

REPORT 2:
HOW CLIMATE CHANGE UNIQUELY IMPACTS
THE PHYSICAL, SOCIAL AND CULTURAL
ASPECTS OF FIRST NATIONS

Prepared for:
The Assembly of First Nations



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The views expressed in this paper are those of the author and not necessarily shared by the Assembly of First Nations

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1.0 BACKGROUND

All people in Canada will be affected to some extent by the impacts associated with climate change such as rising temperatures, changes in precipitation patterns and changes in other weather events (depending on the region). However, it is expected that First Nations will experience the impacts of climate change in ways that most non-Aboriginal Canadians will not, due to a heavy reliance on the environment, their locations, their economic situations. First Nations, similar to other natural-resource dependent communities around the world, depend on the environment for subsistence, maintenance of culture, and other important aspects of their livelihoods. Studies of the developing world have reported that vulnerability and limited capacity to adapt to environmental situations such as climate change have been linked to factors such as a high reliance on natural resources, a limited ability to adapt financially, high poverty, compounding issues (such as ongoing health problems) and a lack of systems of arrangements suitable for dealing with these issues (Thomas and Twyman, 2005). First Nations are also characterized similarly to other developing nations. Therefore, they are also vulnerable to the impacts of climate change.

Throughout history, First Nation peoples have maintained a strong connection with the environment; a connection that is integral to the survival of their physical, social, economic, cultural and spiritual ways of life. Due to this connection, climate change effects will disrupt First Nation people more severely than other citizens. Although there is much diversity among First Nations in terms of language and culture, there is a fundamental recognition between them of the critical importance of a clean and healthy environment. Since their ways of life are so closely tied to the land, they must protect it. Furthermore, it is said that the First Nations assert that they have stewardship responsibilities¹, the role of which has been given to them people by the Creator.

If entire ecosystems change, resulting from climate change, then the current understanding of that system will likely not apply. If First Nations cannot understand the surrounding environment, their role as stewards of the land will be seriously compromised. The following

¹ As implied in "A First Nations - Federal Crown Political Accord on the Recognition and Implementation of First Nation Governments" available as of March 24, 2006 at <http://www.afn.ca/cmslib/general/PolAcc.pdf>.

explains some of the potential physical, social and cultural effects climate change will have on First Nations.

First Nations peoples are observing and experiencing direct impacts of climate change through the loss of traditional foods and medicines, threats to economic opportunities and transportation systems (such as winter roads), damage to homes and other property, and changes to the biological systems around them (e.g. changes to the migratory patterns of animals, insects and birds).

Climate change means more than just changes in weather, and for First Nations, it goes beyond the scientifically studied physical elements of climate change impacts. Given that most First Nations have unique relationships with the land, the impacts of climate change on ecosystems will invariably impact cultural, social, and traditional activities associated with the land as well as the ability to exercise their Aboriginal and treaty rights. The impacts of climate change on First Nations are not quantified, and long term research on First Nations - specific climate change issues is limited. The discussion that follows is an attempt to highlight the issues of climate change so that its effects on First Nations may be discussed within First Nations, Federal and Provincial government departments, institutions, and organisations that currently have an interest in climate change issue.

1.1 RATIONALE FOR PAPER

This report will highlight the impacts of climate change from the perspective of First Nations. It is clear from Report 1 in this series "*An Introduction to the Science of Climate Change and How It Impacts First Nations*", that many facets of First Nation's life will be affected by climate change. These effects include, but are not limited to physical and biological climate and ecosystem processes, the health of ecosystems, the economy and ultimately, the well-being of humans. First Nations and non-Aboriginal peoples in Canada will be exposed to many of the same risks. It is expected, however, that First Nations will face unique challenges as a result of geographic location, reliance on the environment, current limited adaptation capabilities, and the need to protect and preserve Treaty and Aboriginal rights that are adversely affected by climate change.

This report is by no means an exhaustive representation on the subject of climate change and its effects on First Nations. Each of the issues raised in this paper requires further detailed

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analysis. There are many gaps in the current body of research and literature related to the unique impacts of climate change on First Nation people and the mitigation adaptation strategies needed to deal with these unique challenges. This report is intended to raise awareness and to promote discussion between First Nation and non-First Nation stakeholders so that these gaps in knowledge and effective adaptation strategies can be studied and developed for First Nations in Canada. Recommendations on next steps are contained the fifth paper of this series.

Since climate change is a global issue and affects all aspects of the environment and lives of First Nations, the effects discussed herein are not an exhaustive list of all possible effects that could occur due to climate change. A detailed list of possible climate changes and their effects on First Nations is beyond the scope of this report.

2.0 PHYSICAL EFFECTS OF CLIMATE CHANGE ON FIRST NATIONS

As the climate changes, traditional practices, governance, economic development and infrastructure within First Nations will likely be impacted. Warmer winter seasons will impact winter roads, which many First Nations depend on for the transportation of goods and services. Rising sea levels may threaten many First Nations communities in terms of damage to infrastructure and loss of cultural sites. All types of energy production in communities may be threatened because of changes in water flows and changes to the cost of transportation into and out of the community. As well, extreme weather events will impact the quality and quantity of drinking water, level of human health, quality of community infrastructure and even the safety of the community members themselves.

'The livelihood of many Aboriginal and northern residents comes from the land, water and natural resources, and will be compromised as ecosystems and wildlife are affected by climate change over time. In the north, melting permafrost could put buildings, pipelines, roads and other infrastructure at risk. Winter roads to remote Aboriginal communities may no longer be available or available only for shorter periods, thereby increasing the cost of supplying these communities.'
(Government of Canada, 2002)

2.1 EFFECT OF CLIMATE CHANGE ON ACCESS TO NORTHERN COMMUNITIES AND TRANSPORTATION

Effects of Increase in Temperature on Access to Northern Communities

Increased access and security issues are a concern for First Nations living in the Arctic regions of Canada. With a decrease in Arctic sea ice because of warmer temperatures, longer navigation seasons could allow for more shipping routes will be available, and ports, such as the Port of Churchill in Northern Manitoba, will remain open longer. The opening of shipping routes may have major implications for access to natural resources on the traditional lands of First Nations people (ACIA, 2004). Figure 2-1 shows the projected sea-ice retreat and the effects this will have on the Northwest Passage and the Northern Sea Route (ACIA, 2004). For example, conflicts may arise over Treaty and Aboriginal rights to commercially fish and hunt for seal and other marine life. An increase in the number of shipping routes may threaten migration

patterns of birds, mammals, and fish in the north. Safety concerns related to increased ship accessibility include the threat of more oil spills in northern waters.

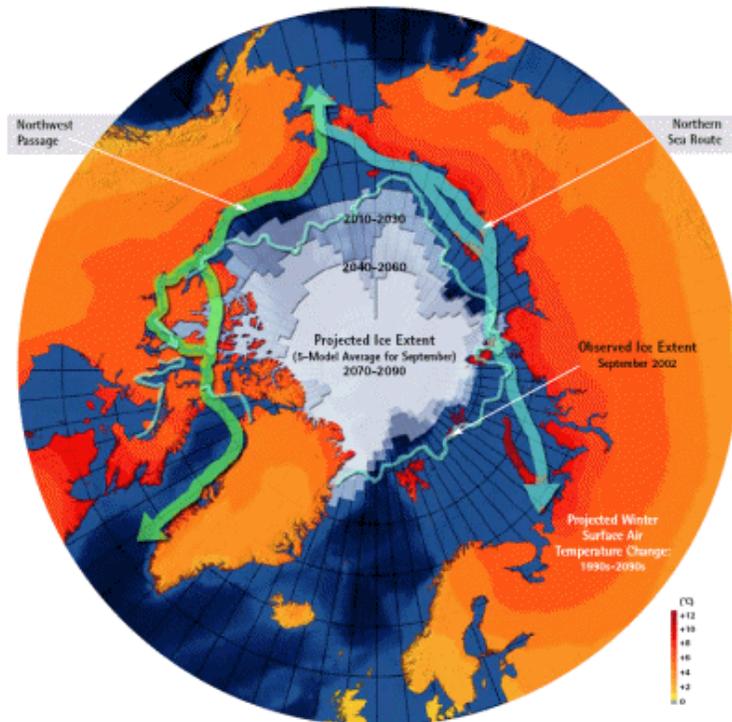


Figure 2-1. Projected retreats in sea ice between 2010-2090 and the effects on shipping routes (source: ACIA, 2004).

Increased accessibility may also make travel into and out of First Nations easier for residents and for the shipment of supplies. Certain First Nations may also benefit from increased tourism as a result of easier access to the communities. However, this may lead to ecosystem impacts if not implemented in an environmentally sustainable manner. As the increases of large groups of tourists travel through this region, the impacts on slow growing plants could include trampling of plant life, compaction of topsoil, increased garbage disposal and introduction of foreign diseases. It may take the ecosystem years or even decades to fully recover.



Port of Churchill

(Source: Omnitrax Website
<http://www.omnitrax.com/portservice.shtml>)

Effects of Increased Temperatures on Transportation

Modern day developments of First Nation people create reliance on cars, airplanes and snowmobiles for their transportation needs. In this regard, they are no differences from non-Aboriginal people. However, there are transportation issues that are unique to First Nations, particularly for isolated First Nations (such as those residents in northern Manitoba and Ontario). Those First Nations are reliant on consistent seasonal and winter road access to transportation of goods and services to and from their communities. In comparison to the ability of non-First Nations to access goods and services, climate changes could increase the transportation challenges already faced by First Nations. The increased cost of transporting these goods and services directly increases the cost of living and decreases the quality of health and life in isolated First Nations. Standard adaptation strategies to address climate change impacts that might be adequate to address non-First Nations issues will not be adequate in First Nations because of the unique adversity of the impacts.

As the climate changes, shorter and potentially milder winter seasons are predicted in different regions of the country.² Changes in winter seasons will have an adverse effect on the construction of winter roads that some First Nations rely on for the transportation of goods and services. Winter roads are used to bring in many of the construction supplies needed new for developments in a community, as well as to bring in fuels and other items that are stockpiled for the summer season. If winter roads are increasingly not an option, alternative methods of transportation, such as transport by air will be required, which is an expensive option for most First Nations. Changes in transportation methods will put greater stresses on already

² Section 4.3.1.2 in the first report of this series – *An Introduction to the Science of Climate Change*.

challenged economic and financial realities faced by many of these communities. The cost of necessities such as food and supplies will increase dramatically, and areas of need, such as housing development may also suffer. This in turn creates fiscal challenges for the First Nations concerned, limiting their opportunities for economic development and imposes an additional burden on federal resources. In addition, reliance on alternative methods of transport, such as aircraft, adds to the problem of climate change (through greenhouse gas emissions) thus further exacerbating the problem.

2.2 EFFECT OF CLIMATE CHANGE ON WATER QUALITY AND QUANTITY

Effects of Increased Temperature on Water Quality

Water quality is an issue that is of great importance to First Nations. Many First Nation people see water as the “the giver of life”. Water is the most important life-sustaining element of this planet, without it, life could not exist. First Nations rely on bodies of water for many purposes such as transportation, drinking water, recreation, harvesting, and agricultural activities. Extreme weather events resulting from climate change, threaten water quality for many First Nations. For example, water quality is affected by changes in precipitation and evaporation rates and by changes in the flow of streams and rivers in and out of a particular watershed³. If water levels decline in lakes and streams, water quality may deteriorate because of the inability to flush out contaminants and nutrient additions from agriculture and wastewater (Cohen et al., 2001). Reduced water quality can have an impact upon the health of a community, surrounding environment and the viability of a business such as farming (which rely on water for crops), fishing and on recreational activities such as swimming.

First Nations located in the Prairies will most likely be affected by changes in water quality due to low flows from decreased glacial melt and less snow cover in the Rockies (C-CIARN, 2006). Lower water levels and higher temperatures in the Prairies will lead to higher nutrient levels in the water and to the proliferation of water-borne diseases². Similarly, First Nations in Ontario, especially those situated close to the Great Lakes will be exposed to water quality issues due to low water levels and higher water temperatures (C-CIARN, 2006). Given the extreme situation facing First Nation water supplies, any impacts of climate change on water quality will be more severely experienced by First Nations than by non-First Nation communities. Additional

³ Section 4.3.2 in the first report of this series – *An Introduction to the Science of Climate Change*

economic pressures on First Nations also add to this problem, because of the serenity of the impacts on First Nations' standard of living

For First Nations situated in low-lying coastal regions such as in the Atlantic Provinces, water quality may be affected by rising sea levels, storm surges, and the intrusion of salt water because of coastal flooding (C-CIARN, 2006). Floodwaters may contaminate fresh water sources, such as wells, reservoirs, and even surface waters. Fresh waters may become inundated with saline seawater and render the fresh water sources unusable. In cases of open area sewage treatment (septic fields, sewage lagoons), an increase in flooding can cause sewage and liquid waste to contaminate water sources, community areas, and the surrounding environment. This raises the risk of the spread of water-borne diseases such as cholera and typhoid. First Nations may need to find alternative secure drinking water sources, increase protection of water sources with dikes, retaining walls or even relocate current facilities (both waste and water) to protect drinking water sources.

Effects of Increase Temperature on Water Quantity

First Nations rely on waters for many purposes such as transportation, drinking water, recreation, fish habitat for food collection, and agricultural activities. If water quantity and quality is a result of predicted climate changes many aspects of First Nations livelihood, health, self-sustainability, economic development and traditional activities will suffer. Alternatively, as global temperatures increase, evaporation rates in oceans are likely to change, leading to increases in regional precipitation levels in Canada⁴. Increased temperatures may also bring extreme weather events that may increase or decrease the time between precipitation events. These changes will result in drought-like conditions for First Nations in vulnerable areas such as the Prairies and the Great Lakes Region. On the other hand, other First Nations, such as those located in the Quebec regions, may experience flooding conditions because of high precipitation level over short periods of time. For instance, in 1996, Saguenay, Quebec received 200 mm of rain in 36 hours, leading to flooding in the region (C-CIARN, 2006). Not all First Nations will experience the same impacts associated with increased or decreased precipitation. As shown in Figure 2-2, there are changes in the precipitation rates across Canada. Although the Figure only shows differences for one month in 2005, it illustrates that at any given time, some areas

⁴ Section 4.3.1.2 in the first report of this series – ‘*An Introduction to the Science of Climate Change*’.

experience above average precipitation rates (which could lead to potential flooding) while other areas experience below average precipitation rates (which could lead to potential drought-like conditions).

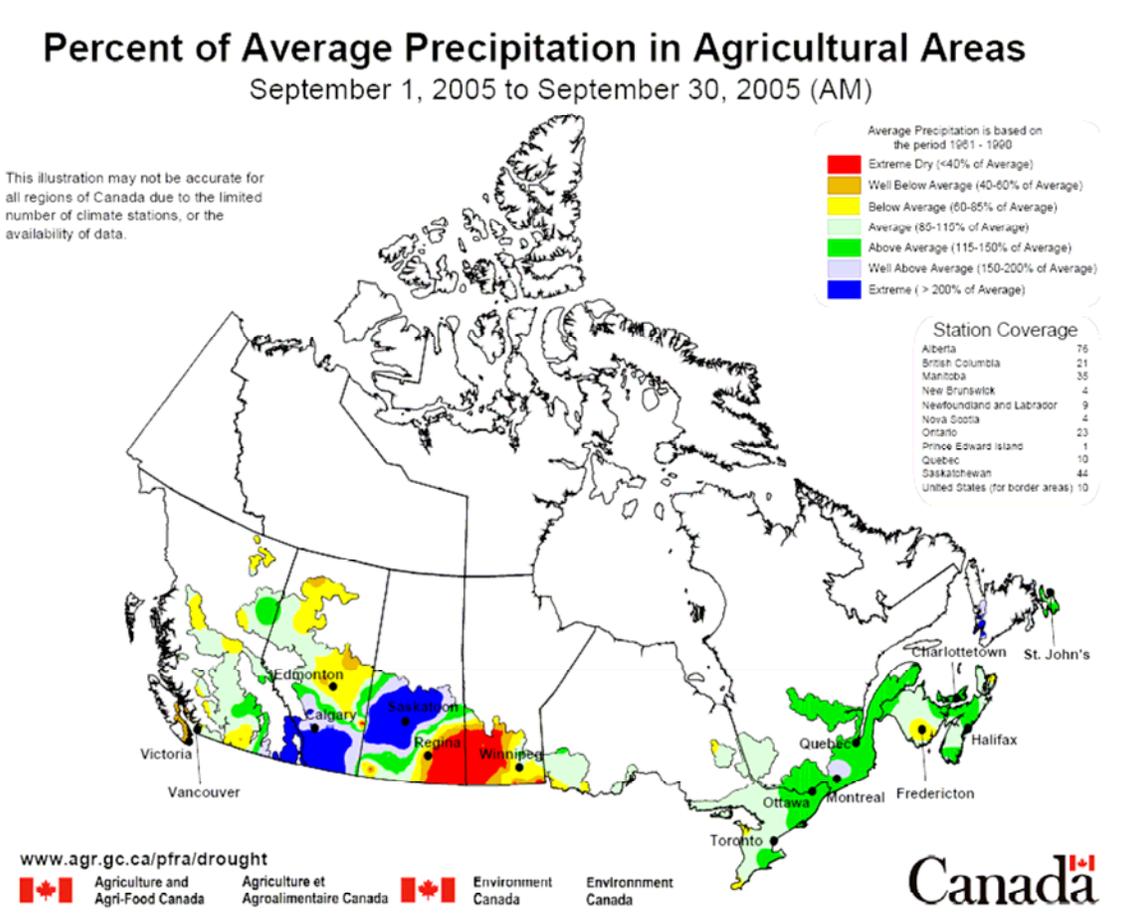


Figure 2-2: Illustration shows the precipitation levels in various regions of Canada (source: Agriculture Canada).

In the face of climate change, droughts can place an increasing demand on water resources in many areas of Canada (such as the Prairies). These drought-like conditions will increase competition for limited water sources further adding to the existing issues affecting First Nations living in these regions. In drought-prone regions, the effect on First Nation’s agricultural activities such as farming and ranching could be extremely damaging. A lack of water can be devastating to the economic viability of a First Nation community. Resulting economic impacts, as a result of climate change will be discussed further in the third paper of this series entitled, ‘How Climate Change Uniquely Impacts First Nation Economies’.

Due to Treaty and Aboriginal Rights issues, many remote and non-mobile First Nations are tied to their traditional territories with no viable option to relocate from these areas, areas that may experience drought or flooding. Mitigation and adaptation measures created by the government for non-First Nations (such as relocation from these drought and flood like regions) will not be adequate for First Nations in the area, largely due to the Treaty and Aboriginal rights issues. These isolated and non-mobile First Nations will be exposed to increased costs associated with accessing water or implementing precautionary flood measures.



Warmer temperatures can influence water levels

(Source: CIER)

2.3 EFFECT OF CLIMATE CHANGE ON ENERGY COST AND USAGE

Many First Nations rely on oil, large-scale hydroelectric power, and nuclear power to meet their energy needs. Many communities located in the south are connected to a large grid system. This grid system is usually fed from a large-scale energy production plant, such as large-scale hydroelectric dams (in Manitoba and Ontario), coal or natural gas (in Alberta and Saskatchewan) or nuclear (in Ontario, Quebec). Climate change will affect the cost of energy in First Nations and the supply of energy to these communities.

In some hydroelectric-dependent First Nation 'on-grid' communities, the production of energy may decrease if water flow levels decrease. If precipitation levels are lower where hydropower production originates, capabilities of production will decrease. This is particularly a concern in potentially drought-prone areas such as the Prairies and in the Great Lakes - St. Lawrence region, where higher evaporation rates due to warmer temperatures would likely lower present water levels² (Mayer 1998; IPCC, 2001). It is also a concern in British Columbia as a result of melting glaciers and decreased snow cover in the Rockies (C-CIARN, 2006). As the amount of energy produced decreases, the need to import energy from other grids increases. This increases costs to receive energy, and would likely add to the financial stress First Nations are currently experiencing.

Other First Nations do not rely on large-scale energy production from hydro, oil, coal, or nuclear sectors. These 'off-grid' communities are usually located in northern isolated regions. The energy produced in these communities is through the burning of diesel fuel, which is often transported into the community from southern locations along winter roads or seasonal barges. The increased costs associated with importing fuel via air travel, resulting from the impacts of climate change on availability of seasonal transportation and winter roads, may again increase the cost of energy for First Nations. Changes to federal funding programs will be required in order to address the increasing pressures on First Nations' financial resources. Alternatively, investments in renewable energy in these communities would have multiple advantages of reducing greenhouse gas emissions while decreasing expensive transportation costs and increasing self-sustainability and economic capacity.

Unstable winter roads increase the cost of importing goods and supplies in isolated communities. Fuel for energy production will increase in price and may put a greater stress on the already difficult economic and financial circumstances faced in many communities.

Climate change predictions indicate warmer summer temperatures, which would increase the use of cooling devices such as fans and air conditioners. This would increase energy demands and would place an unsustainable burden on existing energy supplies in many highly populated areas such as southern Ontario. In times of low energy supply, a reduction of energy use may be required. In First Nations, energy conservation may become mandatory, especially those located near highly populated areas. First Nations may also be affected by low energy supply in drought-prone areas such as in the Prairies and in the Great Lakes - St. Lawrence regions as a result of low water supply. An energy conservation requirement may require community members to endure more variable and unpredictable residential temperatures (with a corresponding effect on human health) in order to ensure energy supplies are available for essential systems, such as hospitals, nursing homes, and food storage areas.

An increase in temperatures and a decrease in use of cooling devices such as fans and air conditioners, can lead to increased exposure and incidents of heat stroke. Alternatively, increased temperatures in winter seasons will decrease energy demands and could reduce energy costs in some communities.

In the event of extreme temperatures, such as heat waves, the elderly and the young are especially vulnerable to the dangers associated with increased temperatures (Health Canada 2001). Extreme temperatures can put people within the community at risk of suffering heat-related problems such as heat strokes and respiratory problems.

In many First Nations, inadequate housing exists. Houses are usually not energy efficient, and many First Nation members experience issues associated with over-crowding. Higher temperatures may intensify already serious health and social issues in First Nations. Given that First Nations are experiencing epidemic levels of certain health issues (diabetes and

tuberculosis), they have less capacity than non-First Nation communities to address these increased health impacts. Any measures intended to minimize these health impacts related to climate change will be insufficient given the already strained First Nation's health care systems.

Predictions indicate a warmer and shorter winter season in some areas of the country. The cost of energy may be lower for some First Nations experiencing warmer winters and the excess money could be used in other programs in the community. Alternative energy such as wind and solar power may also be viable alternatives for many communities.

2.4 EFFECT OF CLIMATE CHANGE ON COMMUNITY INFRASTRUCTURE

An increase in temperature translates into rising sea levels and less sea ice. These conditions can lead to an increase in extreme weather events, such as storm surges and higher wave energy.⁵ As sea levels rise and storm surges increase, coastal erosion also increases, decreasing the traditional territories of many First Nations. Marine geological surveys show that coastal zones have been retreating on average by at least 0.5 m/year for several thousand years (Shaw, 2001). As coastal regions are flooded and eroded, property is lost and coastal infrastructure and community resources are put at risk. In some severe cases, the community itself may need to be relocated to a region less prone to flooding. Community infrastructure and many cultural sites may be at risk of being lost, destroyed or flooded due to a rise in sea levels.



**Water approaching
community home**

(Source: CIER)

First Nation coastal communities can be affected by coastal erosion. Loss of coastal areas may impact community activities such as recreation, fishing, economic development and transportation such as boating, including the implementation of treaty and Aboriginal rights.

⁵ Section 4.3.2.1 in the first report of this series, '*An Introduction to the Science of Climate Change*'

Community infrastructure such as docks and wharfs can be affected as well. Coastal First Nations may suffer decreased economic activity if shipping is limited due to failures of docks and wharfs. Beachfront losses may also affect the community in terms of tourism, real estate or even cultural areas. The loss of cultural areas due to erosion can have an effect on the cultural connection to the land and spiritual identity of the community. Unique impacts of climate change on the protection of Treaty and Aboriginal rights, directly related to the cultural use of lands and resources, may limit First Nations ability to apply and exercise the rights to protect and use their traditional territories.



Lemieux Landslide, South Nation Valley, Ontario, 1993

This type of landslide is caused by melting snow. A change in the amount of winter precipitation as a result of climate change will affect the severity of this type of landslide

(Source: Steve Evans, Terrain Sciences Images Collection – http://sts.gsc.nrcan.gc.ca/clf/tsd_images.asp)

There are significant costs associated with re-engineering community flood protection such as dikes and levies and with rebuilding damaged community buildings or homes. In addition, the financial, social, and cultural costs associated with the relocation of a community are beyond what most First Nations are capable of enduring. The loss of a homeland, the loss of cultural or ceremonial sites, the loss of their identity cannot be solved with an increase in funds. The issues associated coastal flooding and loss of infrastructure may ultimately lead to a loss of cultural and social activities since these are often associated with relationships to the surrounding land.

Climate change may also affect infrastructure in northern First Nations that are located on permafrost. The effects of warmer temperatures on permafrost have been discussed in previous reports.⁶ Some of these affects include slumping and increased incidences of landslides. The melting of permafrost can threaten older buildings, communal roads, transportation routes, water supplies and waste disposal structures in First Nations (C-CIARN, 2006; ACIA, 2004). As permafrost melts, communities will become more susceptible to the impacts of a changing landscape and the cost of adapting and rebuilding community infrastructure can be more than the community can afford. Homes may be lost to melting permafrost as the incidences of landslides and sinkholes increase. First Nations currently have limited access to resources; any impacts will increase pressures on the already insufficient infrastructure funding. In this circumstance, First Nations do not have the capacity of non-First Nation governments to access citizen-based taxation revenue for capital infrastructure monies.

Effects of Climate Change on Housing

Changes in weather patterns such as flooding and wetter seasons due to increased precipitation will affect the stability of soil and permafrost in some areas. These physical changes to the land will affect the construction and sustainability of First Nation houses and infrastructure. There are significant costs associated with re-engineering community infrastructure in the face of change in the land. New construction methods will need to be developed for new homes and community buildings but re-engineering and repair of older buildings is very costly.

The Inter-governmental Panel on Climate Change (IPCC) indicates that the lack of flexibility in most housing where the form, drainage and infrastructure are fixed reduces the capacity to respond to contemporary environmental conditions (IPCC, 2001). In most First Nations, housing is sub-standard and construction is poor and people often live in over-crowded situations (CMHC, 2005). There are also reduced incentives for occupants to maintain and renovate their homes because on-reserve housing ownership status is unclear (CMHC, 2005). The rural living conditions of many First Nation people increases the likelihood that they will feel the impacts of climate change due to variations in the weather. Due to poor economic conditions, complex and inadequate capital programs dealing with housing allocations, infrastructure on many reserves is old and offers limited protection from the environment.

⁶ Section 4.3.3.1 in the first paper in this series, '*An Introduction to the Science of Climate Change*'

Homes in many areas lack effective heating and cooling systems and will be unable to adapt to extreme temperature variability throughout the season.

In many homes, mould is a serious health issue. Moulds are part of a group of microorganisms called fungi that also includes mushrooms and yeasts. Moulds are familiar to most people as food spoilers on items such as bread or fruit. Mould requires the following conditions to grow (CMHC 2005):

- Mould spores (which are always present indoors and outdoors);
- The right temperature range, from 2 to 40 °C;
- A food supply, which means anything organic such as books, carpets, clothing, wood, drywall, etc.; and,
- A moisture source.

In terms of mould in housing, the only controllable issue is moisture. Moisture can enter a home through leakage from outside because of faulty structure or through the production of moisture from occupants in the house. In most First Nations, inadequate ventilation does not allow for the effective removal of moisture produced in the house. In addition, insulation is often poor or non-existent allowing air to be exchanged between the inside and outside. In damp climates, such as coastal regions, this allows dampness to enter the home. In other cases however, this can cause internal moisture to be trapped, which leads to the build up of mould in the house. Human respiration from occupants and humidity from baths, showers and boiling water for cooking only serves to intensify the moisture problem. First Nation homes are currently overcrowded thus exacerbating the problems associated with mould. In fact, according to the most recent census, approximately 12% of houses in the First Nations communities are overcrowded, compared to 1% elsewhere in Canada (Indian and Northern Affairs Canada, 2005).

As the climate changes, First Nation homes are needed that are more effective in energy conservation and provide greater protection against extreme weather events. However, the newer style homes (tighter construction and higher insulation) along with low maintenance schedules tend to exacerbate the mould problem. As homes fall into disrepair or structurally fail due to faulty construction, the issue of mould becomes more serious. Many homes plagued by mould are soon deemed uninhabitable and are condemned. This of course adds to the problem of overcrowding, since now fewer homes are available. As more homes become more

overcrowded, wear and tear on the existing homes is increased, leading to a cycle of poor housing quality for many First Nation community members.

The main concern with mould growth in houses relates to the health problems it can create for residents. Health concerns include respiratory problems such as coughing and wheezing, sneezing, and nose and chest congestion. Moulds can also trigger asthma attacks and can weaken the immune system of those exposed (Health Canada, 2006).

There are limited opportunities for a response to First Nation housing problems associated with climate changes. This is because First Nation housing is subject to complex funding, allocations, and reporting rules that already serve to limit First Nations health and well-being. Mitigation and adaptation measures designed to address climate change impacts to housing will not be applicable in a First Nation's context. Given the already severe housing situation in First Nations this will exacerbate the problem, increasing the cost to already inadequately - funded housing programs.

Effect of Climate Change on Cultural Sites

Cultural sites include areas such as ceremonial sites, spiritual sites, burial areas, medicinal areas and even hunting, fishing and gathering areas. Cultural sites used for spiritual, educational, recreational, and economic purposes are an important part of First Nation identity, spirituality and livelihood. Any effect on cultural sites could impact every aspect of First Nation life, spirituality, and health.

Community infrastructure and many cultural sites may be at risk of being lost, destroyed or flooded due to climate change. Rising sea levels, increased storm surges, increased flooding and unstable landscapes all pose a risk to First Nation traditional practices and cultural sites. A combination of an increase in sea levels and storm surge events may flood, damage, or even permanently destroy coastal cultural sites. Flooding and unstable landscapes may increase the risk to inland cultural sites.

The issues associated with the loss of important cultural sites such as ceremonial grounds, gathering sites or even burial grounds is that in almost all cases these cannot be replaced, rebuilt or relocated. This will have a profound impact on First Nation culture.

Much of the Traditional Knowledge held by First Nation people is attributed to the environment. Elders state that we are part of the land. We received our culture, language and livelihood from the land. These are “gifts” given to us by the creator. If the land changes then we are at risk of losing ‘these gifts’.

There will very likely be unique impacts of climate change on directly related to the cultural use of lands and resources. These impacts may limit First Nations ability to apply and exercise their rights (i.e. implement Treaty and Aboriginal rights) used to protect their traditional and cultural sites. Any measures intended to address these impacts related to climate change within non-First Nation communities context, will not be appropriate or sufficient within First Nations given this ‘rights’ issue.

2.5 EFFECT OF CLIMATE CHANGE ON LANDSCAPES

Effect of Temperature on Land Stability

The arctic and sub arctic regions in Canada are dependant upon the cold climate to maintain many ecosystem functions. An increase in temperature can effect the permafrost foundation of this region. The permafrost layer is a permanently frozen ground layer. Permafrost controls plant communities and biomass production by regulating the moisture content, surface hydrology and temperature of the soil. The permafrost layer is an important function of the northern ecosystem. It is estimated that 50% of Canada’s land mass is comprised of permafrost (Nelson 1989). Figure 2-3 shows current permafrost layers in Canada.

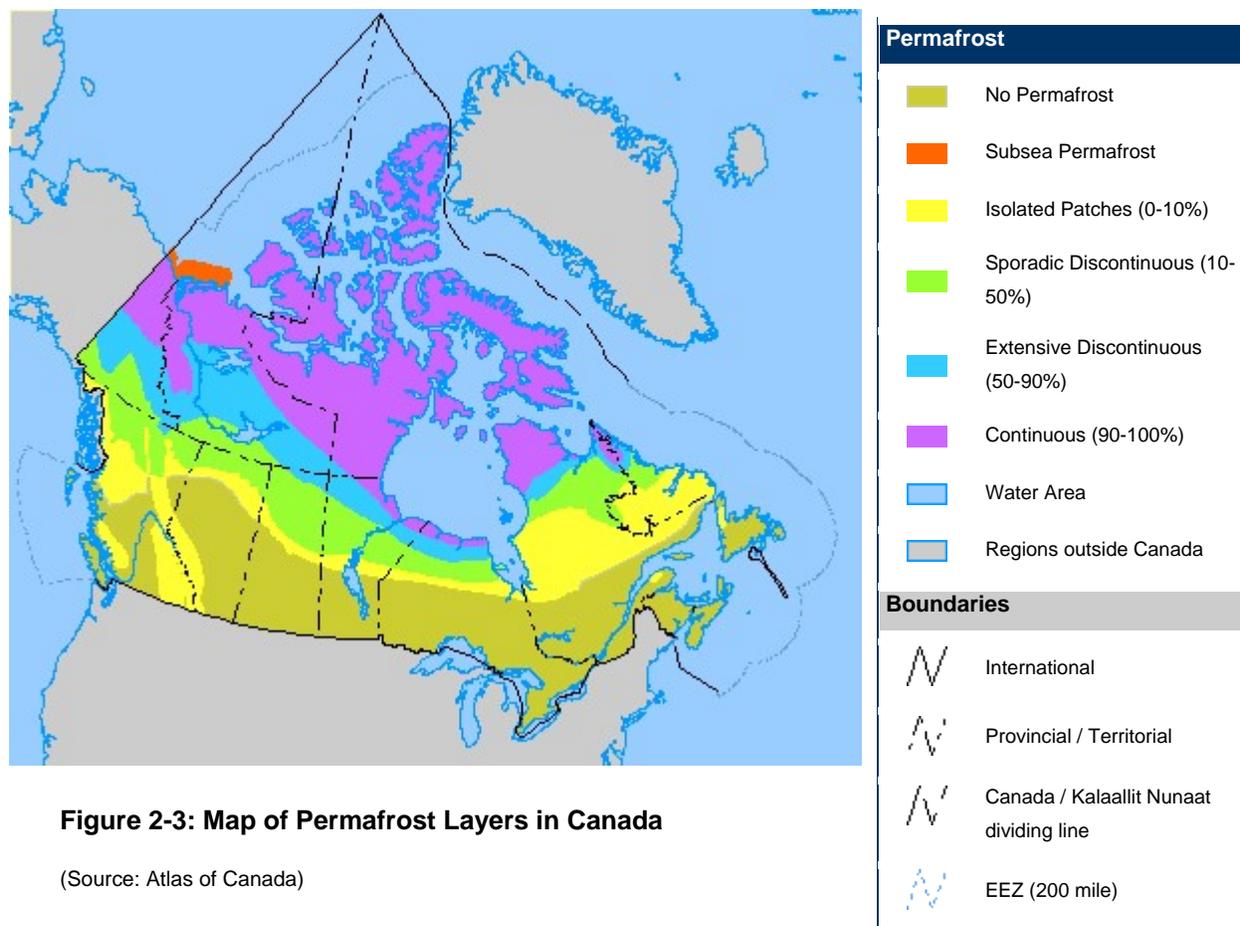


Figure 2-3: Map of Permafrost Layers in Canada

(Source: Atlas of Canada)

Recent data indicates that permafrost is melting (IPCC, 2001).⁷ As the temperature warms, the ground heats to a higher temperature and the seasonal frost layer increases. Permafrost degradation may change the surface hydrology of the region. This is because the permafrost

⁷ Section 4.3.3.1 in the first report of this series, ‘*An Introduction to the Science of Climate Change*’

layer is an impermeable layer and tends to trap water. The severity of melting permafrost will vary amongst regions and flooding or drought may occur, depending on the surrounding drainage patterns. Melting permafrost, in areas of poor drainage can increase the level of water within the soils. As the ground becomes over saturated, surface flora such as trees will begin to die (Jorgenson et al., 2001). Permafrost degradation on well-drained areas will further increase the drainage properties of the area.

This increase in drainage will lead to a decrease in the ground water content of the area. In some areas, the inland lake and rivers that were once held in place by permafrost may drain. Animals may have to travel further to obtain drinking water and community members may have to travel further to engage in traditional activities such as hunting, fishing and gathering. The draining of water may cause flooding and other problems downstream. As water starts to percolate through the ground, it may start to increase the rate of melting of the permafrost layer, which will further exacerbate the problem. As water levels increase in the seasonal frost layer, the ground becomes saturated and unstable. Melting permafrost can cause the ground to shift and slump⁵. As the permafrost melts the overlying surface, soil becomes unstable resulting in landslides and slumping in hilly areas. Sinkholes may develop due to increase groundwater flow and the increase in the depth of the seasonal frost layer.

As discussed in more detail in Section 4.2 below, the melting of permafrost can threaten the structural design of houses, buildings, roads, water supplies, industry pipelines, and waste disposal structures in First Nations. As permafrost melts, First Nations will become more susceptible to the impacts of a changing landscape. Homes and environmental landscapes may be threatened by increased incidences of sinkholes due to slumping.

In areas with developments such as mines, the permafrost layer acts as an impermeable layer for mine tailings and landfill sites. The melting of the permafrost will increase the permeability of the region and can cause contamination to soil and water. First Nations in the area may be impacted by contamination of the soil and/or water, either directly or through increased concentrations of contaminants in the plants and animals relied on by community members for subsistence economies.

Landslides are also of concern because of changes in climate. According to Natural Resources Canada, wetter winters mean less stable slopes and more landslides. The biggest concern with

landslides comes from what is known as 'debris flows', where watery slurries of mud, gravel, and boulders can travel at high speeds down steep slopes during heavy periods of rainfall. These flows will cause damage to infrastructure and will create hazardous situations for residents in the area. Damaging debris flows will become more common if our climate gets wetter with climate change (Natural Resources Canada, 2006). Figure 2-4 shows areas in Canada where landslides have been identified. According the map, First Nations in British Columbia, Alberta, and the Yukon seem to be most at risk for damage due to landslides, although areas in the Prairies, Ontario and Labrador are also at risk.



Figure 2-4. Areas where landslides have been currently identified in Canada (source: Natural Resources Canada, 2006).

Due to Treaty and Aboriginal Rights issues, many First Nations wish to remain, and are tied to their traditional territories. Relocation from these areas as a standard adaptation measure, will be legally and culturally ineffective to address the climate change impacts on these landscapes. These isolated and non-mobile First Nations will be exposed to increased costs associated with structural re-engineering, maintenance, and specialized adaptation needs.

Effects of Temperature on Ice cover

As temperatures increase, the amount of ice cover has started to decrease⁸. A decrease in sea-ice cover would increase the extent and duration of open water. Open water can have an effect on First Nations' travel, personal safety and accessibility to communities and hunting grounds. An increase in open water seasons can have an impact on the traditional way of life for many northern First Nations. Changes in sea-ice cover will likely be the most significant direct impact of climate change on the Arctic coastline (Natural Resource Canada, 2004).

The decline in depth and coverage of sea ice has serious implications for wildlife such as the polar bear, seal and the walrus and for marine hunters who depend on the sea ice as a means to safely hunt these and other animals (Natural Resource Canada, 2004). Open water means that many of the ice dependant game, such as seals and walruses will not be available. First Nations who rely on these animals will need to find alternative game to hunt in order to supply their community needs. In addition, the cohabitation of wildlife and First Nations becomes extremely stress as the surround area of land decreases in size and stability.

Due to the protection and maintenance of Treaty and Aboriginal rights directly related to the cultural use of lands and resources, any impact on cultural uses could have a unique and serious impact on the implementation of their rights – there is the danger that First Nations may lose their rights. Therefore, any standard strategies utilized to minimize impacts of decreased ice cover in non-First Nation communities would be inappropriate to address these impacts in First Nations' territories.

Effect of Temperature on Forest Distribution

Climate change has the potential to greatly influence the future health of Canada's forest ecosystems by changing, not only forest fire, insect, and disease disturbance regimes, but also the overall distribution of forest types, and the productivity of forest resources. These changes will have important implications for the many social, cultural, and economic values First Nations associate with forests.

⁸ Section 4.3.2.4 in first report of this series, '*An Introduction to the Science of Climate Change*'



Forest Fire

(Source: Climate Change Connection
<http://www.climatechangeconnection.org/pages/forests.>)

Under a changing climate, warmer and drier conditions are expected to increase the frequency, duration, and intensity of forest fire outbreaks in many parts of Canada especially in the continental interior (Flannigan et al. 2002). Specifically, increased risks are due to:

- Longer fire seasons;
- An increase in frost-free seasons (Wotton and Flannigan 1993);
- Increased ignitions, due to increases in extreme weather (Price and Rind 1994); and,
- Increased severe fire danger conditions due to increases in the frequency and severity of drought. (Flannigan et al. 2000).

Increased incidences of forest fires would reduce the time it takes for certain species to grow back in some forested regions, resulting in a shift towards younger forests and a decrease in the number of tree and other plant species in the region (C-CIARN, 2006).

In certain regions, defoliation by pests represents the most important factor controlling tree growth. The response of insects to climate change is expected to be rapid, such that even small climatic changes can have a significant impact on the distribution and abundance of certain species. Insects have short life cycles, high mobility, and high reproductive potentials, all of which allow them to quickly exploit new conditions and take advantage of new opportunities. For example, insect pests that are not currently a problem in much of Canada may migrate northward in a warmer climate. Warmer conditions may also shorten the outbreak cycles of species such as the jack pine budworm, resulting in outbreaks that are more frequent.

Warmer conditions will also increase the survival rate of pests like the mountain pine beetle, which are often killed off by very cold weather in the late fall and early spring (Natural Resources Canada, 2004; Stewart et al., 1998). Figure 2-5 shows the intensity of spruce bark beetle infestations in the Yukon between 1994-2002. According to the ACIA, this outbreak represents, '*the most intense outbreak of spruce bark beetle ever to affect Canadian trees*'. Under a changing climate, outbreaks such as this are expected to increase (ACIA, 2004).

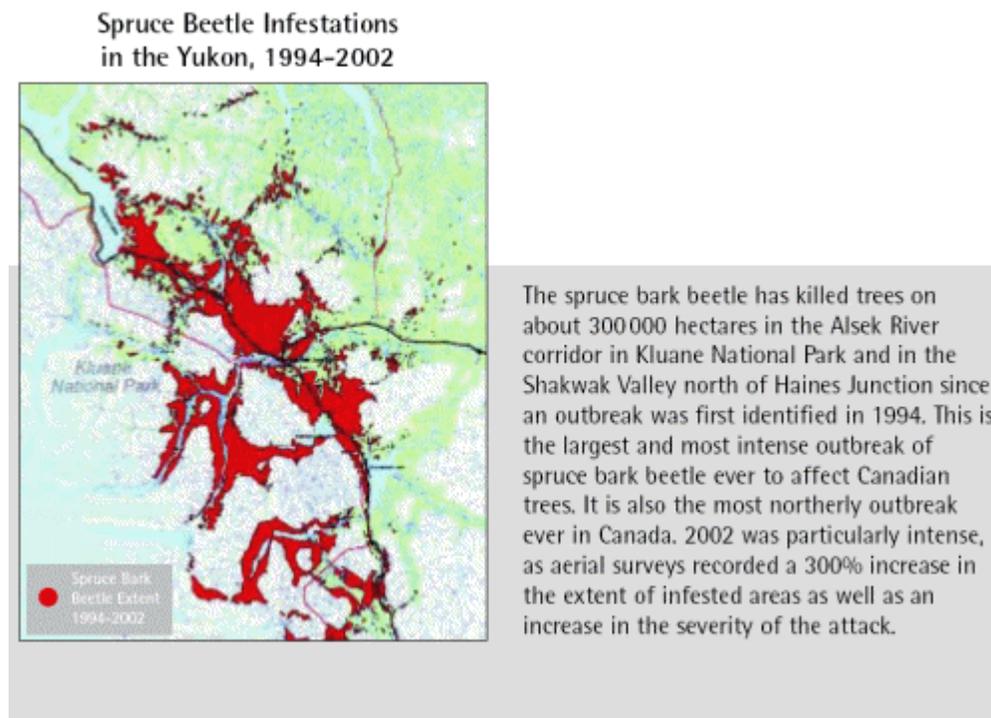


Figure 2-5. Spruce Bark Beetle infestations in the Yukon between 1994-2002 (source: ACIA, 2004).

It is predicted that some tree species will migrate northward and to higher altitudes as the climate warms. The warming of the last 100 years has caused the tree line to shift upslope in the central Canadian Rockies (Natural Resources Canada, 2004). Temperature, however, is not the sole control on species distribution, and temperature changes cannot be considered in isolation. Other factors, including soil characteristics, nutrient availability and disturbance regimes, may prove to be more important than temperature in controlling future ecosystem dynamics (Natural Resource Canada, 2004).

The other possibility is that a northward migration of forest ecosystems will not occur as a result of changes to the climate. Increased temperature has a bigger role in the distribution of southern forest boundaries and grassland ecosystems. As temperature increases and precipitation decreases the moisture content of the soil in the southern regions is predicted to decrease. These areas will become less productive for forest ecosystems and may instead become suitable for the northward migration of grasslands (Environment Canada, 2005). Figure 2-6 shows the projected migration of vegetation ecosystems from present day to when concentrations of carbon dioxide will most likely double (Environment Canada, 2005).

With dryer seasons and reduced moisture, southern forests may experience a reduction in productivity. In forests located in poorly drained soils, such peat, muskegs and bogs, forests may benefit from periods of droughts. Several years of lower water levels in peatland areas showed an increase in productivity rates (Dang and Lieffers 1989).

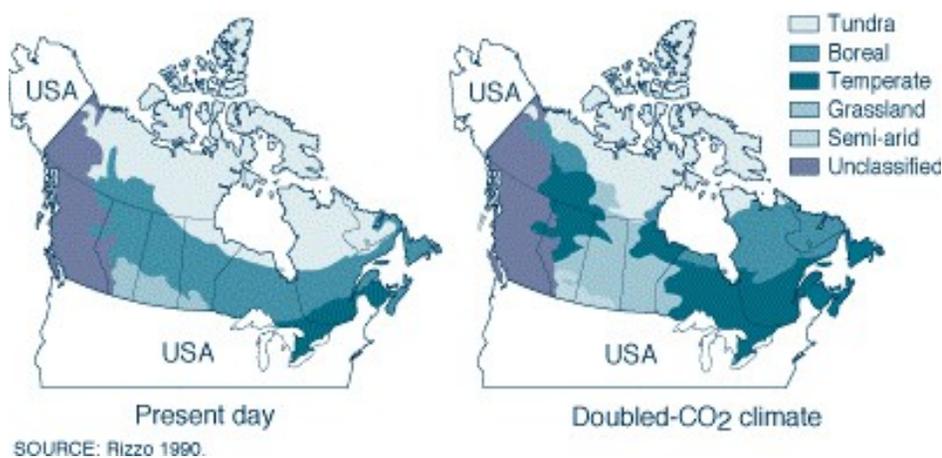


Figure 2-6. Illustration of projected changes in forest and grassland boundaries following an increase in CO₂ concentrations (source: Environment Canada, 2005).

The effects of climate change will not only alter the plant dynamics of the forest ecosystem, but will also have an effect on the animal species in the region. As mentioned in the first report of this series, climate change may affect the distribution, abundance, and diversity of animal species in a variety of ecosystems. Temperature increases may cause the introduction of new animal species or may alter habitats of current species in forested regions. An increase in fires,

pests and a change in the distributions of plant species will only add more pressure on animal species that will rely on forests for their survival.

Approximately 80% of the over 600 First Nations in Canada (over 480 First Nations) are located in the Boreal region (Boreal Forest Network, 2005). The First Nations of the Boreal Forest rely on this ecosystem for their livelihood, their culture, and their homes. The effects of climate change on forested regions in Canada will affect the livelihoods of First Nations who rely on them. Subsistence or income-generating economies relying on forest products may be at risk because of forest loss due to increased forest fires, insects, and diseases. These economies may also be at risk because of changes in species distribution of vegetation species in the forest. Other possibilities exist where First Nations will benefit from increases in forest productivity due to changes in climate. However, positive impacts on the forest economy will only exist in disturbances from insects, fires, and extreme weather events are minimal in these regions. The risks and benefits of climate change to First Nations' economies are discussed further in the third paper in this series.⁹

First Nations have a connection to the surrounding environment that is tied to their culture, their spirituality, their livelihood, and all aspects of their community. Climate change has the potential to impact this connection in terms of changing landscapes, altering ceremonial and medicinal plant and animal species, and by affecting other aspects of the First Nation relationship with the surrounding environment. These impacts will be discussed in other sections of this report.¹⁰

Treaty and Aboriginal rights are directly related to the cultural use of lands and resources; therefore any climate change impact on the regions could have unique and serious consequences on the implementation and application of these rights in First Nations.

Effects of Temperatures on Inland Wetland Areas

Wetlands are areas of shallow waters and upland environments that provide habitats for plants and animals species adapted to life under saturated conditions. Wetlands account for 14% of Canada's total surface area and about 24% of the globe (IPCC, 2001). Climate change can have a great impact on these environments, in terms of structure and function. Wetland species

⁹ The third paper in this series is entitled, '*The Impacts of Climate Change on First Nation Economies*'.

¹⁰ Sections 3.0 and 4.0 of this report.

are very susceptible to small changes in water levels. Changes in water levels can be attributed to the predicted changes in the water cycle.¹¹ Wetlands in general have been predicted to decrease in area and in number as a result of climate change. Climate change can have significant impacts on wetland structure and function, primarily through alterations in hydrology, especially at water table level (IPCC 2004). As water table levels drop due to decreases in precipitation and increases in evaporation, water flows into wetland areas will decrease.

In certain areas, the draining of wetland areas can be seen as a positive effect of climate change. In areas of the northern boreal forests, winter roads are relied upon for the transportation in and out of isolated communities. Muskeg area or bogs are a type of wetland that occurs in these regions. Muskeg is a challenging ecosystem to work in when constructing winter roads, as they do not completely freeze in times of milder weather. In many cases, winter road construction cannot be completed until these regions are frozen. If many of these areas are altered (dry out) then milder temperatures will no longer be an issue for regions with land-based winter roads.

First Nations throughout the country use wetlands as harvesting and cultural sites. Any impact of Treaty and Aboriginal rights related to the cultural use of these wetlands and cultural site could have devastating impacts directly on the First Nations ability to apply and exercise their rights. Any standard mitigation and adaptation strategies that might be adequate to address these climate change effects on wetland areas in non-First Nations, will not be appropriate to protect First Nations interests.

Effect of Extreme Weather Events on Plains and Rangelands

In the plains and rangeland areas of North America, the climate is expected to warm, with an increase in unpredictable weather. As weather changes in these regions, the effects will vary: in many regions, there will be an increase in drought due to the decreased frequency of precipitation events.¹² There is also the possibility that some areas may experience an increase in the frequency in flooding events as the incidence of extreme storms increase¹¹.

¹¹ Section 4.3.2 in the first report of this series, *'An Introduction to the Science of Climate Change'*

¹² Section 4.3.2.2 in the first report of this series, *'An Introduction to the Science of Climate Change'*

In the plains and rangeland areas of the North America region, agriculture is a part of the economy and livelihood of First Nation people, as many First Nation people participate in agricultural activities. Some are involved in large-scale crop production and livestock operation, while other communities are involved in these ventures through the lease of land and resources. There is currently little information on to what extent First Nation agricultural activities contribute to the overall agricultural economy of Canada, however, First Nation operations are at some risk from both drought conditions and increased hazards associated with flooding events. Drought conditions will impact water resources for many types of operations. Alternatively, extreme weather events and increased flooding risks crop damage and causes damage to agricultural infrastructure such as machinery, buildings and livestock (Standing Senate Committee on Agriculture and Forestry, 2003).

2.6 EFFECT OF CLIMATE CHANGE ON SPECIES

As discussed in the previous paper,¹³ ecosystems and biological species will be impacted by climate change. Warmer temperatures will alter habitats, shift distribution areas, and change migration patterns. As habitats change the migration of certain species to new areas may have an effect on established species. For instance, with the introduction of new species, competition for available resources becomes a factor and new species may be able to out-compete established species. Established species may then migrate to find alternative habitats or to become extirpated from an area.

Many of the biological species affected by a warming climate are traditional food sources, medicinal plants, and sacred species to First Nations in Canada. The effects of climate change on these species will affect the health, economy, and livelihood of First Nation people. As species migrate into new areas, traditional foods may become scarce, therefore increasing the reliance on store bought foods. The financial implications of this change in diet are discussed in the next report⁸. The cultural and social implications of this change are discussed in further sections of this report⁹. For example, sacred species may also migrate out of importance areas for First Nations, which may impact First Nation culture and spiritual activities. Species relied on for traditional uses and important to medicines and ceremonies may no longer be available as a

¹³ Sections 4.3.3.4 and 4.4 in the first report of this series, '*An Introduction to the Science of Climate Change*'

result of migration or unsuitable habitats. New species that migrate into these areas cannot be used as replacements without jeopardizing traditional customs or ceremonies.

Effect of Climate Change on Fish

The fisheries industry is important to many First Nations in Canada; fish play an important social and cultural role in First Nations, and there are established Treaty and Aboriginal rights to fish throughout Canada. Therefore, a further discussion of climate change impacts on fish is warranted.

Climate change is expected to have significant effects on fish populations and sustainable harvest levels. Fish have a distinct set of environmental conditions under which they experience optimal growth, reproduction and survival. As conditions change in response to a changing climate, fish may be impacted both directly and indirectly. Climate change may affect water temperatures, water levels, extent of ice cover, and occurrence of extreme weather events. Climate change and its associated impacts will vary across Canada. The effects on fisheries will vary from region to region and from marine to freshwater.

Along the Pacific coast, temperature changes are currently affecting salmon directly, through impacts on growth, survival and reproduction, as well as indirectly, through effects on predator-prey dynamics and habitat. Changes in river flows and extreme climate events have also been shown to affect salmon survival and production (Natural Resource Canada, 2004).

Predictions of a warming trend in marine ecosystems in the Atlantic predict a future warming trend that may impact shellfish populations. Water temperature has been shown to have a strong influence on snow crab reproduction and distribution (Natural Resource Canada, 2004). There is also concern that the frequency and intensity of toxic algal blooms due to changes in temperature may increase, causing detrimental shellfish poisoning (Natural Resources Canada, 2004).

The most significant effects of climate change in Arctic marine ecosystems relates to changes in the extent of sea-ice cover (Natural Resource Canada, 2004). A decrease in sea-ice cover could affect marine productivity, fish distribution and fishing practices (e.g., accessibility to sites, safety), as well as the habitat and survival of several marine mammals.

The impacts of climate change on freshwater fisheries are associated with higher water temperatures, lower water levels, shifts in seasonal ice cover, and the invasion of new and exotic species. Overall, some fish (e.g., warm-water species) would likely benefit, while others (e.g., cold-water species) would suffer. Higher water temperatures have been shown to decrease the growth rate and survival of rainbow trout, yet increase the population sizes of lake sturgeon (Natural Resource Canada, 2004). The northward migration of fish species and local extinctions are expected, which would lead to changes in sustainable harvests. Higher temperatures and lower water levels would also exacerbate water quality problems¹¹, which would increase fish contamination and impair fish health.

There is evidence that marine ecosystems are relatively resilient to changes in the environment, (Kennedy et. al., 2002) and that freshwater fish will adjust their habitat and range to deal with changes in temperature regime (Magnuson, et. al. 1997). However, there are concerns that the rate of climate change may overwhelm the ability of aquatic systems to adapt.

The effects of climate change on aquatic species will not only vary from region to region, but will also depend on the individual fish species as well. For example, species with longer life cycles are usually better able to survive in an environment less favourable for reproduction (Beamish, 2002) whereas species with higher reproductive rates and faster maturity rates are more likely to recover from prolonged population decline (Hutchings, 2002).

The overall effects of climate change on First Nation fisheries operations are challenging from a mitigation and adaptation perspective. In some areas, climate change may decrease the viability of fish populations through the alteration of habitats and biophysical changes to the marine/freshwater environment. In other areas, predictions indicate that there may be increases in the abundance of certain aquatic species.

The overall impact climate change will have on fisheries is still uncertain. Many First Nation communities who rely on fisheries could be greatly affected by changes in fish populations that occur due to climate change. If fish populations migrate to find suitable habitats, the dominant fish species of a region could change. Changes in fish species may result in the collapse of small-scale fisheries operations. If suitable commercial fish species are forced to migrate, fishing industries depending on these commercial species may be threatened. First Nation owned fisheries and the ability to implement Treaty and Aboriginal Rights to fish may also suffer

if climate change affects reproductive levels in fish, which may result in population crashes (Natural Resource Canada, 2004). In certain cases where healthy populations of different fish species migrate into areas suffering from the decline of a particular species, the fisheries sector can likely benefit with changes in the marketing strategies of these new species.

Aquaculture may thrive in the face of climate change. First Nation communities have the opportunity to develop the industry in many regions. With the decrease of natural fish stocks due to climate change and other influences (such as over-harvesting), aquaculture can fill the void left by decreasing fish stocks. The extension of the growing season due to warmer temperatures allows for aquaculture populations to increase. Close-system aquaculture farming would allow fish to be raised in an isolated and controlled environment, allowing for impacts that negatively affect natural populations to be minimized.

The cultural and social value of particular fish species cannot be undervalued as it relates to its inclusion in ceremonies, social gatherings, and the traditional diets of First Nations. A discussion of the value of traditional species can be found in further sections of this report¹⁴.

¹⁴ Sections 3.0 and 4.0 of this report.

3.0 CULTURAL EFFECTS OF CLIMATE CHANGE ON FIRST NATIONS

As for most societies, First Nation social structures are in part built around the traditions of food, spirituality, and medicine. However, for most First Nations, the activities of hunting, fishing, gathering, and the fruits of this labour continue to be important components of their cultures and traditions. Oral history and oral tradition allow common experiences to be shared and passed on through generations. Sharing customary foods through traditional ceremonies strengthens the bonds amongst families and communities.

The loss of opportunities to exercise and experience cultural activities as a result of the impacts of climate change on settlement patterns, sources of food and medicines, or spiritual sites undermines First Nations lifestyles. This adds to the severe pressures already facing First Nations as a result of their reliance on a changing environment and complex social pressures. As the environment changes as a result of climate change, First Nation culture is also forced to change.

3.1 TRADITIONAL KNOWLEDGE (TK) AND CLIMATE CHANGE

Traditional Knowledge (TK) is accumulated over generations and passed on by word of mouth and through direct experience. TK has played an important role in cultural activities and cultural heritage of the First Nations people, and is acquired through many years of observations and experiences and is used in everyday activities. Traditional activities and heritage also feed back into the development of this knowledge base.

As the climate changes so does the understanding of the surrounding environment. If the climate changes too quickly, First Nations may not be able to efficiently integrate these changes. As a result, the applicability of TK to the current understanding of the environment is jeopardized.

TK is an evolving knowledge base as information and observations are always being added. There is an understanding that the environment is always evolving and is not static, therefore TK cannot be considered static. In the face of climate change however, TK is being challenged as a result of the rapid rate at which global temperatures are rising and the effects this has on rapid changes in the environment (IPCC, 2001; ACIA, 2004). The understanding of the

environment as a system may start to be challenged due to the high variability brought about by climate change.

Many First Nations are expressing concern over the changing environment. Many of the traditional ways of life and traditional activities are threatened. Much of the knowledge held by the communities is environmentally-based. Methods of predicting weather and environmental conditions are being threatened. The surrounding environment is changing so rapidly that the evolution of Traditional Knowledge cannot keep up.

As a result of climate change, many traditional activities are under the threat of changing and the knowledge base that has been developed through these activities may no longer hold as much relevance or applicability.

The Importance of TK to First Nations

First Nation people who have close relationships with the land are keen observers of the natural environment due to their reliance on it for economic, cultural, social and subsistence ways of life. Extensive studies have been completed on the extent and intensity of land use by northern First Nations and Inuit people and their knowledge of such aspects as animal behaviour and biology, harvested vegetation species, and ecological relationships (e.g. ACIA, 2004; Watson et al., 2003; Ashford and Castleden, 2001; Moller et al., 2004). Other studies have been completed for First Nations in the southern regions of Canada that have identified similar issues (e.g. Turner et al, 2000; Davidson-Hunt and Berkes, 2003).

First Nations people rely upon a complex set of indicators to illustrate the state and health of the natural environment and to enable them to operate within it (Fenge, 2001). The relationship with the environment and its associated set of indicators is Traditional Knowledge that is passed on through generations. Traditional Knowledge (TK) of the land by Aboriginal people was once dismissed by many experts as anecdotal and unreliable but is now broadly recognized as legitimate, accurate and useful. Federal statutes and international agreements, such as the *1997 Canada Oceans Act*, *Species at Risk Act*, *Canadian Environmental Protection Act, 1999*, *Canadian Environmental Assessment Act*, *Convention on Biological Diversity*, The Arctic Council, The International Arctic Science Committee, *United Nations Framework Convention on*

Climate Change and other United Nations bodies recognize and use TK in reporting and decision making.

Traditional Knowledge observations on changes in distribution, abundance and diversity of biological species help to shed light on the real concerns of climate change for First Nation and other Indigenous peoples. The use of TK in climate change studies helps to identify ecological baselines from oral histories for areas where scientific baselines are not available. Its use also allows for ecological impacts of climate change to be linked with the social and cultural impacts of climate change for First Nations.

First Nations repeatedly offer to share what they know of their environment with the hope and expectation that their observations will assist others to improve humanities engagement within the environment. Passing information and hunting-based skills from one generation to the next provides a partial picture of the past rarely provided by comprehensive scientific monitoring programs (Fenge, 2001). Traditional monitoring methods may be qualitative but they complement science-based approaches because they are founded on observations over long time periods, incorporate large sample sizes, are inexpensive, invite the participation of harvesters as researchers, and they sometimes act as checks for scientifically observed resource and ecosystem change.

Federal and Provincial strategies for adaptation measures for protection and preservation of non-First Nation communities cultural knowledge will be ineffective and insufficient to protecting the Traditional Knowledge of First Nations. The passing of knowledge and teachings from generation to generation in the awake of constant and devastating climate changes, directly impacts First Nation's ability to implement and maintain the protection of their rights on these lands and territories.

The Effects of a Changing Environment on TK

Climate change will bring variability to precipitation levels, temperatures, weather events, and other physical processes associated with ecosystems. This variability in the environment is threatening the predictability of TK for Indigenous people. The observations of the Inuvialuit in

Sachs Harbour summarize the following impacts of climate change on the predictability of the environment (ACIA, 2004):

- It has become difficult to tell when ice is going to break-up on rivers
- Arrival of spring has become unpredictable
- It is difficult to predict weather and storms
- There are 'wrong' winds sometimes
- There is more snow, blowing snow, and whiteouts

The effects of climate change on the predictability of TK in northern and southern First Nations is likely similar to the situation in the Inuvialuit population in Sachs Harbour because of a similar reliance on the environment for many aspects of their livelihoods. For instance, several observations from First Nation people located below the 60° parallel, indicate increased incidences of milder winters, changes in wind and precipitation patterns, less snow in the winter and changes in ice-depth (CIER, 2003), however, more First Nations need to be engaged in this type of discussion in order to identify the whole range of climate change impacts according to First Nations who are currently experiencing the effects of a changing climate.

The unpredictability of TK presents problems for traditional activities, especially for the hunting and harvesting of wildlife and plant species. Hunters are finding it hard to predict ideal hunting conditions or migration patterns of birds and wildlife species (Jolly et al., 2001). The unpredictability of TK also presents safety issues for First Nations people. Traditional Knowledge of ice conditions is becoming less reliable with variable snow and ice conditions, which threatens the safety of fishers and hunters who travel on the ice for harvesting winter food species. Preliminary research on three Inuit communities on James Bay indicate that hunters from these communities take increased risks when travelling on the land, particularly along the coasts, due to changes in the climate (George, 2004). Hunters in these areas are taking different routes to avoid danger but this adaptive strategy may not work over time, as increasing temperatures create more instability on the ice. The same is likely true for First Nations although we located no specific studies on this.

The variability in environmental conditions brought on by climate change threatens the predictability of Traditional Knowledge held by First Nations people about their environment. This threatens their livelihoods and their safety.

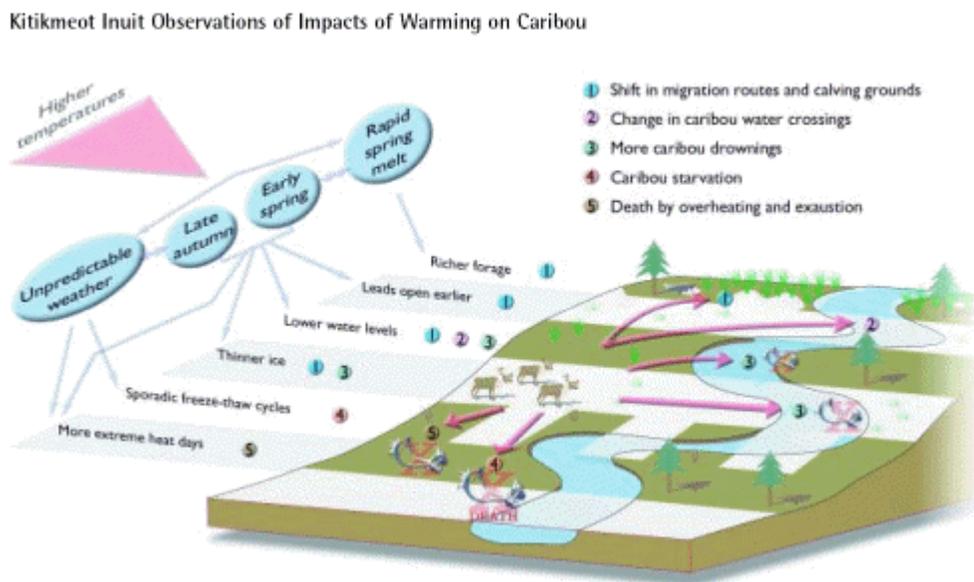
Changes in plant and animal distributions are affecting the Traditional Knowledge and activities that take place in the environment. As the climate changes, there is disruption of natural communities leading to changes in animal and plant distribution. Inuvialuit observations noted that mosquitoes are not native to the north, but are currently appearing in greater numbers, perhaps due to a shift in climate (ACIA, 2004). Inuvialuit observations have also been noted for caribou. For example, Figure 3-1 shows Kitikmeot Inuit observations of the impacts of warming on caribou. Some of these impacts include shifts in migration, more caribou drowning, and higher death rates because of overheating and exhaustion (ACIA, 2004). Perhaps First Nations are experiencing similar changes as shifts towards both southern and northern poles have also been noted for other aquatic and terrestrial species (IPCC, 2001). Similar to Arctic Indigenous peoples, First Nation observations and knowledge about the environment would provide an important source of information to climate change. These observations need to be documented in order to provide the same kinds of information for First Nations as Arctic Indigenous peoples have provided for their environment.

Figure 3-1. Kitikmeot Inuit observations of the impacts of warming on caribou (source: ACIA, 2004).

The impacts of climate change on Traditional Knowledge may effects the relationships First Nations share with the environment. Many traditional activities, practices and predictions based on years of knowledge passed down through generations may no longer be sufficient to ensure the protection and continue of First Nation’s economic, cultural, social and subsistence ways of life.

3.2 EFFECTS OF A CLIMATE CHANGE ON LAND USE AND TRADITIONAL ACTIVITIES

As the environment changes, the activities carried out in that environment will also change. First Nation peoples have a relationship with the land; their livelihood is taken from the land, their culture is derived from the land. A decrease in the amount and type of traditional activities could lead to a decrease in culture. Culture is tied to TK and traditional practices. As traditional practices and customs are forgotten, culture too begins to fade.



There is a threat to First Nation culture as the climate changes. The ways of the land may become no longer sustainable. New methods of hunting, fishing, trapping and gathering will

need to be developed. The teachings associated with the 'old ways' of doing things may be under threat of being lost permanently. Traditional teachings are used to teach younger generations about the environment. These teaching are the basis for the formation of the relationship to the land. First Nation teachings help the young generation develop a respect for the environment and teach them about their environmental stewardship.

Loss of TK as a result of climate change will have implications for biological diversity as well (United Nations Environment Programme (UNEP, 2005). The *Convention on Biological Diversity*¹⁵ is dedicated to the idea that biological diversity¹⁶ is critical for the survival of species. According to the Convention, the cultural and linguistic diversity of Indigenous peoples knowledge, innovations, and practices are also important requirements for the conservation of species. According to the Working Group on Article 8(j)¹⁷ of the Convention,

'Elders throughout North America and Hawaii speak about the changes that they have observed in their lifetimes both to the people and to the land. For example, Indigenous Elders at a meeting in Whitehorse, Canada said the level of TK retention of their generation was around 75% of the forbearers. The Elders estimate that the level of TK retention of the younger generation stood at around 25%. They link the decline of the people to the decline of the diversity of the land. The land is not being used in the same way, people are not gathering traditional foods or medicines, and new plants and animals have been introduced that compete with the existing flora and fauna. Instead of using traditional sources of food, medicine, clothing, and housing materials, Indigenous peoples, either through choice or necessity, increasingly rely on non-traditional items to fill these needs. The change in cultural experiences of the Indigenous peoples has occurred hand in hand with changes in the ways they use the land and the resources of the land. This change has coincided with a decline in the diversity of the land. The parallel between the decline of the global diversity of peoples and the decline of species on which they rely to sustain their unique cultures is apparent.'

Canada is one country of many who are involved in the Convention of Biological Diversity. The participants from Canada recognized the importance of TK to the conservation of biological

¹⁵ The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources. <http://www.biodiv.org/default.shtml>

¹⁶ "Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

¹⁷ Article 8(j): Traditional Knowledge, Innovations, and Practices' - <http://www.biodiv.org/programmes/socio-eco/traditional/default.aspx>

The Gwich'in and the Porcupine Caribou Herd

'Climate-related factors influence the health of the animals and the herd's seasonal and annual distribution and movement. Climate-related factors also affect hunters' access to hunting grounds, for example, through changes in the timing of freeze-up and break-up of river ice and the depth of snow cover' (ACIA, 2004).

diversity and suggest that, *'[t]he key to making decisions that do not adversely affect diversity is a better understanding of ecosystems and how they are affected by human activity. This includes a better understanding of Traditional Knowledge and the role it might play in conservation and sustainable-use efforts' (Canada, 1998).*



Passing on TK to younger generation is an important aspect of First Nation culture.

(Source: CIER)

The effects of climate change on land use and traditional activities directly impact the culture and identity, type and amount of traditional activities of First Nations. As culture is impacted, the ability to protect and maintain their Treaty and Aboriginal Rights related to the use and sustainability of the land is in jeopardy and may be lost over time.

3.2.1 The Effect of Climate Change on Hunting and Gathering

Traditional activities of First Nations will be affected by climate change as a result of the northward shifting of ecosystems or the disappearance of species due to physical changes on the land. For example, the agricultural ecosystem may shift northward due to warmer temperatures in the north. This may lead to economic benefits for First Nations who want to

participate in the agricultural economy. However, wildlife habitat will be threatened as a result of changing ecosystems, which is important for traditional activities such as hunting or for social and cultural activities related to wildlife or their habitats (Cohen, 1997).

As habitats change due to climate change, wildlife patterns will also change. Wildlife species will adapt to the new environment and will change their migration patterns and calving grounds. Communities are not as mobile as they once were long ago. Communities have a difficult time relocating to areas of abundant wildlife. As the surrounding environment changes, for example, if agriculture becomes the dominant sector in the surrounding areas, First Nations may have to alter their cultures and traditional activities to follow suit. Teachings and lessons passed on to younger generations that we once associated with the activities of hunting or gathering may not be passed down. As traditional activities change, the associated teachings may not survive the transitions.



Teachings are passed on from Elder to student through the pursuit of traditional activities.

(Source: CIER)

The traditional activity of collecting these medicinal plants is under threat because of climate change. Vegetation will likely be negatively affected by climate change, as a result of changes in temperature, moisture, insects, disease, and ecosystem shifts. First Nations people may experience the disappearance of local sources of plants, or perhaps even extinction of entire plant species because of climate changes. People in the prairie region of Saskatchewan are noticing that the abundance of sweetgrass, a traditional medicine important to First Nation culture in the regions, is threatened by a changing environment. Elders tell of a time when vast fields of sweetgrass grew abundantly on the prairies. During these times, the Sweetgrass would

grow “waist high” and now only certain areas of sweetgrass can be found and these plants are rarely over “knee high”.

When plant species are threatened, so is the TK associated with the use of those plants. The sharing of Traditional Knowledge and common experiences through medicine, are part of First Nations’ social values and structures. Conservation of sacred ecosystems and plant species is essential to ensure that populations of them remain for the continuation of the Traditional Knowledge and traditional activities associated with them.

Traditional lifestyles are being threatened by other factors besides climate change such as over-exploitation of natural resource-based industries (e.g. forestry), changes in wildlife harvesting opportunities, inability to pass on TK to youth because of the death of elders who possess this knowledge, poverty, and loss of traditional languages. If changes due to a warming climate occur quickly, or are unpredictable, they will intensify the impacts of some of these already existing threats to traditional lifestyles. The impacts of climate change on the environment will leave traditional First Nations in a vulnerable position and traditional activities would be at risk of disappearing (Cohen, 1997).

3.3 THE EFFECT OF CLIMATE CHANGE ON FIRST NATION LANGUAGES

‘Language is generally agreed to be a defining characteristic of culture, a fundamental element of distinction’ (UNEP, 2005)

The loss of Indigenous languages around the world is said to be in a “state of crisis” (Crawford, 1995) and First Nations in Canada are not exempt from this problem. The resulting loss of a traditional language within Aboriginal communities has a significant impact on the livelihoods of aboriginals in Canada (Sachdev, 1998). A loss of Traditional Knowledge about the natural environment is also an important consequence of Indigenous language loss (UNEP, 2005; Tsuji, 1996). In Saanich Inlet, BC, many of the plant species in the region were used for medicines, food sources, technological, and spiritual or ceremonial purposes. The traditional languages of Sencoten and Hul’qumi’num each have corresponding names for all of the plant species in the area and many locations in Saanich Inlet are named after these plant species (Simonsen et al.

1997). Many First Nation languages stem from a relationship to the environment and are passed down through oral traditions through the generations.

As climate changes the environment and in turn traditional activities, there is a threat to the survival of First Nations languages. First Nations languages are associated with action - with traditional activities. Once action and traditional activities decrease, the use of language will also decrease. If traditional activities cease, it is only a matter of time before the language is also lost. A conscious effort is required to save First Nation languages in the face of climate change.

4.0 SOCIAL EFFECTS OF CLIMATE CHANGE ON FIRST NATIONS

Climate change is having an impact on the environmental conditions throughout the world and Canada. The effects of climate change can be seen in all aspects of First Nation lives including physical (infrastructure) aspects, cultural activities and Traditional Knowledge bases, and social effects such as health and safety. The social impacts of climate change are becoming more apparent as the understanding of climate change increases. Climate change will have an effect on traditional diet, and on the health and safety of individual people.

4.1 THE EFFECTS OF CLIMATE CHANGE ON DIETS

Many First Nation communities undertake hunting, fishing, and other resource-based activities for subsistence. Climate change is likely to dramatically alter the abundance and distribution of wildlife, fish, and vegetation. As a result, food supplies and economic livelihoods of many First Nations peoples would be in jeopardy (Last et al., 1998; Weller and Lange, 1999).

First Nations people traditionally consumed a diet that consisted of food that they hunted, fished, trapped and gathered on the land. Traditional food is nutritionally better for First Nation people than non-traditional food and provides protection against diseases. Some First Nations still try to follow a traditional diet, but the effects brought on by climate change threaten this way of life. Climate change will affect the distribution, abundance, behaviour, and structure of animal and plant species in Canada. Changes in traditional food gathering activities will increase the reliance on store bought foods, which are expensive and nutritionally different than traditional foods.

'Besides its nutritional values, the traditional diet is also a source of cultural strength and is critical for the social, mental and spiritual well-being of individuals and communities' (Dickson, 2003).

Diabetes in First Nations is becoming an epidemic and even occurring in children (Public Health Agency, 2006. Website). Diabetes is being attributed to a change in the diet of the First Nation people from a traditional "country foods" diet to a store bought "process foods" diet.

A change in food sources is also associated with a decrease in physical activities, such as hunting, hiking or even recreational activities (such as hockey or soccer), which has led to an increase in health problems. Climate change can decrease the amount and types of traditional activities, and can also have an impact on the amount of recreational activities for youth. In warmer winters, ice may not freeze and therefore skating is not possible. Summer heat and increases in insect migration may affect outdoor activities, by increasing the comfort level of community members but by also exposing them to health risks associated with insect-borne diseases such as West Nile Virus.

The highest number of Type 2 diabetes cases in First Nation children and youth are reported in Manitoba, Saskatchewan and northwestern Ontario. [National Indian & Inuit Community Health Representatives Organization (NIICHRO)]

Climate change can affect the range and distribution of traditional foods; increase the reliance on store bought foods and reduces physical and or traditional activities. As this trend continues it is predicted that illnesses and diseases associated with diet and reduced activities will increase in First Nations.

4.2 CLIMATE CHANGE AND ITS EFFECTS ON HUMAN HEALTH AND SAFETY

Climate change has implications for the health and safety of many First Nations. Most of the health and safety implications of First Nations people have already been alluded to in previous sections. Below are ways that climate change can have an impact on First Nation health and safety. The following discussion is not meant to be an exhaustive list of climate change implications.

Effects on Human Health

Temperatures are predicted to increase in all regions of Canada. An increase in temperature can affect First Nations in many ways. Since many First Nations have substandard housing that offer little to no protection against the heat, summer heat waves are a major concern, especially in regions such as the prairies and Ontario, where summer temperatures are usually higher than the rest of Canada. Increasing intense temperatures in the summer leading to extreme heat

waves and extreme smog conditions may affect the respiratory capability of vulnerable parts of the community, including First Nation youth, seniors, and the sick (Health Canada, 2001; Last et al., 1998). As a result of increasing ultraviolet (UV) radiation levels from the sun, the incidence of skin cancer, cataracts, immune system suppression, viral infections, aging of the skin, sunburn, and other skin disorders may arise in First Nations due to a changing climate (ACIA, 2004). First Nation economic situations also play a key role in increasing temperatures and heat stroke. Many First Nation people are living below the poverty line and cannot afford luxuries such as air conditioning units. A combination of environmental and social/economic issues exacerbate the negative impacts that warmer temperatures could pose (Health Canada, 2001).

Increased precipitation and higher moisture levels in some First Nations will likely increase the incidences of indoor mould. As mentioned earlier, health concerns related to mould include respiratory problems such as coughing and wheezing, sneezing, and nose and chest congestion. Moulds can also trigger asthma attacks and can weaken the immune system of those exposed (Health Canada, 2006).

As a result of warmer winter temperatures, First Nation food security becomes an issue due to winter road transportation issues and to the potential changes in traditional diets as a result of the loss of certain plant or animal species. Additionally, decreases in water quality due to increases or decreases in water flow and increases in sedimentation and contamination related to climate change¹⁸ pose health risks associated with water-borne diseases to First Nation members (Health Canada, 2001).

Effect on Human Safety

As temperatures affect ice cover, safety also becomes an issue. As ice cover becomes unstable or unpredictable, travel over the ice becomes more of a hazard. In times of freeze up or break up, unstable weather patterns can change the length of the season. If hunters travel on the ice too early, dangerous conditions can be encountered, such as open water and thin ice. In times of break up, hunting expeditions can become isolated if temperatures increase too fast and expedite time of break up. Traditional Knowledge about times of freeze up and break up are not as accurate as they once were. Extra care is usually needed when traveling near the

¹⁸ Section 4.3.2 in the first report of this series, '*An Introduction to the Science of Climate Change*'

beginning or end of the winter season but now it is a consideration even in the middle of winter as ice conditions are no longer predictable.

The animals themselves can suffer from longer open water seasons. For example, polar bears need sea ice to launch hunting expeditions for ringed seals, their primary prey, but longer open water seasons restrict the time they can hunt each year. As polar bears are freed to remain on the land longer, they now pose a health risk to coastal communities. If polar bears are stranded on land for longer period of time, the search for food becomes vital. Polar bears may start to look towards coastal communities for food, and this may put people, pets and the community at risk.



Photo credit: TRAVEL MANITOBA

**Polar Bear (Northern
Manitoba) near open
water**

Already mentioned in previous sections of the previous and present reports, the following list summarizes other risks associated with changes to the environment as a result of climate change that may impact human health. These include:

- As the climate changes, traditional practices, governance, economic development and infrastructure within First Nations will be affected. Changing snow ice conditions on lakes, rivers, and on the sea leading to unpredictability and possible drowning or loss of equipment;
- Extreme weather events will impact the quality and quantity of drinking water, level of health, the quality of community infrastructure and even the safety of the community itself.
- Changing local and regional hydrological conditions that may lead to droughts, flooding, landslides driven by increased or decreased rainfall intensity;

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- Changing permafrost conditions that may lead to slumping and variable land stability, which may affect building conditions in First Nations; and,
- The increased incidence of extreme weather events that may cause storm surges and flooding, as well as coastal erosion in coastal First Nations.

5.0 CONCLUSION

6.0 REFERENCES

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