past few decades. Sub-surface

oxygen concentrations are likely to continue to decline along the west coast over the coming decades due to global climate warming; specifically, decline in oxygen in subarctic waters caused by reduced ventilation (gas exchange between ocean and atmosphere) along the east (Fisheries and Oceans Canada, 2012).

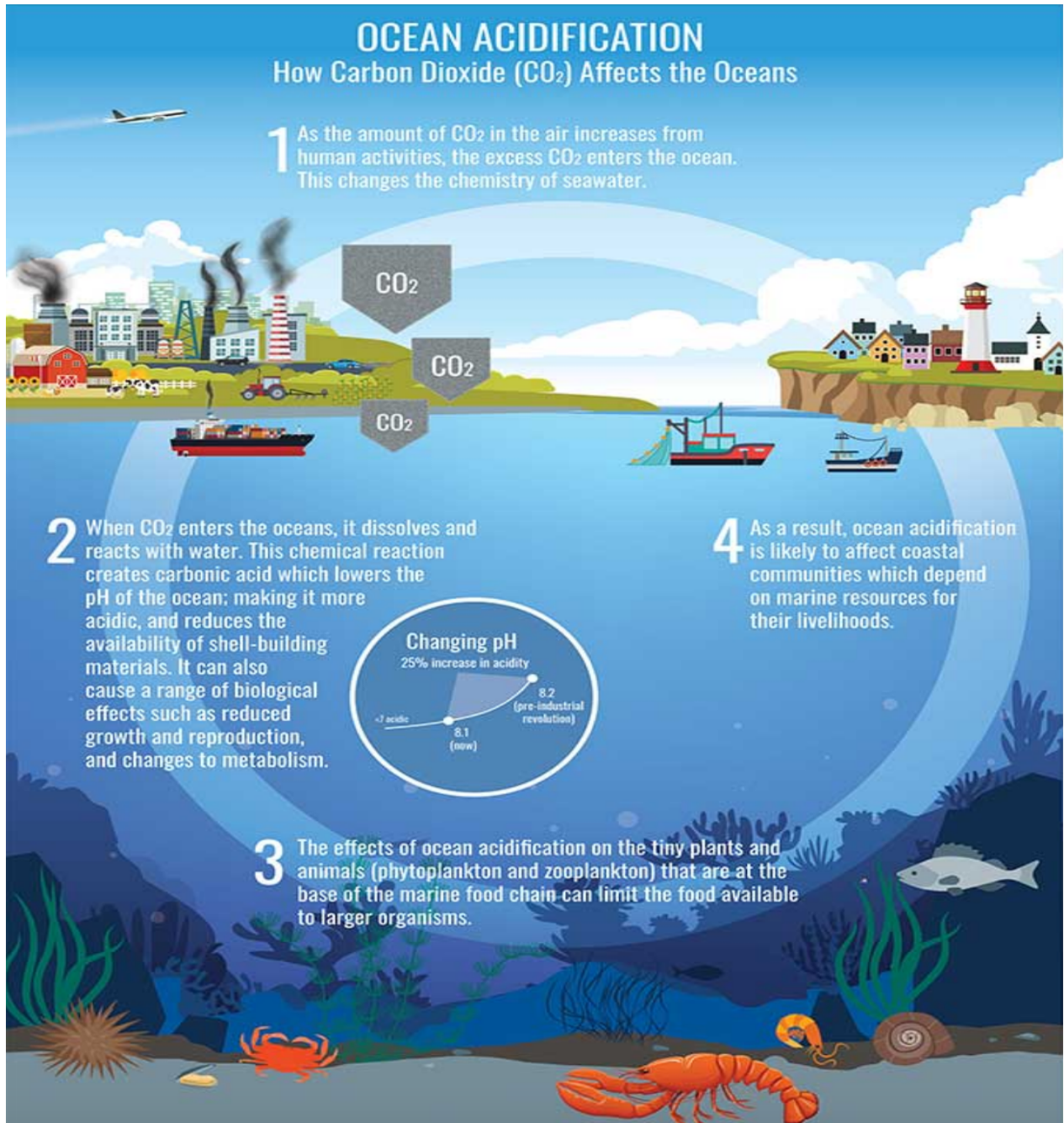


Figure 14: Ocean Acidification

Source: Fisheries and Oceans Canada, n.d.

Physical

There is no evidence that suggests ocean acidification causes direct loss of life, morbidity, injury, disease, or hospitalization. Some research has shown that ocean acidification may contribute to shellfish toxins, which could threaten health (ICF, 2019).

Emotional and Spiritual

The impact of ocean acidification and hypoxia on marine species can cause emotional and spiritual distress due to the loss of species that are available to harvest. Changes to the water and its quality will impact coastal populations due to their connection to the water.

Psychological

Ocean acidification can cause localized, severe, and long-term psychological impacts (including anxiety, depression, and loss of identity) since the ocean is linked to many coastal Métis identity, culture, and economy (ICF, 2019). Ocean acidification can also cause localized or even permanent loss of livelihoods for those reliant on the shellfish industry for food or employment, which can result in stress and anxiety (ICF, 2019).

Cultural

Shellfish and other marine life are particularly vulnerable to ocean acidification. Acidification can alter critical behaviours and chemical reactions in the bodies of fish that may affect their ability to survive. While these species may not be lost entirely, they will be weakened permanently and likely unable to recover if ocean acidification persists. This loss can disrupt Métis fishing activities and food security. Changes in marine life can also mean adjustment in the transmission and network of Indigenous knowledge on the ocean and coasts.

Vector-borne and Zoonotic diseases

Vector-borne and zoonotic diseases are caused by viruses, bacteria or parasites that are transmitted to humans from animals or insects. Some diseases that originate in animals must be transmitted through a “vector” (e.g., mosquito, tick) in order to infect a human.

Vector development and survival is significantly affected by temperature conditions (Caminade et al., 2019). The optimal temperature range for disease transmission varies depending upon the vector–pathogen combination being studied. However, vectorial capacities of the most harmful tropical vector-borne diseases consistently peak at relatively high temperatures. Climate change will likely impact the length of the transmission season and the geographical range of a significant proportion of infectious diseases (Caminade et al., 2019).

While there are a number of vector-borne diseases that are emerging in Canada, the country is most at risk from the following vector-borne diseases, both of which emerged over the past 25 years:

West Nile Virus

West Nile Virus (WNV) is transmitted through the bite of an infected mosquito. Most people infected with WNV do not show symptoms. Others can get fever, head and body aches, fatigue, rash, meningitis or encephalitis. The first human case of West Nile virus infection in Canada was reported in Ontario in 2002. The Government currently has data for West Nile virus in human clinical cases reported between 2002 and 2018. In 2007 there were 2215 cases reported, while in 2019 there were 37 cases (Health Canada). Surveillance detects only a portion of the West Nile virus cases in Canada as the true number of West Nile virus infections reported in Canada is likely greater.

Lyme Disease

Lyme disease is an infection transmitted through the bite of an infected blacklegged tick. The majority of human cases occur as a result of exposure to areas known to have infected blacklegged ticks. Rainfall, moisture, and temperature affect the life cycle and habitat of ticks, and they prefer habitats with at least 85% relative humidity and search for hosts when the temperature exceeds about 7 °C (Caminade et al., 2019). The first infected ticks were found on the Ontario shore of Lake Erie in the early 1990s (Caminade et al., 2019). These ticks have since spread farther north into Ontario, parts of Quebec, Manitoba, New Brunswick, and Nova Scotia. The incidence of Lyme disease has increased from 0.4 to 2.7 per 100,000 population from 2009 to 2016 in Canada; 88% of cases were reported in the provinces of Quebec, Ontario, and Nova Scotia (Caminade et al., 2019).

Physical - West Nile Virus

Morbidity

Symptoms can range from mild to severe. Most people (70% to 80%) who are infected with West Nile virus have no symptoms (Public Health Agency of Canada, n.d.). Some people have mild symptoms that can include:

- fever
- headache
- body aches
- mild rash
- swollen lymph gland

Anyone infected with West Nile virus can be at risk of developing more severe symptoms and health effects. Adults 50 years or older and those with underlying conditions or weaker immune systems, however, are at greater risk. Very few people (fewer than 1 per cent of people infected

with the virus) will develop severe symptoms and health effects. In many of these cases, the infection can affect the central nervous system (this is the nervous system tissues in the brain and spinal cord).

Serious symptoms can include:

- rapid onset of severe headache
- high fever
- stiff neck
- nausea or vomiting (sometimes both)
- difficulty swallowing
- drowsiness
- confusion

Source: Public Health Agency of Canada

Physical - Lyme Disease

The most current estimates of Lyme Disease in Canada indicate a steady increase of cases between 2009 and 2017, rising from 144 cases to 2025. In 2016, over 88% of the cases reported were from Ontario, Québec and Nova Scotia. In 2016 there were less than 10 cases reported in Saskatchewan and Alberta, with upwards of 20 cases in Manitoba and about 40 cases in British Columbia.

Morbidity

Symptoms of Lyme disease can be different from person to person. Early signs and symptoms of Lyme disease usually start 3 to 30 days after you have been bitten by an infected blacklegged tick. Most people experience mild flu-like symptoms soon after being bitten, while a small number may have more serious symptoms, sometimes weeks after the bite.

Early signs and symptoms of Lyme disease may include:

- Rash, sometimes shaped like a bull's eye (Erythema migrans (EM rash))
- Fever
- Chills
- Headache
- Fatigue
- Muscle and joint aches
- Swollen lymph nodes

If left untreated, more severe symptoms may occur and can last from months to years. Severe symptoms may include:

- Severe headaches

- Additional EM skin rashes
- Facial paralysis (i.e. Bell's palsy)
- Intermittent muscle, joint, tendon and bone aches
- Heart disorders (heart palpitations, abnormal heartbeat), known as Lyme carditis
- Neurological disorders (dizziness, mental confusion or inability to think clearly, and memory loss, inflammation of the brain and spinal cord, nerve pain, numbness or tingling in the hands or feet)
- Arthritis with severe joint pain and swelling, particularly the knees and less commonly in other joints such as the ankle, elbow and wrists

In rare cases, Lyme disease can lead to death usually because of complications involving infection of the heart.

Source: Public Health Agency of Canada

Emotional and Spiritual

A diagnosis of a vector-borne disease can completely alter a person's life causing intense emotional distress.

Psychological

A broad range of psychiatric reactions have been associated with Lyme disease including paranoia, dementia, schizophrenia, bipolar disorder, panic attacks, major depression, anorexia nervosa, and obsessive-compulsive disorder. Depressive states among patients with late Lyme disease are fairly common, ranging across studies from 26% to 66% (Fallon & Nields, 1994).

Cultural

The risk of contracting vector-borne diseases can prevent people from engaging in cultural outdoor activities (adapted from BC strategic climate risk assessment, ICF, 2019).

COVID-19 and future Global Pandemics

The outbreak of COVID-19 and the related containment measures has had devastating impacts to people living in Canada. The virus has infected people of all backgrounds across Canada, causing long-term debilitating complications for some and, in the worst cases, proving fatal.

The effects of COVID-19 have been particularly harmful for Indigenous communities, including Métis. According to Canada's chief public health officer, Dr. Teresa Tam, First Nations, Inuit and Métis "are among the most vulnerable to COVID-19 due to distances, access to necessary resources and underlying health conditions." The inequity in determinants of health between Métis and non-Indigenous population can predispose Métis to the pre-existing conditions that are co-morbid with the worst cases of COVID-19 and prevents the timeliness and quality of

response to the virus. The social distancing and quarantine measures implemented in response to COVID-19 have also had profound mental-health implications amongst Indigenous peoples. For example, the number of deaths from illicit drugs among First Nations, Métis people and Inuit in B.C. between January and May of this year jumped by 93 per cent compared with the same period last year (Stuek, 2020). The economic impacts are similarly devastating, with many small businesses forced to closed and unemployment rates rising rapidly.

It is too early to tell what the extent of the impact the COVID-19 pandemic will have on the Métis Nation. The COVID-19 pandemic is far from over and risks of similar virus outbreaks are only increasing. Research shows that the risk of disease pandemics, like COVID-19, are tied to human intervention in the environment (Tollefson, 2020). An increasing number of animal carriers of diseases are changing their behaviour and migrating to new areas closer to human development due to climate change and habitat loss. Compounded with globalization, the increased contact between animals and humans exacerbates the risk of virus transmission. Important lessons can be learned for future climate change adaptation plans from research into the differing effects (both direct and indirect) of the present pandemic on diverse members of the Métis community.

It's worth noting that COVID-19 also adds another layer of complexity to emergency preparedness plans and climate change adaptation measures for the Métis Nation. For example, present forest fires in California, USA are among the worst in the state's history (Schwartz, 2020). The response to the fires is complicated by the COVID-19 pandemic (Singh, 2020). State officials are asking residents to evacuate their homes to seek safety – in contradiction to the pandemic public health guidelines to stay at home to stop the spread of the virus (Singh, 2020). To mitigate the risk of virus transmission, the Red Cross have arranged for smaller evacuation shelters, with staff on site to check temperatures and screen for Covid-19. However, the eradication of transmission is unlikely since COVID-19 spreads most efficiently in crowded, indoor spaces, and can go undetected by asymptomatic people. The pandemic is a particular threat to wildland firefighters. Firefighters are exposed to large amounts of smoke that could aggravate their lungs and cause complications if they were to contract the COVID (Singh, 2020). Moreover, firefighters often live in crowded camps near major blazes during fire seasons. Robert Foxworthy, a spokesman for CalFire, California's fire agency, described the current situation as "uncharted territory. Everybody is learning as we go" (Singh, 2020). Similarly, Métis governments will need to consider the dual threat of a climate emergency and pandemic in future response plans.

Chapter 4: British Columbia

The Population

In the 2016 Census, 89,405 people self-identified as Métis in British Columbia (BC); 33% of the Indigenous population in B.C. (Statistics Canada, 2016a). Approximately 18,000 people are registered Métis citizens with the Métis Nation British Columbia (MNBC) (Shaw, 2019). The MNBC is recognized by the provincial and federal governments and the Métis National Council as the official Governing Member in the province of British Columbia. MNBC represents thirty-seven (37) Métis Chartered Communities in British Columbia.

British Columbia	Non-Indigenous	Métis (Census)
Population	4,648,055 (2016)	89,405 (2016)
Housing: Major repairs	5.4% (2012)	3.0% (2012)
Crowded housing	6.5% (2012)	11.5% (2012)
Highest level of educational attainment (25-64): Bachelor degree or higher	28.1% (2012)	12.2% (2012)
College diploma	19.9% (2012)	22.6% (2012)
Apprenticeship certificate	11.1% (2012)	16.9% (2012)
High school diploma	25.1% (2012)	26.1% (2012)
No certificate, diploma, or degree	9.4% (2012)	17.0% (2012)
Employment rate (25-64)	74.8% (2012)	71.6% (2012)
Excellent or very good self-rated overall health of population (12+)	60.0% (2012)	55.4% (2012)
Excellent or very good self-rated mental health of population (18+)	68.0% (2012)	62.6% (2012)

Figure 15: A Socio-economic Profile of Métis living in British Columbia

Source: Statistics Canada, British Columbia Census Profile, 2016

As shown in the figure above, Métis peoples in British Columbia are disproportionately likely to live in crowded housing and have lower levels of educational attainment than the non-Indigenous population. These inequities increase Métis peoples' vulnerability to extreme weather and climate events.

Climate Risks in British Columbia

- **Forest fires:** In 2018, British Columbia experienced its worst fire season on record with 2,115 fires and 1.35 million hectares burned (Wang & Strong, 2019). Fires in British Columbia accounted for about 60% of the total burned area in Canada in 2018, compared to an average of 7% over the 1990 to 2018 period (Wang & Strong, 2019). Wildfire frequency is expected to increase throughout the province and its forest regions, with the interior of the province expecting a higher number of days that present a potential for a fire to develop. (Wang et al 2017, Wang et al 2015).
- **Flooding:** The B.C. coastline has a total length of approximately 29,000 km. Over 80% of the population of B.C. lives within 5 km of the coast. In the Lower Mainland, where **55,320 self-identified Métis live** in Greater Vancouver and the Fraser Basin, there are many areas close to sea level which are vulnerable to the potential effects of sea level rise. Over 4,600 hectares of farmland and over 15,000 hectares of industrial and urban residential areas in the Lower Mainland are located within 1 meter of sea level. On Vancouver Island, almost all communities have ocean exposure and many have vulnerable coastlines or low-lying areas. Along the northern coast, critical infrastructure in the Port of Prince Rupert is close to sea level, as are most settlements on Haida Gwaii (The Arlington Group Planning + Architecture Inc. et al., 2013).
- **Landslide:** Landslide risks are high close to mountainous terrain in B.C. Researchers have suggested that recent melting of glaciers in British Columbia has de-buttressed rock slopes adjacent to glaciers. These slopes are susceptible to climate change and are subject to catastrophic failure due to their deep slopes. Of 38 catalogued landslides over a three-decade period from 1973 to 2003, ten rock avalanches on glaciers were the result of de-buttressing. This represents over 25% of landslides that are occurring as a result of a changing climate (Geertsema et. al., 2006).
- **Heat Waves and Droughts:** On May 10, 2019, 15 temperature records were broken in British Columbia. Temperature is expected to increase within the province by 1.3°C to 2.7°C by 2050. BC has been defined as having four ecoregions with differing geography, very different population structures, and quite different heat vulnerabilities. The Coast Ecoregion has an average mean temperature of 19.9°C, reaching maximum temperatures on particularly hot days of approximately 35.5°C. The Dry Plateau Ecoregion of BC has average temperatures of approximately 24.2 °C and maximum heat of 38.4 °C. The Mountain Ecoregion has average temperatures of 21.0 °C and maximum temperatures of 33.5°C. The North Ecoregion has average temperatures of 18.6 °C and maximum temperatures of 33.1 °C. (BC Centre for Disease Control, n.d.). Drought conditions are expected to be longer and will hamper growing seasons and will impact farmers and ranchers as they experience soil erosion and new pests (Government of British Columbia, n.d.).

- **Glacial Retreat:** B.C. has around 17,000 glaciers that cover approximately 25,000 km² or about 3% of the province (ICF, 2019). Glacier area declined by approximately 11% between 1985 and 2005 (ICF, 2019). Due to projected increases in temperature, glacier area is projected to further decrease by 30 to 50% by 2050, relative to 2005 (ICF, 2019). Glaciers are an important freshwater resource for the province, contributing to rivers that support communities, industry, hydroelectricity generation, irrigation, and ecosystems (ICF, 2019). By the 2050s, the contribution of glaciers to streams and rivers will decline and associated streamflow is projected to decrease, which could affect natural ecosystems and communities. As glaciers decline, reduced river flow and related changes to water quality and temperature in glacier-fed watersheds may impact Coho salmon including delaying sockeye entry into spawning grounds in the autumn. (Lemmen et. al. 2016).
- **Sea Level Rise:** Studies suggest that sea-level rise, changes in the nature, timing and intensity of storms and precipitation events, and the altered distribution of marine species present the greatest concerns in coastal British Columbia. Projected median sea-level change is expect to be up to 70 cm on southern Vancouver Island, in the region surrounding the City of Vancouver and in northern coastal BC. Smaller amounts are projected for the remainder of Vancouver Island and the adjacent mainland coast (Lemmen et. al., 2016). As sea level rises, the height of waves relative to the shoreline will increase due to deeper water and, with it, the destructive potential of higher waves during positive storm surges. (Lemmen et. al., 2016). Rising sea levels are expected to strain drainage and sewages systems, and intrude into groundwater aquifers with low-lying agricultural lands becoming too saline for cultivation (Government of British Columbia, n.d.).
- **Ocean Acidification and Hypoxia:** On the west coast of Canada, subsurface corrosive Pacific water wells up on the outer shelves from south. This corrosive water also feeds into the restricted circulation of the Strait of Georgia, via Juan de Fuca Strait, and coastal fiords, which are made even more sensitive to the addition of CO₂ because they receive large inputs of fresh water and organic matter from land. This can affect the behaviour of animals as they become disoriented due to the low pH/high CO₂ coral reef environments and they can exhibit reduced ‘flight’ response in the presence of predators. Shellfish farming operations in the Salish Sea already report detrimental effects from acidification, especially at the larval stage. (Canadian Climate Forum, 2017).
- **Vector Borne Diseases:** In BC, West Nile Virus (WNV) has been detected in the eastern Fraser Valley, the Okanagan and the southern Kootenays. The first cases in B.C. occurred in 2009 with the BC Centres for Disease Control monitoring WNV since 2004. On an annual basis since 2009, there have been zero to two human cases reported. Small numbers in bird populations (3 in 2018) and small numbers in horse populations (a high of 10 in 2016) have also been reported.

In BC, less than 1 percent of ticks tested carry the bacteria *B. burgdorferi* that cause Lyme disease. The prevalence of *B. burgdorferi* in ticks in BC has remained consistently low over time. The risk of Lyme disease in BC is lower and more stable than it is in eastern/central Canada and in the northeastern USA.

- **Invasive Species:** As of 2014, 978 alien species are known to have established in B.C. Most of those are plants (86.8%) and 8.5% are invertebrates (Statistics Canada, 2017). Since the 1990s, B.C. has lost millions of hectares of forest to the mountain pine beetle (MPB) epidemic (ICF, 2019). Over 18 million hectares of forest were impacted to some degree, resulting in a loss of approximately 723 million cubic meters (53%) of the merchantable pine volume by 2012 (Natural Resources Canada). As the climate shifts during the next century, changing conditions are also likely to influence the distribution and abundance of marine species, with significant ecological implications. Records indicate that there will be a more rapid decline of smelt in southern rivers along the Pacific coast relative to rivers farther north, an increasing occurrence of previously rare warm-water species such as the Humboldt squid and an increasing biomass of California sardine (Lemmen et. al 2016).

A 2007 study indicated there were 10 types of invasive plant species in BC which could be impacted by climate change (Balnaldo, 2007), many of which could have direct and indirect impacts on human health. The total area suitable for Tansy Ragwort (*Senecio jacobaea*) and Hound's Tongue (*Cynoglossum officinale*) are predicted to decrease by the year 2050. The total predicted area for Rush Skeletonweed grew by 275% from its original predicted suitable area. The remaining 7 species would have limited impacts due to climate change - the Canada Thistle (*Cirsium arvense* var: *horridum*), Dalmatian Toadflax (*Linaria dalmatia*), Diffuse Knapweed (*Centaurea diffusa*), Leafy Spurge (*Euphorbia esula*), Orange Hawkweed (*Hieracium aurantiacum*), and the Spotted Knapweed (*Centaurea biebersteinii*).

Métis Nation of BC Perspectives and Recommendations

Many of the Métis in BC can identify a number of climate change issues that are immediately impacting them. Data was collected through a series of breakout groups at the Métis Nation of British Columbia's Climate Change and Mental Health Forum, held in Richmond BC, on February 1-2, 2020. Participants were asked about what they are seeing from climate change within the different regions of BC. This information is a valuable input towards analyzing the impacts of climate change to Métis people within the Nation.

In general, participants identified risks that are similar to the general risks that have been identified for the province. This included risks from extreme temperatures, sea level rise, flooding, fires, invasive species, and vectors. Climate change is having immediate impacts on the health of ecosystems due to changes in habitat, species movement and migration patterns, pollinators, as well as the availability of seafoods, plants and medicines. Each of these components were identified as having impacts on peoples' physical health directly through

“Our needs are not being met or, perhaps, not being identified correctly.”

Métis Nation of British Columbia, *Climate Change & Mental Health Forum, Perspectives and Recommendations – Feedback* February 1 – 2, 2020

respiratory issues, changes in food consumption and the ability to connect to the land. From mental, emotional and spiritual points of view, there was a feeling that these changes were impacting Métis culture, specifically the ability to live off the land, and this is leading to depression, anxiety and, in cases where extreme weather events have happened, post-traumatic stress disorder.

Vancouver Coastal and Fraser Valley Health Authority

Issues such as sea level rise, climate change induced natural disasters (mudslides, changes to ecosystems and habitat), as well as extreme weather events (floods and fires) were identified. These risks from climate change were being manifested in this region through loss of access to traditional foods and land, the ability to live off the land, and increased concern with respiratory issues. Participants within this region indicated that to reduce these risks, more education and knowledge sharing needed to occur.

Vancouver Island Region

Issues related to loss of and changes to habitat, invasive plants and species, changes to fish habitat, extreme temperature events and flooding, are having negative impacts on the Métis populations in this region. This was being observed through more rodents living in private dwellings, dirty rivers, blackberries, ivy and other plants moving into new areas; jellyfish and starfish invading coastal areas; and, traditional medicines and foods not being available. Solutions to these risks included the development of knowledge transfer tools such as information on edible plants, how to process food, how to make shelters and understanding traditional medicines. These ideas could form components of a capacity building program within the Métis Nation.

Interior and Kootenays

Forest Fires were front and center in this region’s risks. With the influx of wildfires in the past several years, air quality has been affected, leading to concerns about respiratory issues. In addition, extreme weather events have led to more flooding, rain and snow in the region, placing individuals at high risk during these events. Additional risks such as decreased water quality and quantity, an influx of predators due to changes in habitat, and impacts to pollinators such as bees have led to less traditional plants and use of the territory. In addition, this has had impacts on pre-existing vulnerabilities such as stress, anxiety and depression. Proactive environmental actions such as composting, becoming more energy efficient and using less disposable products

and plastics, are viewed as actions that could have a positive impact on people's mental health and provide less of a feeling of hopelessness.

Northern Health

Extreme events and natural disasters such as flooding and fires were the major concerns discussed in this region. Fires were viewed to have an impact on medicines, crops and the hunting of traditional foods. Flooding is also having an impact on food production. Finally, these changes and the powerless feeling that climate change is generating is leading to depression and anxiety in the region. It was felt in this region that the use of social media platforms and communications methodologies could assist in reducing stress.

Chapter 5: Alberta

The Population

In the 2016 Census, 114,375 people self-identified as Métis in Alberta (Statistics Canada, 2016a). The Métis Nation of Alberta (MNA) is recognized by the provincial and federal governments and the Métis National Council as the official Governing Member in the province of Alberta. MNA represents six regions.

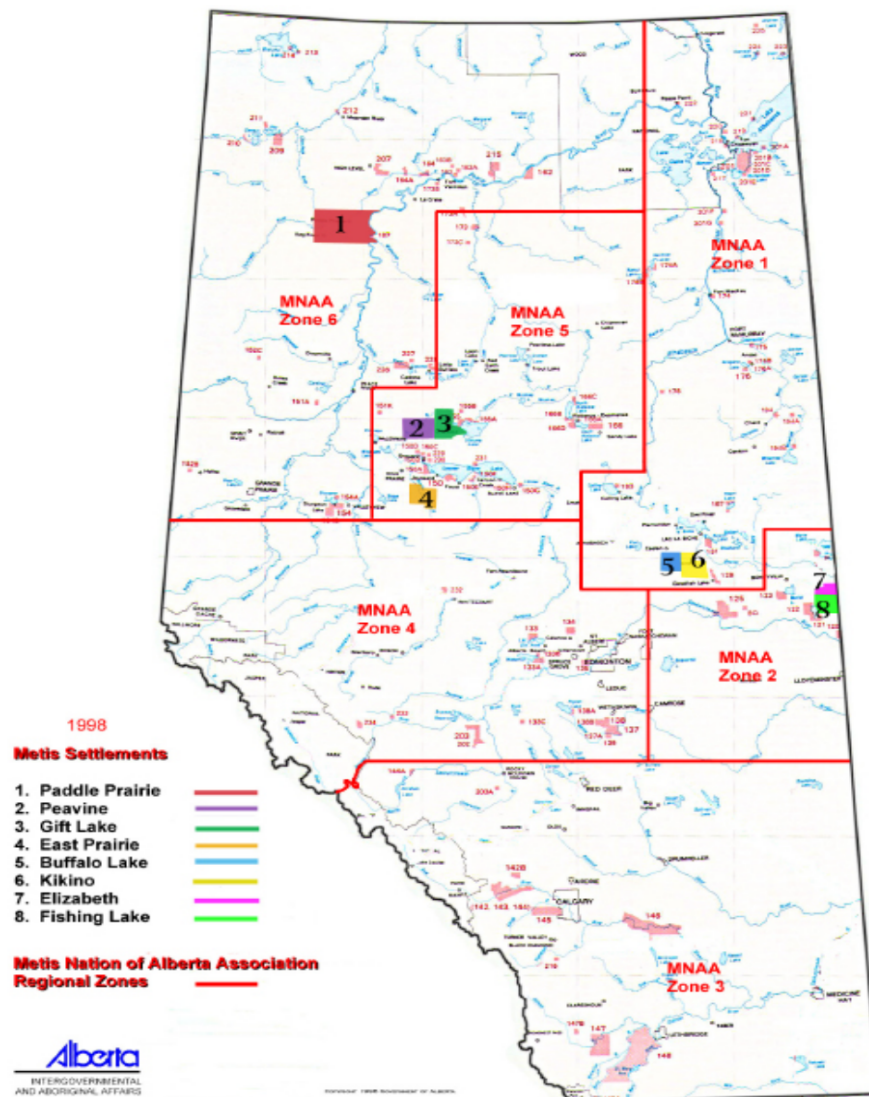


Figure 16: Métis Nation Alberta Regions
Source: Métis Nation of Alberta

Alberta	Non-Indigenous	Métis single identity (Census)
Population	4,067,175	114,375
Housing: Major repairs	6.1% (2011)	11.7% (2011)
Crowded housing	3.5% (2011)	3.4% (2011)
Highest level of educational attainment (25-64): Bachelor degree or higher	26.5% (2011)	9.9% (2011)
College diploma	21.4% (2011)	23.3% (2011)
Apprenticeship certificate	12.1% (2011)	16.7% (2011)
High school diploma	23.9% (2011)	24.5% (2011)
No certificate, diploma, or degree	11.3% (2011)	22.6% (2011)
Median total income of those with no certificate, diploma or degree (rounded to nearest \$1,000)		\$22,000 - \$47,000
Employment rate (25-64)	81.2% (2011)	74.0% (2011)
Excellent or very good self-rated overall health of population (12+)	62.5% (2011)	56.2% (2011)
Excellent or very good self-rated mental health of population (18+)	71.2% (2011)	64.2% (2011)

Figure 17: Socio-economic Profile of the Métis in Alberta
Source: Statistics Canada, Alberta Census Profile, 2016

As shown in the figure above, Métis peoples in Alberta are disproportionately likely to live in housing needing repairs and have lower levels of educational attainment than the non-Indigenous population. These inequities increase Métis peoples’ vulnerability to extreme weather and climate events.

Climate Risks in Alberta

- **Forest fires:** The 2019 wildfire season in Alberta saw 989 wildfires spread out over the province from May to October. A total of 883,411 hectares were burned, which was the second largest area burned over the last 50 years. The Macmillan and Chuckegg Creek wildfires were two of the five largest wildfires on record in the province (wildfire.alberta.ca). Fire frequency and the economic costs of fires are becoming exorbitant. The 2016 Fort McMurray wildfire was the largest wildfire evacuation in Alberta's history, with upwards of 88,000 people forced from their homes. The community of Fort McKay accepted an estimated 5,000 individuals during the evacuation period. With an estimated damage cost of C\$9.9 billion, it was the costliest disaster in Canadian history. Wildfire frequency is expected to increase throughout the province and its forest regions (Wang et al 2017, Wang et al 2015).
- **Flooding:** Precipitation will be a factor in the amount of flooding that occurs in AB. Depending upon the projection scenario, Alberta will see a consistent increase in fall-winter-spring (Sept-Apr) precipitation, an increase in the number of days per year with more than 25mm of rain, an increase in the average amount of precipitation falling on the wettest day of the year, and a consistent and continued decrease in the amount of fall-winter-spring (Sept-Apr) precipitation that falls as snow (Hayhoe and Stoner, 2019). Two of the five most destructive floods in Canadian history have occurred in Southern Alberta since 2010. The 2013 flood in Southern Alberta, when a rain-on-snow event caused the Bow, Elbow, Red Deer, Sheep, Little Bow and South Saskatchewan rivers to swell well over their banks, forcing 100,000 people to evacuate from their homes. Damages totalled an estimated \$2.72 billion. The 2010 flood in Southern Alberta and Saskatchewan, when record rainfall made the South Saskatchewan River and surrounding tributaries swell, caused evacuations on the Blood Tribe reserve and in Medicine Hat, AB. Damages totalled an estimated \$1.03 billion. More recently, in the Spring of 2020, major flooding due to ice jams on the Athabasca and Clearwater Rivers and the Peace River in Mackenzie County, led to evacuation orders for some residents of Fort McMurray and Fort Vermilion. This impacted Métis citizens in these regions to the extent that the Métis Nation of Alberta announced emergency relief funds totalling \$140,000. (Metis Nation of Alberta, May 2020). Flooding led to drinking water advisories and social isolation of many Métis people in the region.
- **Landslide:** Landslide activity is common in Alberta. Climate influences landslide susceptibility because large precipitation differences occur across Alberta. Examples include the Rycroft landslide in the Saddle River Valley, Slide-Earth Flows at Porcupine Hills, Grierson Hill and Forest Height Landslides within Edmonton, Slide-Earth Flow at Cypress Hills, and the Translation Landslide at the Athabasca River Valley. (Pawly et. al., 2017). The walls of major river valleys and their tributaries comprise the longest contiguous zones of landslide susceptible terrain across Alberta. Widespread, contiguous zones of landslide susceptible terrain occur along steep slopes flanking relatively un-dissected plateaus including: the Caribou Mountains, Birch Mountains, Buffalo Head Hills,

and the western Clear Hills. Less contiguous zones of landslide-susceptible terrain occur across heavily dissected plateaus or rugged uplands including: the Swan Hills, Grand Cache Benchland, Summit Benchland, Cypress Hills, the eastern Clear Hills and Porcupine Hills. (Pawly et. al. 2017).

- **Heat waves and Drought:** Since 1950, average summer and growing season temperatures warmed at a rate of +0.1 to +0.3 °C per decade. Average summer and growing season temperatures are also projected to continue to increase by approximately 1.5 °C per degree of global warming, up to 5-7 °C under a +4 °C warming. In terms of their geographic distribution, projected increases in summer and growing season temperatures are slightly greater towards the south and eastern part of the province compared to the north (Hayhoe and Stoner, 2019). Temperature extremes are also changing, with cold temperature extremes becoming less frequent and high temperature extremes more frequent. Since 1950, the temperature of the warmest day of the year has increased by about 0.25 °C per decade. In the future, it is projected to increase by about 1.5 to 2 °C per degree of warming, increasing by a total of +6 to +8 °C if global mean temperature increases by +4 °C . Very warm days above 30 °C could increase quite sharply to the point where the southern half of the province could see between 60-80 days per year over 30 °C. (Hayhoe and Stoner, 2019). As temperatures are projected to increase and soil moisture during the growing season is projected to decrease, there will be an increased risk of drier conditions and drought. During the period 1999-2004 a North American drought became one of Canada's costliest natural disasters, while ten counties in Alberta declared a state of emergency during the drought of 2009-2010 and areas of Northern Alberta declared agricultural disasters. At the peak of the drought, farms received only 60% of their allocated water (Alberta Water Portal Society).
- **Glacial Retreat:** The Alberta glaciers act as natural reservoirs, with snow and ice melt contributing significantly to summer flow in some of Alberta's major rivers: the Bow, Red Deer, North Saskatchewan, Athabasca, and Peace. Glaciers in northeastern B.C. also contribute to the headwaters of the Peace River. Western Canada lost about 11% of its glacier area between 1985-2005, with area loss exceeding 20% on the eastern slopes of the Canadian Rockies. Ice volume losses in the eastern slopes during 2000-2007 represented 3% and 4% of the mean annual discharge of the North Saskatchewan and Bow Rivers. Projections indicate that glaciers on the eastern slopes will lose about 40% of their volume by 2100 if climate stabilizes near its current state, and 80-90% of their volume under more realistic scenarios for future climate change.
- **Sea Level Rise:** Sea level rise will not directly impact Alberta.
- **Ocean Acidification and Hypoxia:** Ocean Acidification will not directly impact Alberta.
- **Vector Borne Diseases:** In 2003, Alberta confirmed its first West Nile Virus (WNV) infected bird as well as its first human case. In 2007 the first human reported death was reported along with 318 probable and confirmed cases. The next death to occur in Alberta was not

until 2012 (Alberta Health Services). In 2018 there were 50 cases of WNV reports and only 4 cases reported in 2019 (Government of Alberta).

Between 1991 and 2018, there were 115 human cases of Lyme disease reported to Alberta Health. All were reported as having been acquired while travelling outside of the province in areas where the bacteria causing Lyme disease and the ticks that carry it are known to circulate (Government of Alberta).

- **Invasive Species:** It is expected that climate change will allow for more hospitable conditions in Alberta for new invasive species. Already the Mountain Pine Beetle has impacted forests in the Hinton, Slave Lake and Grand Prairie area of Alberta. Jasper National Park has also been infected and over the winter of 2018 saw a decline in the number of larvae. There is a high risk of invasion of invasive plant species in the Grasslands Natural Region. By 2050s Pincher Creek, Cardston and County of Forty Mile habitats will be at risk for a high number of new invasive species. Back country areas that are of importance to conservation, including Wilmore Wilderness Park, Jasper National Park and Banff National Park, are also at high risk of invasion by more than one new invasive species. Three terrestrial invasive plants species are expected to be the highest threat of invasion in Alberta. They include: giant knotweed which outcompetes native species for water (*Fallopia sachalinensis*); tamarisk (*Tamarix chinensis*) which lowers the water table and increases wildfires; and alkali swainsonpea (*Sphaerophysa salsula*) which alters nutrient cycling and invades wetlands (Chai et. al., 2014).

Chapter 6: Saskatchewan

The Population

In the 2016 Census, 57,880 people self-identified as Métis in Saskatchewan (Statistics Canada, 2016a). The Métis Nation of Saskatchewan (MN-S) is recognized by the provincial and federal governments and the Métis National Council as the official Governing Member in the province of Saskatchewan and represents the political, socioeconomic, cultural and educational interests of the province’s Métis citizens. In 2020 the MN-S identified over 80,000 registered Métis people in 12 representative system-based regions and approximately 130 Locals.

The Métis Nation Legislative Assembly (MNLA) is the governing authority of MNS, made up of the Presidents of Métis Locals and the Provincial Métis Council. The MNLA has the authority to enact legislation, regulations, rules and resolutions governing the affairs and conduct of the Métis in Saskatchewan.



Figure 18: Métis Nation Saskatchewan Regions

Source: Métis Nation of Saskatchewan

	Non-Indigenous	Métis single identity (Census)
Population	1,098,352 (2016)	57,880 (2016)
Housing: Major repairs	8.8% (2011)	15.6% (2011)
Crowded housing	2.7% (2011)	5.0% (2011)
Highest level of educational attainment (25-64): Bachelor degree or higher	21.1% (2011)	10.7% (2011)
College diploma	19.6% (2011)	19.6% (2011)
Apprenticeship certificate	14.2% (2011)	15.1% (2011)
High school diploma	27.1% (2011)	27.3% (2011)
No certificate, diploma, or degree	12.8% (2011)	23.5% (2011)
Median total income of those with no certificate, diploma or degree (rounded to nearest \$1,000)		\$21,000 - \$41,000 (2011)
Employment rate (25-64)	82.5% (2011)	71.1% (2011)
Excellent or very good self-rated overall health of population (12+)	58.5% (2011)	57.0% (2011)
Excellent or very good self-rated mental health of population (18+)	68.7% (2011)	65.4% (2011)

Figure 19: A Socio-Economic Profile of Métis Living in Saskatchewan
Source: Statistics Canada, Saskatchewan Census Profile, 2016

As shown in the figure above, Métis people in Saskatchewan are disproportionately likely to live in housing needing repairs and have lower levels of educational attainment than the non-Indigenous population. These inequities increase Métis people’s vulnerability to extreme weather and climate events.

Climate Risks in Saskatchewan

- **Forest fires:** Saskatchewan has a very active fire environment and one of the highest rates of wildfire in the country. Between 1945 and 2000, the average area burned was 270,000 ha/yr. Fires in 2010 and 2015 burned 1,734,806 ha and 1,721,912 ha respectively, leading to the evacuations of many northern communities (Johnston, 2017). Current research indicates that climate change could lead to a doubling of potential forest fire spread days in the Lake Athabaska Region (5 to 10 days to 15 to 20 days) by 2080. (Wang et al 2017, Wang et al 2015). This represents most of the central and northern areas of the province. Research also

indicates that climate change will produce a higher frequency of days of high to extreme fire weather conditions, as well as more intense fires on average. An increase in fire intensity would likely be translated into greater fire spread and more erratic fire behavior, leading to increased area burned (Prairie Adaptation Research Collaborative).

- **Flooding:** The province of Saskatchewan comprises three major continental drainage basins: the Arctic, Hudson Bay and Gulf of Mexico. The Hudson Bay comprises the Churchill River basin, the Saskatchewan River basin, and the North and South Saskatchewan rivers which includes streams that rise on the eastern plains of the province and ultimately flow to Lake Winnipeg and on to Hudson Bay. The only community on the South Saskatchewan River that is vulnerable to flooding from mountain runoff is Saskatoon. On the North Saskatchewan River, the cities of the Battlefords and Prince Albert are vulnerable to flooding. On the Saskatchewan River, the most significant flooding issue relates to Cumberland House. Access to the community is by means of a single unpaved road. During high flow or wet conditions, the community is often evacuated. With a presumably greater likelihood of precipitation extremes, the occurrence of many types of flooding could increase. This would apply to mountain runoff flooding, plains runoff flooding and overland flooding (Saskatchewan Research Council, 2018).
- **Landslide:** Landslides are not viewed as a significant risk due to climate change in Saskatchewan. Valley slopes throughout southern Saskatchewan are prone to landslides. Landslides are particularly common in the South Saskatchewan River valley where, over time, the river has eroded its banks, forming steep valley slopes.
- **Heat waves and Drought:** Saskatchewan summers are expected to warm about 3° to 4°C, on average, across most of the province. Cities such as Saskatoon will see their average annual temperature rise by almost 7°C by the end of the century under current emissions production rates as compared to the historical baseline from 1976–2005 (1.8°C) (City of Saskatoon, 2019). The warmer temperatures for all the seasons will lead to longer growing seasons, less cold winters and warmer summers and many other changes.
- The years 1961, 1988 and 2001–2002 were among the worst droughts in recent decades in Saskatchewan. Changing characteristics of drought severity, frequency, and maximum duration indicate that six- and ten-month droughts will become more severe over southern Saskatchewan in the 2050s compared with the 1971–2000 period. The ten-month droughts are expected to increase by as many as four events in the 2050s (Saskatchewan Research Council, 2018).
- **Glacial Retreat:** There is no risk of glacial retreat in Saskatchewan.
- **Sea Level Rise:** Sea level rise does not present a risk in Saskatchewan.

- **Ocean Acidification and Hypoxia:** Ocean acidification does not present a risk to Saskatchewan.
- **Vector Borne Diseases:** In 2019 there were no cases of West Nile Virus (WNV) reported in Saskatchewan. The province is not currently at risk to this disease as there have been few cases reported on an annual basis going back to a high of 7 in 2013.

As of December 31 2018, 28,899 ticks have been collected and identified in Saskatchewan since 2008, only 71 were black-legged ticks. Among these 71, only 10 black-legged ticks tested positive for the bacterium that causes Lyme disease (Government of Saskatchewan, n.d.). Since 2008 there have been 7 diagnosed cases of Lyme Disease in the province with 5 of the cases related to travel outside the province (CBC News, 2018).

- **Invasive Species:** The Mountain Pine Beetle is increasing in population in western Alberta and may spread east and expand to the Swan Hills area of Alberta and eventually into east-central Alberta and Saskatchewan's northwest boreal forest. Many of Saskatchewan's most visited provincial parks (Cypress Hills, Meadow Lake, La Ronge, Narrow Hills, Candle Lake and Makwa Lake) have large pine forests that, if killed by the beetle, would have serious implications on visitation, experience and public safety (Saskatchewan Environment, 2019). There is a high risk of invasion of invasive plant species in the Grasslands Natural Region. Species that have been identified in a study for Alberta include: giant knotweed which outcompetes native species for water (*Fallopia sachalinensis*); tamarisk (*Tamarix chinensis*) which lowers the water table and increases wildfires; and alkali swainsonpea (*Sphaerophysa salsula*) which alters nutrient cycling and invades wetlands (Chai et. al., 2014).

Chapter 7: Manitoba

The Population

In the 2016 Census, 89,355 people self-identified as Metis in Manitoba (Statistics Canada, 2016a). The Manitoba Metis Federation (MMF) is recognized by the provincial and federal governments and the Metis National Council as the official Governing Member in the province of Manitoba and for its 42, 388 citizens.

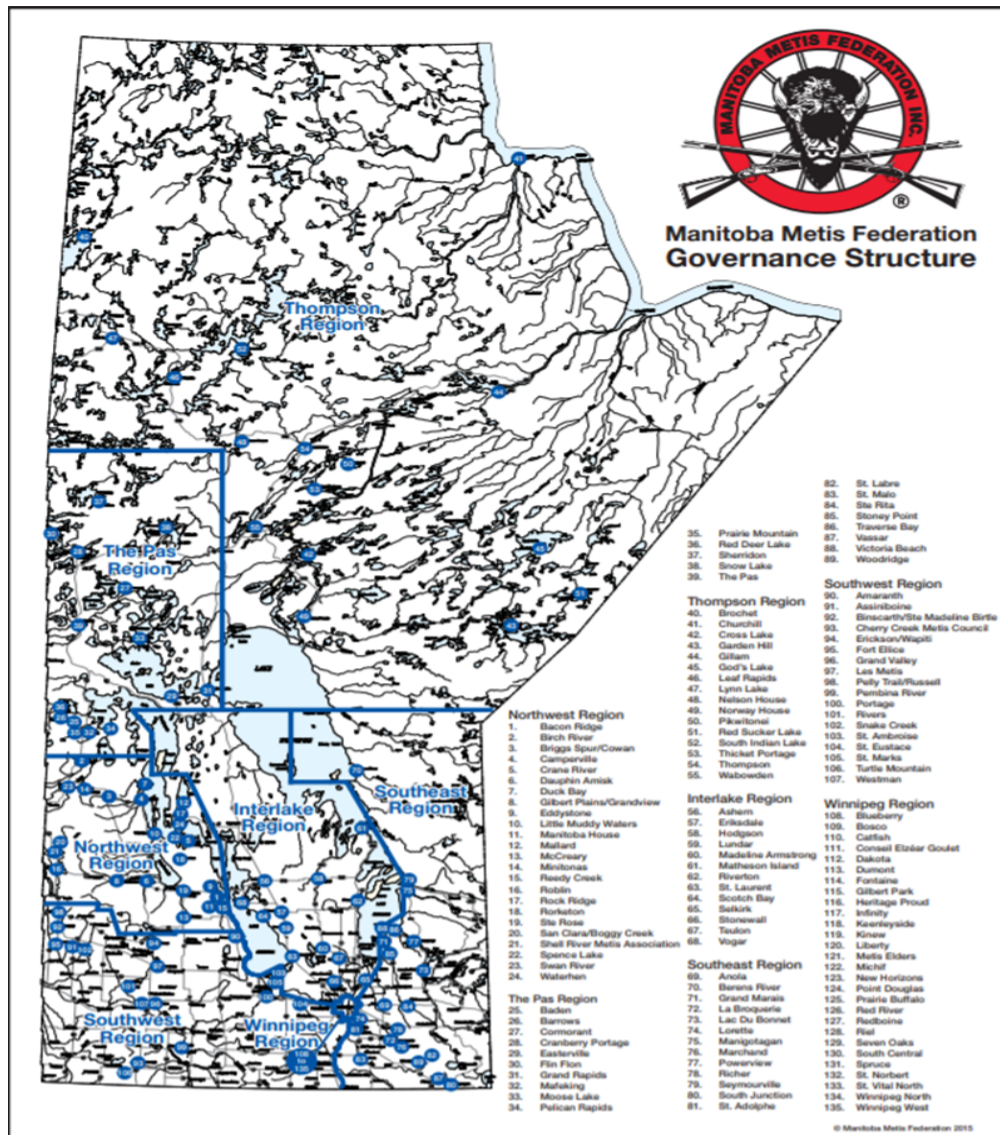


Figure 20: Manitoba Metis Federation Regions
Source: Manitoba Metis Federation

Manitoba	Non-Indigenous	Métis single identity (Census)
Total Population	1,278, 365 (2016)	89,355 (2016)
Housing: Major repairs	8.3% (2011)	14.3% (2011)
Crowded housing	4.7% (2011)	3.8% (2011)
Highest level of educational attainment (25-64): Bachelor degree or higher	24.9% (2011)	11.0% (2011)
College diploma	21.4% (2011)	19.6% (2011)
Apprenticeship certificate	13.3% (2011)	10.6% (2011)
High school diploma	25.9% (2011)	27.3% (2011)
No certificate, diploma, or degree	13.9% (2011)	23.9% (2011)
Median total income of those with no certificate, diploma or degree (rounded to nearest \$1,000)		\$22,000 - \$47,000
Employment rate (25-64)	80% (2011)	75.7% (2011)
Excellent or very good self-rated overall health of population (12+)	54.5% (2011)	60.3% (2011)
Excellent or very good self-rated mental health of population (18+)	63.1% (2011)	69.6% (2011)

Figure 21: A Socio-Economic Profile of Métis Living in Manitoba
Source: Statistics Canada, Manitoba Census Profile, 2016

As shown in the figure above, Metis people in Manitoba are disproportionately likely to live in housing needing repairs and have lower levels of educational attainment than the non-Indigenous population. These inequities increase Metis people’s vulnerability to extreme weather and climate events.

Climate Risks in Manitoba

- **Forest fires:** In 2013, Manitoba experienced its second worst fire season on record, with over 1,115,415 hectares burned. The fire season of 1989 proved to be the worst season with 3,567,947 hectares burned. Annually a number of the fires have been caused by humans based upon historical observations of fires. Hotter summers are projected for all parts of Manitoba and these conditions are expected to increase the frequency, intensity, and extent of forest fires. (Climate Atlas of Canada). Current research indicates that climate change

could lead to a doubling of potential forest fire spread days in the Lake Winnipeg Region (5 to 10 days to 15 to 20 days) and the Western Sub-Arctic Region (0 to 5 days to 5 to 10 days) by 2080 (Wang et al 2017, Wang et al 2015). This represents most of the central and northern areas of the province.

- **Flooding:** “Indigenous peoples in Manitoba have a higher risk of severe flood exposure, which results in more negative health, social, environmental, livelihood and other outcomes” (Thompson, 2015). The drainage basin of Lake Winnipeg includes the Red River, Assiniboine River (which includes the Souris River) and the Saskatchewan River (through Cedar Lake) from the West. The Bloodvein River, Berens River, Poplar River and Manitowagon River flow from the East. Historically, frequent flooding has occurred from rivers from the West side of the lake. Precipitation projections from the Canadian Centre for Climate Services indicate that under medium scenario for climate change an addition 350 mm of rainfall is expected annually for the 2021 to 2050 time period in the region (ClimateData.ca, n.d.) Two of the five most destructive floods in Canadian history have occurred in Manitoba since 2010. This includes the 2014 flood in Southern Manitoba, when the Assiniboine, Qu’Appelle and Souris Rivers reached record flows after heavy rains in which damages totalled an estimated \$1.16 billion. The 2011 flooding in Manitoba, which affected 15 communities along the Assiniboine, Roseau, and Red Rivers after wet spring weather caused these rivers to breach their banks. Roughly 2500 people were forced to evacuate, including many First Nations. Damages were estimated at just under \$600 million.
- **Landslide:** Landslides are not viewed as a climate change risk in Manitoba.
- **Heat wave and Drought:** Manitoba’s southern cities and towns that already experience hot summers will face large increases in both daytime and nighttime temperatures. Gimli is expected to see as many as 45 days with temperatures exceeding 25°C, while Morden is expected to have up to 36 days of more than 30°C. Overnight temperatures in Winnipeg could be over 20°C for up to 15 nights, adding to the difficulty to acclimatize during cooler periods when the sun is down. Many northern places will have to start coping with significant heat for the first time, with cities such as Thompson facing possible hot days rising from 31.8°C to 35.4°C. Climate models suggest that southern Manitoba is expected to get wetter – especially in the spring – but summers may see a decline in precipitation. Given that many communities in the south are projected to see a tripling or even quadrupling in the number of very hot days, even minor declines in summer precipitation will create the perfect recipe for drought (Prairie Climate Centre). A study on the Assiniboine River Basin looked at the impacts of climate change on supply and demand for water and found that reduced summer precipitation, coupled with increased temperatures resulted in the potential for increased summer droughts (Manitoba Government).
- **Glacial Retreat:** There is no risk of glacial retreat in Manitoba.
- **Sea Level Rise:** Sea level rise does not present a risk in Manitoba.

- **Ocean Acidification and Hypoxia:** Ocean acidification does not present a risk to Manitoba while hypoxia remains an important knowledge gap in Lake Winnipeg (Scott et. al. 2011). Research suggests that the diversity of aquatic species in Lake Winnipeg will decline as water temperature rises. As the climate warms, the assemblage of species in the Lake Winnipeg's food web will change with unclear consequences to overall ecosystem performance. Among the phytoplankton community, blue-green algae, with a tolerance for higher temperatures, will become much more prevalent. Of the 56 fish species presently found in Lake Winnipeg, approximately one half could face thermal stress and possible extirpation if predicted water temperature increases are actualized by 2089 (Climate Change Connection).
- **Vector Borne Diseases:** In 2007 the number of human cases of West Nile Virus (WNV) reached 587. The number of human cases has fluctuated between zero in 2010 and 2011 and 39 in 2012. In 2019 there were 2 human cases of WNV reported. This information indicates the yearly seasonal climate variations have an impact upon the vector.

Since 2015 the number of confirmed cases of Lyme disease has steadily increased in the province, rising from 12 in 2015 to 30 in both 2018 and 2019. The Southern part of the province, South of Dauphin is the area of incidence of black legged ticks (Government of Manitoba, n.d.)The area surrounding Flin Flon is also at risk from the black legged tick.

- **Invasive Species:** As in other provinces, there is a risk of invasive plants and animals from climate change such as the giant knotweed. Invasive aquatic species such as the Zebra and Quagga mussels, Spiny Waterflea, Rusty Crayfish and Asian Carp are freshwater species that are already established in Manitoba.

Manitoba Metis Perceptions of Climate Change and Health Issues

Over 2019, the Manitoba Metis Federation (MMF) conducted engagement sessions regarding climate change impacts with the Manitoba Metis communities (the Community) throughout the seven MMF regions. The Community discussed changes they have been seeing as well as concerns for the future, with health in a changing climate being a substantial point of discussion. As a result, the MMF was able to catalogue the impacts of climate change for their citizens throughout the province. This knowledge will help the MMF to create programs that will aid to address these concerns, and help limit the impact of climate change felt by the Community.

The engagement sessions represent a snapshot in time which the MMF gathered as much initial information as possible. The sessions did not focus health, and it is recommended that further engagements and research to further explore the impacts of these and new emerging issues for the Community is necessary. This research will require further capacity support and funding for workshops and engagement sessions to better learn how climate change is impacting the Community.

Natural Hazards

Throughout the Province, the Community reported changes in frequency and severity of extreme weather and climate events. The Community is concerned regarding the intensity of weather events; reporting increases in high winds, tornadoes, and violent storms in many of the MMF's regions. In 2007, in Elie Manitoba, the MMF's Southwest Region experienced Canada's only class F5 tornado in documented history.

A large portion of Manitoba lies within the Boreal ecozones and is home to sprawling forests as well as a vast network of lakes and rivers. High-water events and floods have become an increasing point of concern for Metis citizens. These water-related events not only impact the properties of the Community, but their livelihoods and traditional ways of life as well. During the summer months, the threat of forest fires has also increased, threatening Metis health, livelihoods, and culturally significant areas.

Through partnerships with groups such as the Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS), the MMF is working towards the monitoring of weather events throughout the province of Manitoba. This will contribute to the collection and reporting of the highest quality data for natural resource, education, and research applications.

Mental Health and Well-Being

Throughout the Province, a number of climate change concerns have been identified that are impacting the mental health and well-being of the Metis. As listed in the previous section, this includes stress from natural hazards and extreme weather events such as floods, tornadoes, forest fires, hail, among others. This is also manifest in concerns over the possibility of being evacuated due to extreme weather events, and the potential for long term displacements from such events, which in turn can impact health and well-being.

Many members are experiencing stress and worry over the decline of traditional food sources including predator species (bears, coyotes) that are displaced from their territory and are now present in communities. These changes to ecosystems are also making individuals wonder how population shifts of various species will affect traditional ways of life. Maintaining culture and a way of life, remain a high priority for the Manitoba Metis.

Finally, there are intergenerational concerns and what type of a world will be left for Métis children and grandchildren. This changing world and the costs of climate change, such as the need to purchase food to replace insufficient harvests, the increase of carbon tax and hydro, and the impacts on rural communities are adding levels of stress to the Manitoba Métis populations.

Air Quality

Similar to many of Canada's other boreal provinces, Manitoba has seen an increase in forest fires, predominantly in the Boreal Forest. The Community has observed a change in air quality during these events and has concerns regarding the possible negative health impacts on citizens, notably those with underlying respiratory conditions such as asthma and COPD.

Food Safety and Security

During the MMF climate engagement sessions, the Community identified food safety and security amongst their top concerns in a changing climate. With harvesting traditional food sources being a large part of the Metis lifestyle, shifts in species' populations and increase of diseases could be detrimental to the traditional way of life. Declines in traditional plant and animal species, such as eneca root, blueberries, and moose, lead to insufficient harvests for Metis citizens. Diseases such as Chronic Wasting Disease and tick-related illness from winter ticks have the ability to devastate local populations of cervids, especially moose and elk.

Harvesters have already noted changes in animal behaviour and migration patterns, leading them to spend more time harvesting in order to meet their needs. With eutrophication from increased water temperature and nutrient loading throughout lakes and rivers in Manitoba, the Community is noticing a decline in good quality fish for harvesting. In the northern regions of the province, the increased cost to receive goods makes harvesting traditional food sources the best option in order to avoid an increase to the Community's cost of living.

The MMF continues to investigate wildlife monitoring strategies for the Manitoba Metis Community. The goal is to be able to monitor the health, wellness, and presence of wildlife species throughout the entirety of Manitoba; results and feedback will lead to the development of Metis driven conservation efforts in areas where wildlife populations appear to be struggling. The MMF is also working within its regions in order to help Métis citizens gain access to food through community gardens and food sharing programs.

Water Quality, Safety, and Security

The Community has recognized serious water quality issues in Manitoba caused by pollution and nutrient loading which are being exacerbated by climate change. The warming climate causes a rise in water temperatures; driving increases in size and intensity of algal blooms, thereby jeopardizing the health of aquatic ecosystems. The Community is concerned that toxic algal blooms of cyanobacteria will impact recreational uses of Lake Winnipeg, potentially harming citizens. The Community recognizes the importance of Lake Winnipeg and worries that the current laws and monitoring initiatives are not adequate protection and prevention of declining water quality.

Concern over Manitoba's Lake Winnipeg and its watershed has been long recognized in the province. The MMF has partnered with the Lake Winnipeg Foundation to support Metis community-based water monitors throughout the province in order to collect water samples for

phosphorus analysis. This data is uploaded to The Gordon Foundation's DataStream where it aids to provide a clearer picture of freshwater health and a stronger foundation for policy makers to make informed decisions.

Infectious Disease

Throughout the MMF's seven regions, the rapid spread of ticks and tick-borne disease is a rising concern for the Community. Citizens have reported the tick range is increasing north, into The Pas and towards Thompson. In the southern regions there are reports of new varieties emerging, bringing new types of illnesses and disease with them.

The MMF is working to provide awareness and information to their citizens regarding ticks, Lyme Disease, and the importance of taking preventative measures when accessing the outdoors.

Health Systems

In the Northern regions of Manitoba, the Community is concerned that emergency response plans are not adequately communicated with remote communities. Without suitable systems in place, there is concern over how to prepare for an emergency as well as how emergencies will be communicated to the Community.

Chapter 8: Ontario

The Population

In the 2016 Census, 120,585 people self-identified as Métis in Ontario (Statistics Canada, 2016a). The Métis Nation of Ontario (MNO) is recognized by the provincial and federal governments and the Métis National Council as the official Governing Member in the province of Ontario. As of 2020, over 20,000 individuals have registered with the MNO as Métis citizens in approximately 30 Chartered Community Councils across the province.

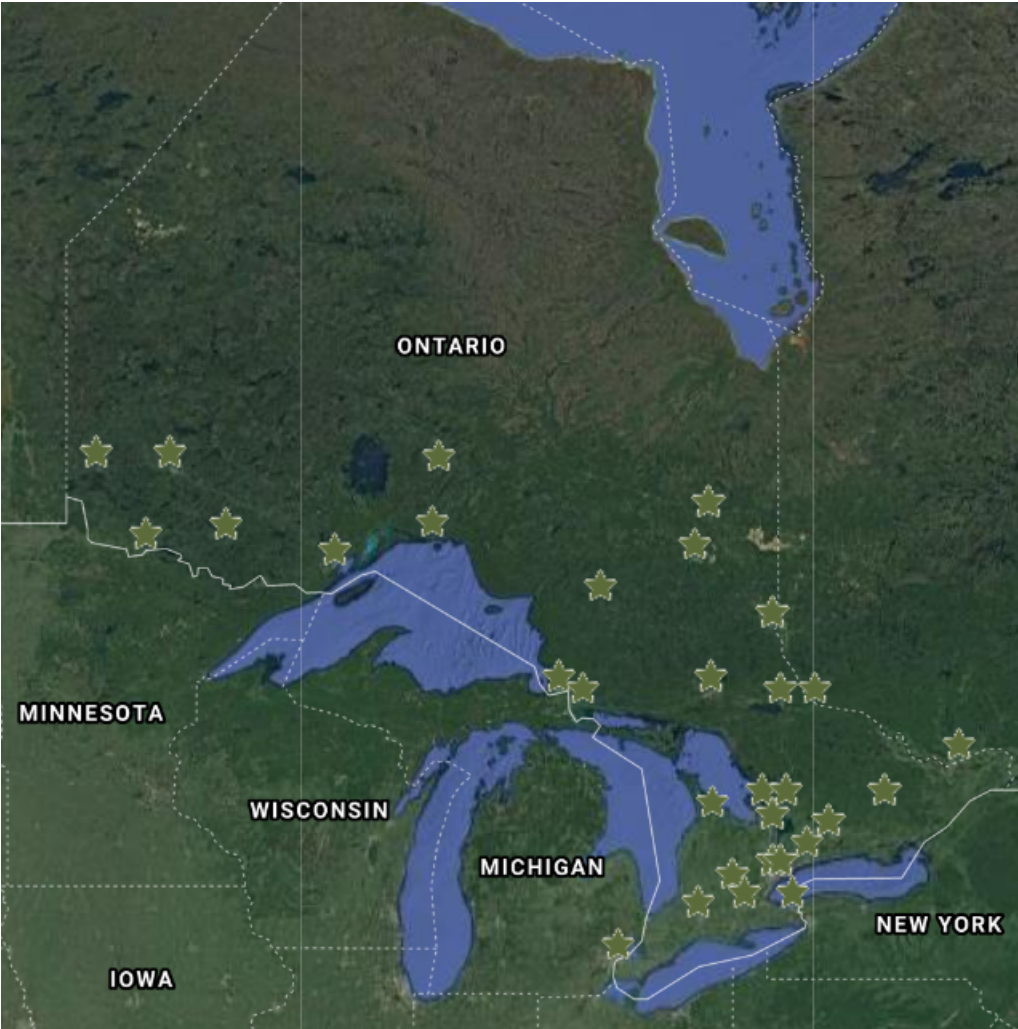


Figure 22: Métis Nation of Ontario
Source: Métis Nation of Ontario

Ontario	Non-Indigenous	Métis single identity (Census)
Population	13,448,494	120,585
Housing: Major repairs	6.3% (2011)	12.5% (2011)
Crowded housing	5.0% (2011)	2.0% (2011)
Highest level of educational attainment (25-64): Bachelor degree or higher	29.3% (2011)	13.9% (2011)
College diploma	23.5% (2011)	29.1% (2011)
Apprenticeship certificate	7.7% (2011)	13.2% (2011)
High school diploma	24.2% (2011)	24.2% (2011)
No certificate, diploma, or degree	10.7% (2011)	16.8% (2011)
Median total income of those with no certificate, diploma or degree (rounded to nearest \$1,000)		\$20,000 - \$40,000 (2011)
Employment rate (25-64)	75.5% (2011)	68.4% (2011)
Excellent or very good self-rated overall health of population (12+)	61.3% (2011)	50.1% (2011)
Excellent or very good self-rated mental health of population (18+)	71.7% (2011)	61.0% (2011)

Figure 23: A Socio-Economic Profile of Métis Living in Ontario

Source: Statistics Canada, Ontario Census Profile, 2016

As shown in the figure above, Métis people in Ontario are disproportionately likely to live in housing needing repairs and have lower levels of educational attainment than the non-Indigenous population. These inequities increase Métis people are vulnerable to extreme weather and climate events.

Climate Risks in Ontario

- Forest fires:** Within the Métis homeland of Ontario the Boreal forest represents over 74% of the landmass with many of the regions and communities remote and isolated. Previous studies conducted by the Ontario Ministry of Natural Resources and the Canadian Forest Service indicated that a combination of human and lightning caused wildfires, plus increased temperatures, would result in an increase between 75% to 100% by 2090 (Wotton, et al 2005). A more recent study, looking at the frequency of lightning storms due to climate change indicates a tripling of area burned by the end of the 21st century (Salkova, 2016).

- Flooding:** Historically flooding has occurred in a number of the watershed areas of the Métis homeland of Northwestern Ontario. Precipitation projections from the Canadian Centre for Climate Services indicate that under medium scenario for climate change an addition 350 mm of rainfall is expected annually for the 2021 to 2050 time period in the region (ClimateData.ca, n.d.). This would mean additional flooding pressures at various times of the year within various regions, increasing risks of flooding events. Since 2000 flooding events from rainfall have occurred in many areas. In 2002, parts of northwestern Ontario were declared disaster areas because of severe flooding. Roads and highways were washed out and closed, power and telecommunication lines were disrupted, and private properties were greatly damaged. The municipalities of Ignace, Fort Frances, Rainy River, Alberton, Atikokan, Chapple, Dawson, Emo, La Valle, Lake of the Woods, Morley, Machin; Township of Sioux-Narrows – Nestor Falls were all affected. In Thunder Bay in 2012 and in Kenora in 2016, both cities required state of emergencies to be called to manage the damages (Public Safety Canada, n.d.). In 2014 a record rainfall in June in the Rainy Lake and the Namakan Chain of Lakes raised the water table to exceptionally high levels for several weeks, and the fully opened outlets of these lakes could not pass water nearly as quickly as it was entering. Ten communities in the Ontario portion the Rainy River watershed declared States of Emergency as a result of high water. This included 4 First Nations, the towns of Fort Frances and Rainy River, and the townships of La Vallee and Emo (International Joint Commission, 2015).
- Landslide:** The Canadian Shield of Northwestern Ontario is not susceptible to landslides from a climate change perspective. There are a number of rock slides due to the geological formations of the area. The risk from increased landslides due to climate change in the region is low.
- Heat waves and Drought:** Increases in mean annual air temperature are projected through the 21st century in the Métis homeland of Ontario. Models project mean annual air temperatures could increase by up to 8.8°C by the 2080s. On average, annual temperature may increase by 2.2 to 2.4°C by the 2020s, 3.0 to 4.8°C by the 2050s, and 3.1 to 8.3°C by the 2080s. Summer temperatures are projected to increase less than winter temperatures in the region. With respect to drought, only slight increases in precipitation are projected for the western portion of the region, becoming progressively wetter from the Manitoba border towards the boundary with the Great Lakes Basin. Changes in total annual precipitation are likely to increase on average by up to 64 mm by the 2080s. Summer precipitation may decline throughout the century.
- Glacial Retreat:** There is no risk of glacial retreat in the Métis homeland in Ontario.
- Sea Level Rise:** Sea level rise does not present a risk in the Métis homeland in Ontario.
- Ocean Acidification and Hypoxia:** Ocean acidification does not present a risk to Northwestern Ontario. Indications are that as seasonal temperatures increase, and warmer temperatures come sooner in the spring, toxic blue-green algae will begin to grow earlier in the season in Kenora and Lake of the Woods and last later into the summer/fall. Wildlife in

the region dependent on bodies of water plagued with bluegreen algae are more likely to experience health complications, as they have increased and longer-term exposure to the poisonous growth. Recently, Kenora has seen a rise in the number of dog deaths and human poisonings specifically (City of Kenora).

- **Vector Borne Diseases:** Ontario Public Health has been consistently reporting on West Nile Virus (WNV) since 2002. In that year, the highest number of cases were reported amounting to 395. The number of cases has varied from lows of 4 in 2009 to highs of 217 in 2012. In 2019 there were 19 positive cases of WNV in humans with no reported cases in the Northwestern Health Unit.

In 2017 there were 959 probable and confirmed cases of Lyme disease reported in Ontario with 2 of those cases reported in northwestern Ontario (Nelder, et.al., 2017). Most cases of Lyme Disease have been reported in eastern Ontario. That said, a map produced by Ontario Public Health for 2019 indicates that Kenora and Rainy River areas are identified as a high-risk area.

- **Invasive Species:** Ontario has the highest number of invasive plants in Canada. Invasive aquatic species such as the Zebra, Quagga mussels and Asian Carp are freshwater species that are of concern in Ontario. There is little research specific to Northwestern Ontario on the subject of invasive species and climate change.

Chapter 9: Knowledge Gaps

The process in developing a National Métis Climate Change and Health Vulnerability Assessment inevitably leads to the identification of gaps in the data and information available. Health authorities require information about current associations between health outcomes and weather or climate, vulnerable populations, projections of future risks and adaptation opportunities. Such information can assist the Métis Nation to take needed protective actions and help in building health systems that meet the need of Métis people. Numerous studies have indicated that there are significant barriers related to data accessibility, a limited number of climate and health models, uncertainty in climate projections and a lack of funding and expertise, challenge health authority efforts to conduct rigorous assessments and apply the findings. (Berry et. al., 2018).

The statement above is more of the rule than the exception for Métis data and information. During the scope of this work, numerous databases were reviewed, federal agencies were contacted, research consortiums were consulted and academics were interviewed. The consensus coming out of this work is that there is very little information available to assist in conducting risk and vulnerability assessments for the Métis population. This holds true for a number of reasons.

First, during the course of this information gathering exercise, it is evident that there are different levels of capacity among Métis Nation members. Chapters 4 to 8 of this report provided a review of risks to the Métis Nation of Ontario, the Manitoba Métis Federation, the Metis Nation Saskatchewan, the Métis Nation of Alberta and the Métis Nation British Columbia. Risks were gleaned from various sources including census information, research reports and government databases and publications. Additional information was collected through semi-structured interviews with government officials, university researchers and experts in the area of climate change, including members of the Métis Nation that were available prior to the COVID 19 lockdown measures that were put in place across the country. Governing Members that were able to provide more detailed information regarding climate change were Manitoba and British Columbia. Both Members had conducted climate change information gathering exercises within their respective jurisdictions and this data was significant in the identification of perceived risks among those Nations members. Additional information of this sort is crucial if the Métis Nation is to further identify, understand and address risks from climate change.

In this sense, there is a fundamental role for that of the Métis National Council in addressing this concern. Its mandate and direction from come from the MNC Governing Members, with its central goal “to secure a healthy space for the Métis Nation’s on-going existence within the Canadian federation”. Given the global and national risks associated with climate change, and in this case, the risks posed to human health, the MNC has a pivotal role in coordinating Métis action on climate change and in developing programs and policies that are in the interests of all members.

First, Census information has been limited to the definition of Métis. Within past census forms participants were asked to self-identify as Métis. This has led to a growing number of Métis people within the Canadian population. However, this has not been consistent with the way in which Provincial Métis governments have identified who is able to register as a member of the Métis Nation within each province. This makes it difficult to inform planning and policy decisions when there is inconsistency with the data used. It is the understanding that future data collection efforts are to focus on the utilization of Métis registration information within each provincial organization.

Indigenous Peoples Survey (formerly the Aboriginal Peoples Survey) conducted by Statistics Canada has traditionally asked respondents to self-identify as Métis, First Nation or Inuit person. In the 2017 version of the survey it asked Métis respondents if they were part of a Métis organization (Does the respondent have a card or certificate issued by a Métis organization that identifies him/her/them as Métis?). Such types of questioning, and the information it provides, can assist the Métis Nation in defining how its members are being affected by climate change.

A report based upon this Survey has indicated that climate change is also playing an increasingly significant role in influencing harvesting activities. However, the report indicates that many studies on harvesting do not focus on Métis people. “A national picture on trends, reasons for participating or not participating, and factors associated with harvesting activities among First Nations people living off reserve, Métis and Inuit is lacking.” (Kumar et. al.). Clearly more work needs to be done in order to address Métis needs in addressing climate change.

Within the health sector itself, there are some steps being taken to address these gaps. The Canadian Institute for Health Information currently has no Métis specific data holdings and is in the process of developing and Indigenous Health Strategy (2020). This Strategy will help to align policies so that access to data and customized requests can be made that are Métis specific. The Pan-Canadian Health Inequalities Reporting Initiative is an effort by the Public Health Agency of Canada in collaboration with Statistics Canada, provincial and territorial government partners and key non-governmental data custodians to more routinely disaggregate data to inform action on health equity. Métis specific information on health status and health determinants is a useful tool to understand some of the resiliency factors that are in place in the face of climate change.

Indicators such as those listed below are eliminating some gaps in data collection. Such efforts will allow one to identify and monitor priority areas for action, such as chronic disease among adults. It will also allow one to identify areas where Métis are doing well compared to other population groups, and make health inequality comparisons across Provinces.

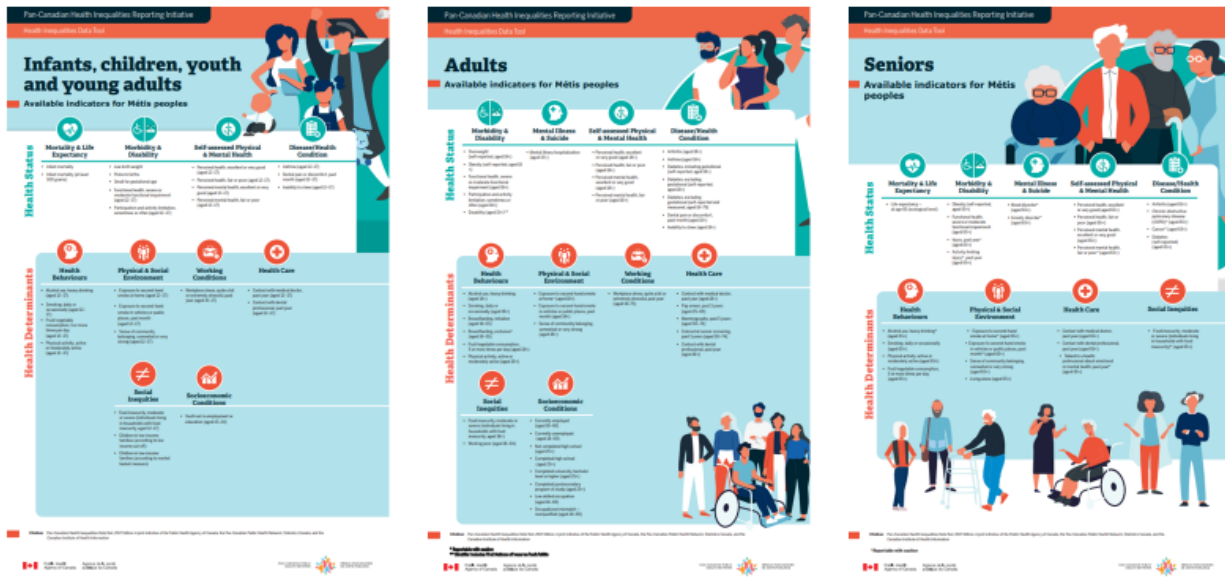


Figure 24: Health Inequalities faced by Métis people: Data from the Pan-Canadian Health Inequalities Reporting Initiative

Source: Presentation to the Métis National Health Forum, Feb. 26-27, 2020.

In developing this report, attempts were made to meet with a few respected climate consortiums. This included the Pacific Climate Impacts Consortium (PCIC), the Prairie Climate Centre (PCC) and the Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR). Interviews were conducted with representatives of PCIC and OCCIAR and due to the global pandemic, the efforts to connect with PCC did not take place. Regardless, the two interviews that were conducted highlighted the data gaps that exist when it comes to understanding climate change risks to Métis populations. While there is general information related to flooding, forest fires, extreme temperatures, changes in migration routes, vector borne disease, among others, there has been no effort to correlate how this information is impacting Métis populations directly. Efforts directed towards more community-based monitoring by and for Métis people, developing correlations and comparisons between local climate change assessments and those of Métis people, and the inclusion of Métis associations in health and climate change planning processes at the local and regional levels, were a few suggestions that were put forward.

Interviews with federal staff who have climate change programming also reinforced these ideas. Data collection specific to Métis, community-based monitoring, understanding the mental, emotional, physical cultural links between the land and Métis people were a few suggestions for future funding. Also, the need for community-based health and vulnerability assessments to include Métis people as part of the process were viewed as positive steps that could be taken.

Chapter 10: Summary and Recommendations

As a result of climate change, forest fires, flooding, extreme heat and drought, vector-borne disease and invasive species have been identified as major risks in all Métis regions, resulting in potential impacts on the health of individuals. Numerous data and information gaps exist across the country that are not unique to any one jurisdiction. This indicates a strong role for a national voice through the Métis National Council to lobby federal agencies, academia and knowledge brokers in further data and information collection efforts as well as research at a national level. This role further extends to Governing Members in addressing knowledge gaps specific to their region and in particular to work with local health authorities include the Métis as part of their data collection and research efforts. In this sense, community-based monitoring programs are initial steps that could be taken across all regions.

The Table below are places where initial efforts could be placed by each Métis governing body. There are similar areas identified within each region where collaborations could occur and intersectoral work through health and environment groups could be of benefits to members. The MNC could play a coordinating role in this regard. The table below also reflects information that was gleaned from efforts that were conducted by the MMF and MNBC through workshops and surveys that were conducted in each region. It is strongly suggested that all regions undertake similar efforts in order to gain a more fulsome understanding of the perceived risks that members face within their respective areas.

Region	Major Risks Identified	Key Areas for Action
Métis Nation of Ontario	Forest Fires Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, flooding and invasive species. • Lobby regional health authorities to collect additional information on Métis health status and outcomes especially those related to respiratory issues, food security and mental health.
Manitoba Metis Federation	Forest Fire Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, flooding, extreme heat and drought, and vector-borne disease. • Lobby regional health authorities to collect additional information on Métis health status and outcomes. • Based upon engagement sessions hosted by MMF, hold workshops to define health and climate change risks especially those related to air

		quality, mental health and food safety.
Métis Nation - Saskatchewan	Forest Fires Flooding Extreme Heat and Drought Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, extreme heat and drought and vector-borne disease. • Lobby regional health authorities to collect additional information on Métis health status and outcomes related to respiratory issues, and mental health.
Métis Nation of Alberta	Forest Fires Flooding Landslides Extreme Heat and Drought Glacial Retreat Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, flooding and invasive species. • Lobby regional health authorities to collect additional information on Métis health status and outcomes. A good starting point would be addressing respiratory and mental health related issues.
Métis Nation British Columbia	Forest Fires Flooding Landslides Extreme Heat and Drought Glacial Retreat Sea Level Rise Ocean Acidification and Hypoxia Vector-borne Diseases Invasive Species	<ul style="list-style-type: none"> • Address information needs related to forest fires, sea level rise, glacial retreat and invasive species. • Based upon needs collected through MNBC effort should be directed to lobby regional health authorities to collect additional information on Métis health status and outcomes related to respiratory issues and mental health.
Métis National Council		<ul style="list-style-type: none"> • Work with federal agencies and researchers to develop a national Métis and climate change data collection strategy and research agenda. • Work intersectorally with environment and health officials at all levels of government and with Governing Members.

Figure 25: List of Major Risks and Key Areas of Action for each Governing Member

During the course of this project, a number of suggestions were made by key informants and stakeholders regarding data tools and information that is required in order to better inform decision making within the Métis Nation; along with those who are conducting research to inform

policies and programs to improve climate change adaptation and mitigation efforts. The recommendations below are those that can be acted upon to improve outcomes related to climate change and health. No costs have been identified for this effort and would need to be the subject of future work. In addition, it is assumed that the MNC would have a strong coordination role in overseeing these efforts. As the national body they are well placed to ensure a consistent approach is undertaken and that research and data collection efforts benefit all members.

Ensure Data Collection Efforts Utilise Métis Registration Information

As identified in the gaps section, there are a number of useful data collection efforts being undertaken at the federal level that can prove to be useful for decision making. An important component in many of these data tools is the identification of Métis within the data sets. Many tools do not provide breakdowns of Métis populations within the data sets, while others, such as the Census information, use self-identification as the primary way to break down Métis population data. MNC and its Environment and Health Ministries must work with data providers so that both self-identified Métis, and those registered with provincial bodies, form part of the data collection efforts. This point goes beyond the climate change area and impacts all levels of decision making within the Métis Nation.

Gabriel Dumont Institute Climate Change Program

Create a course to train the next generation of climate change and health specialists. This need not be limited to health, but it must form a core component that integrates climate change science, adaptation and Métis knowledge into a curriculum that promotes mitigating health impacts from climate change.

Capacity Building at the Local Level

Many locals in each one of the regions need to understand the risks that climate change poses to their citizens. This includes establishing a dedicated fund for the Métis Nation that can be used to assist locals in developing health and climate change adaptation and/or mitigation plans. This would include, but not be limited to, the training of youth; supporting the knowledge translation from Elders; enhancing community-based monitoring efforts; identifying health risks; developing food and traditional medicine programs to reduce risks; and provide capacity supports to work with federal and provincial agencies to monitor/report health risks.

Develop Health and Climate Change Indicators for Métis

Work with federal and provincial agencies to expand data collection efforts to inform adaptation planning among Métis communities. Focused efforts could build towards developing human

health and well-being indicators for Métis aligned with the recommendations made to the Government of Canada by the Expert Panel Climate Change Adaptation and Resilience Results.

Establish Local Risks for Métis People

In order to merge health and scientific data with the risks that the Métis population is facing, it is imperative that Métis perceptions of risk be included in decision making. This requires research surrounding local populations understanding of climate change and the risks this poses to their health and way of living. A research program could be set up within each Governing Member to survey citizens on these risks.

Fund a Climate Change and Health Specialist

As the impacts of climate change grow across the country, it is important that a resource be available to run programs as listed above. A person responsible for managing climate change programs such as those listed above will ensure that proper information is collected and integrated into planning. This person will also act as an important liaison with the health and environment committee members and will be a crucial participant in the distinctions-based table under the Pan Canadian Framework on Climate Change.

Develop a Youth Interchange Program

This could be accomplished with Indigenous Services Canada (ISC), the Public Health Agency of Canada (PHAC) and Health Canada (HC), as well as research consortiums and academia, in order to advance Métis capacity in this area. Youth enrolled in university programs or through the Gabriel Dumont Institute could work with, for example, the First Nations and Inuit Health Branch at ISC and the Climate Change and Innovation Bureau at HC to build capacity to understand the linkages between federal programming, climate change and the Métis people.

Develop a Métis Climate Change Strategy

Work intersectorally with all ministries within the Métis Nation to develop and articulate a national approach for the Métis people so as to further its efforts with the federal and provincial governments. Such an approach can build upon the recommendations listed here, but also incorporate additional measures outside of the scope of this work, such as infrastructure, emergency management and transportation need of the Métis. The Inuit Tapirriit Kanatami Climate Change Strategy could be used as a model to inform efforts.

Create a Métis Experts Group on Climate Change and Culture

The nature and degree of climate-related impacts on Métis ways of life will vary by region, as will the cultural considerations required to respond. As called for by the Canadian Council of Academies in their report on Canada's Top Climate Change Risks, there is a need for proactive

adaptation measures to anticipate future stressors. Incorporating culture as a way to reduce these stressors can form the basis for community adaptation actions to reduce the negative mental health aspects of climate change. An intersectoral health and environment Métis Experts Group could also form the foundation for a broader Indigenous Experts Group that could provide collaborative solutions to governments as they develop policies and programs related to climate change and health.

To complement this Experts Group, a National Métis Youth Advisory Council on Climate Change can be created to ensure the work that the Métis Nation does/supports included the perspectives, vision and priorities of the youth.

Dedicated Research Grants

Work with the Canadian Institutes for Health Research, academia and research consortia such as the Pacific Institute for Climate Change, the Saskatchewan Research Council, the Prairie Climate Centre and the Climate Risk Institute to advance the state of knowledge surrounding climate change and human health. This would include targeted funding to understand adaptation activities within the global context and funding that integrates Métis traditional knowledge with that of western science so that a more holistic approach can be taken towards climate change solutions. Direct funding to Métis students enrolled in programs at post-secondary institutions could be created to bridge the gap in knowledge.

Impacts of Global Pandemics (COVID-19)

Global pandemics such as COVID-19 have changed the way society interacts and the way the economy functions. For the Métis people, gatherings, face to face interaction and the oral tradition is important to culture and the sharing of knowledge. There is a need for the MNC to work with stakeholders to develop virtual dialogue tools that can assist members to participate in information exchanges, gatherings and workshops at both the national and regional level. In addition, research should be undertaken to better understand how, for example, evacuations or community gatherings during extreme heat or air quality events should be conducted as part of the normal emergency planning process.

Appendix 1

Questions presented to participants at Métis Nation British Columbia Climate Change and Mental Health Conference:

1. *What are the health impacts of climate change in your community and traditional territories?*
2. *What are the regional level climate change and health priorities?*
3. *How do we build capacity at the local level to respond and adapt to climate change?*
4. *What are the roles of BC Métis, governments and stakeholders in preparing for and adapting to climate change?*
5. *What are the strengths of the Métis people in reducing the health risks?*
6. *What education is needed in your community to prepare for and adapt to climate change?*
7. *What tools should be developed to raise awareness?*
8. *What processes and procedures need to be in place to reduce risk?*
9. *What types of services are required during evacuations?*

Questions included in the Métis Nation British Columbia postcard initiative:

1. *What are your concerns about the environment, health, and land use?*
2. *Have you noticed any changes in the land, water, or wildlife species around you?*
3. *What initiatives would you like MNBC take to learn more about Climate Change and the role we can play in the solution?*

Appendix 2

List of Organizations and People Interviewed

Organization	Attendants	Date
Canadian Centre for Climate Services	<ul style="list-style-type: none"> ● Abder Yagouti, Manager ● Carrington Pomeroy, Physical Science Officer, Data and Science Office 	January 8 th 2020
Crown-Indigenous Relations and Northern Affairs	<ul style="list-style-type: none"> ● Marlene Doyle, Manager, Indigenous Community-Based Climate Monitoring Program ● Anita Walker, Director, Adaptation Program 	January 28 th 2020
Natural Resources Canada	<ul style="list-style-type: none"> ● Christopher Jennings, Director, Climate Change Impacts and Adaptation Division – Lands and Minerals Sector ● Tanya Burger, Senior Policy Analyst, Climate Change Impacts and Adaptation Division ● Nicole Lulham, Science planning officer ● Brenda Reid, Policy analyst 	January 29 th 2020
Public Health Agency Canada	<ul style="list-style-type: none"> ● Lesley Doering, Director, Policy Integration and Zoonoses Division ● Dr. Nicholas Ogden, Senior Research Scientist of vector-borne diseases ● Dr. Robbin Lindsay, Research scientist, Zoonotic Diseases and Special Pathogens section of the National Microbiology Laboratory in Winnipeg ● Christina Lee Fuller, Manager of Infectious Disease and Climate Change program ● Annie-Claude Bourgeois, Manager and Senior epidemiologist ● Sheena Pharand, Program Officer ● Lesley-Anne Dams, Program Officer 	January 29 th 2020
Métis Nation British Columbia	Climate Change and Mental Health Forum <ul style="list-style-type: none"> ● Susie Hooper, Health Minister, MNBC ● Leona Shaw, Environment Director, MNBC ● Tanya Davoren, Health Director, MNBC ● Regional Directors of Health ● MNBC community members 	January 31 st – February 2 nd 2020

Environment and Climate Change Canada	<ul style="list-style-type: none"> ● Marie-Eve Neron, Director, Conservation Program ● Rhonda Arsenault, Senior Program Coordinator 	February 28 th 2020
Canada Centre for Mapping and Earth Observation, Natural Resources Canada	<ul style="list-style-type: none"> ● Michelle Poirier, Geomatics Advisor, Flood Plain Mapping ● Paula McLeod, Program Manager ● Tina Lynn Lindsay, Geomatics Project Officer ● Laura Salisbury, Geospatial Standards Advisor 	February 28 th 2020
Les Femmes Michif Otipemisiwak	<p>Métis Women's Forum</p> <ul style="list-style-type: none"> ● Members of LFMO 	March 3rd – 6th 2020
Health Canada	<ul style="list-style-type: none"> ● Dr. Peter Berry, Senior Policy Analyst and Science Advisor to the Director ● Gregory Richardson, Senior policy analyst 	March 6 th 2020
Climate Risk Institute	<ul style="list-style-type: none"> ● Al Douglas, President 	March 9 th 2020
Public Health Agency of Canada, Health Promotion and Chronic Disease Prevention Branch	<ul style="list-style-type: none"> ● Sarah MacKinnon, Acting Manager, Centre for Surveillance and Applied Research 	March 10 th , 2020
University of Alberta	<ul style="list-style-type: none"> ● Sherilee Harper, MSc, PhD, Canada Research Chair in Climate Change and Health, Associate Professor, School of Public Health 	April 6 th , 2020

Appendix 3

List of Acronyms

2SLGBTQQIA: Two-spirit, lesbian, gay, bisexual, transgendered, queer, questioning, intersex and asexual

AGI: Acute Gastrointestinal Infections

APS: Aboriginal People's Survey

BC: British Columbia

CO₂: Carbon Dioxide

CoCoRaHS: Community Collaborative Rain, Hail, and Snow Network

COPD: Chronic obstructive pulmonary disease

ELCC: Early Learning and Child Care Accord

GMs: Governing Members

HC: Health Canada

ISC: Indigenous Services Canada

IPCC: Intergovernmental Panel on Climate Change

MDD: Major Depressive Disorder

MNA: Métis Nation of Alberta

MNBC: Métis Nation British Columbia

MNC: Métis National Council

MMF: Manitoba Métis Federation

MNLA: Métis Nation Legislative Assembly

MNO: Métis Nation of Ontario

MNS: Métis Nation Saskatchewan

NAHO: National Aboriginal Health Organization

OCCIAR: Ontario Centre for Climate Impacts and Adaptation Resources

PCC: Prairie Climate Centre

PCIC: Pacific Climate Impacts Consortium

PTSD: Post-traumatic stress disorder

PHAC: Public Health Agency of Canada

TEK: Traditional Ecological Knowledge

WNV: West Nile Virus

Appendix 4

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