**3.2 Social Injury**

The burning of a large portion of the world’s reserves of fossil fuels has already begun to, and will continue to with increasing severity, inflict great social injury through a number of ecological changes and resultant social outcomes. The characteristics of social injury caused by climate change include:

1. Impacts on agriculture

2. Effects on coastal regions: Maritimes case study

3. Storms, droughts, and other extreme weather events

4. Increased risks to human health

5. Ecosystem collapse: salmon case study

6. Threats to First Nations groups and Indigenous cultures

7. Threats to the infrastructure of cities, including Toronto

8. The threat of abrupt and non-linear adverse climate impacts, arising from positive feedback effects and important thresholds in the climate system.

We briefly elaborate on these points in the following sections, providing empirical evidence of the adverse affects and predicted future risks relevant to these areas posed by climate change and its various impacts.

1. **Impacts on agriculture**

Agriculture is widely considered to be one of the most vulnerable systems to climate change in large part because its productivity is highly dependent on stable climate cycles and weather patterns. Changes in climate that will affect Canadian agricultural production include events such as heat waves and droughts, infestation of pests, and severe storms. As outlined on the Ontario Ministry of Agriculture and Food’s website (<http://www.omafra.gov.on.ca/english/engineer/facts/climatechange.htm>), impacts of climate change include the following:

* increased heat stress on livestock
* increased pest volumes and number of pest species
* modified geographical extent of agricultural production and locational shifts for growth of certain crops
* potential limitations on food processing expansions due to water quality and quantity issues
* financial challenges for rural municipalities exposed to extreme weather events and needing large infrastructure enhancements to cope with such events (bridges, roads, etc.)

Studies exploring economic approaches to dealing with climate change show that adaptation can provide one route to alleviate risks to Canada’s agricultural sector (Amiraslany, 2010). However, extreme weather events, which are predicted to occur with increasing frequency as global temperatures rise (see **Section X**) are significant drivers of yield and impact changes (Isik & Devadoss, 2006) and can therefore disrupt adaptation practices and threaten the health and prosperity of agricultural systems. Indeed, possibilities of extreme weather events are often outside the scope of adaptation policies that outline strategies and recommendations for coping with less acute impacts such as those listed above (see, for example, Malcolm et al., 2012). An example of one such event is the drought that currently covers 56% of the continental United States. Beginning in the spring of 2012, the drought originally affected areas along the plains and western mid-west regions of the country. As the drought continued, the federal government declared most of the central and southern U.S. wheat belt a natural disaster area. By July, the drought had reached such extreme conditions that officials in north-central Oklahoma declared a state of emergency on account of record-low reservoir conditions. Furthermore, the U.S Department of Agriculture (USDA) granted eligibility for low-interest emergency loans to wheat growers in four major wheat-growing states: Kansas, Colorado, Oklahoma and Texas. In early 2013, experts from the National Oceanic and Atmospheric Administration's Climate Prediction Center and the National Drought Mitigation Center at the University of Nebraska-Lincoln predicted that, despite various localized improvements, the drought is set to worsen in general through spring 2013, and will in fact expand to affect areas in California, Texas and Florida (see <http://www.noaanews.noaa.gov/advisories/20130219-advisory-climatewebinar.html>). Moreover, less than average snow accumulation in surrounding areas including the central and southern Rockies, results in a decrease of water flowing from streams and rivers to reservoirs, which adds to concerns about the potential for the drought to increase in scope.

Prolonged heat waves and periods of drought are projected to intensify globally concurrent with accelerating warming of global temperatures caused by the increase of GHG levels in the atmosphere (Intergovernmental Panel on Climate Change 2001).Canada has experienced significant extreme heat and drought events in its recent history. For instance, six wide ranging and severe droughts took place over southern Ontario between 1936 and 1998. Two droughts, one in 1988 and the other ten years later in 1998, were both consistent with predictions in climate change scenarios for the Great Lakes region (Koshida et al., 1999). Despite an overall increase in annual precipitation in the province, frequent extreme weather events and water shortages in numerous other countries around the world will pose serious challenges to Canada’s agricultural production in addition to other social and environmental damages **(see Section X and X of this brief**). Furthermore, the IPCC (2007) reports that climate change will continue to significantly threaten the sustainability of water supplies on a global scale, with water scarcity potentially impacting hundreds of millions of people by the end of the century.

The International Food Policy Research Institute finds that declines in yields of one critical world crop – wheat – will become greater the longer mitigation is delayed. According to its modeling, the decline in yield from the year 2000 is predicted to be between 1.3 and 9 per cent by 2030, 4.2 to 12 per cent by 2050, and 14.3 to 29 per cent by 2080. Up to 2050, climate change’s impact on agriculture might be manageable to some extent. However, as the IFPRI report concludes, “Starting the process of slowing emissions growth today is critical to avoiding a calamitous post-2050 future” (Gray et al., 2010). While adaptation strategies may provide certain methods for dealing with select risks to agricultural production that are directly associated with climate change, mitigation in the form of reducing GHG emissions is essential for ensuring the long-term health and prosperity of the agricultural sector in Canada.

**2. Effects on coastal regions: Maritimes case study**

Across Canada, coastal communities, forests, agriculture, and fisheries are increasingly at risk from climate change (Lemmen & Warren, 2004). A closer look at the potential impacts of changing temperatures to the economic stability of the Maritime provinces illustrates some of these risks in more detail. The 2008 report “From Impacts to Adaptation: Canada in a Changing Climate 2007” provides a detailed analysis of both current and projected effects of climate change to different areas in Canada, including an extensive discussion on effects specific to the Maritimes region. As outlined in this study, predictions suggest that summer temperatures in the Maritimes could rise by more than 3°C by the 2050s and by at least 5°C by the 2080s; scientists also forecast that East Coast winter temperatures could rise by almost the same amount, reaching 4°C before the end of the century. Projected climate-related impacts on the Maritimes include more severe storms as well as warmer seasons, which in turn will lead to earlier frosts and increased land erosion.

These effects interact to have major economic and environmental consequences for the Maritime provinces. For instance, there is general consensus amongst fisheries scientists that the changing climate is going to significantly impact the Canadian fishing industry. The harvesting of wild fish and shellfish, or the raising of these same species in anchored cages, is a major business in many Maritime coastal communities.  However, warmer water temperatures could lead to the migration of various fish species to other areas. Similarly, increased land erosion causes greater amounts of sediment to fall into surrounding waters, which can disrupt the feeding and breeding patterns of many species of fish.

It is difficult for scientists to predict exactly how these types of impacts will affect fish populations, let alone proscribe recommendations for dealing with them, because of the many biological and environmental complexities involved in the life cycles of fish and in the marine ecosystems in which they live. For instance, even a slight rise in water temperature can affect various aspects of a fish’s development and behaviour, such as the survival rates of juveniles, the amount of food a fish eats at a time, the time it begins to migrate, and so on. As a result, it is extremely difficult to assess the level of environmental or economic disruption that might occur as a consequence of large-scale changes to marine environments.

Many Maritime coastal communities such as those along the Bay of Fundy are also at risk due to the melting ice sheets, glaciers, and ice caps that are causing the steady and continuous rising of sea levels across the globe (see Figure 1) (Percy, 2007). Concurrent with rise in water levels, the land around the Bay of Fundy is subsiding by almost a foot every 100 years. Taken together, these two effects could result in the rise of sea level along the Fundy coast of almost two feet by the end of the century. This seemingly insignificant rise could in fact have a devastating effect on many local coastal areas. Firstly, the increase in coastal erosion caused by rising sea levels will affect sensitive regions along the Bay, including vulnerable areas in the northern edges as well as the large low-lying sections of the coast that are already well below sea level and that accommodate roads, railways, businesses, and residential areas. Moreover, the threat of more frequent severe storms poses risks to lands and buildings guarded by the many dykes along the coast, since these structures could prolong flooding by preventing seawater drainage in the increasingly likely case of extreme weather or heavy rainfall events. Taken together, threats to natural resources, increased frequency of extreme weather events, the acceleration of coastal erosion, and the threats to safety and stability of infrastructure due to rising sea levels, could have unparalleled consequences for Maritime communities.

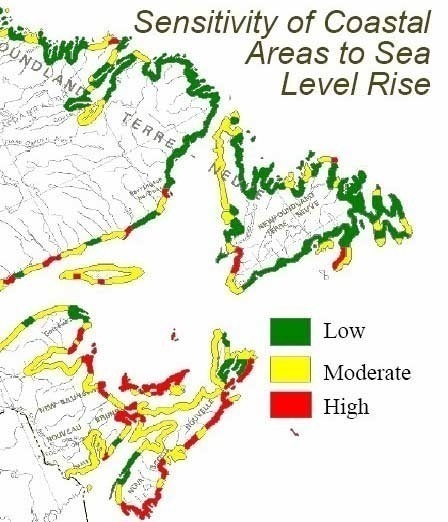


Figure 1. *Many coastal areas in all Maritime provinces are moderately to highly sensitive to the impacts of rising sea levels. (Photo: Gary Lines)*

**3. Storms, droughts, and other extreme weather events**

Figure 2 shows the notable rise in the number of great natural catastrophes that are driven by climate-related events over the past 25 years.[[1]](#footnote-1) For example, over the past 10 years, countries around the world have experienced approximately 785 natural catastrophes per year. During 2010 alone, a total of 950 natural catastrophes took place, nine-tenths of which were weather-related events such floods, hurricanes and storms (Environment Canada, 2010a). Climate change is likely responsible, at least in part, for the rising frequency and severity of extreme weather events, such as floods, storms and droughts, since warmer temperatures tend to produce more violent weather patterns (Environment Canada, ND). The Fourth Assessment Report of the IPCC (2007) asserts that changes in the frequency and intensity of extreme climate events will occur going into the future and will likely challenge human and natural systems to a much greater extent than natural changes in weather conditions. Such events include phenomena such as hurricanes (Knutson & Tuleya, 2004) and other extreme events including tornadoes, severe thunderstorms, and freezing rain events (IPCC, 2001)

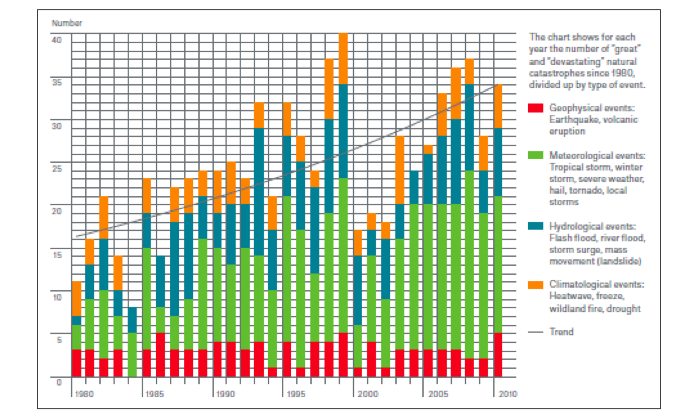


Figure 2. Global trend for great natural catastrophes (as defined by Munich Re) since 1980.

In Canada, temperatures have warmed by an average of 0.24°C per decade, as indicated by data dating from the first official records of temperature conditions in 1948 through to 2010. This figure represents twice the global average, with temperature rises in the far north occurring at rates three times faster. The average national temperature in 2010 reached 3.0°C above normal, making it the hottest year on nationwide records.

As noted in **Section X.**, precipitation levels in Canada have risen during the past half-century, with mean national levels increasing by about 12%. This averages to about 20 more days of rain nation-wide compared with the 1950s. As climate change accelerates, and the rate of warming increases, the conditions for more volatile weather patterns become more common. Trends consistent with projections of climate models show increasing occurrence of extreme weather in Canada that can be traced back into the early 20th century. For instance, **Figure X** shows the increase in weather-related disasters in Canada over 100 years. These are contrasted to the number of geophysical disasters (earthquakes and landslides) that took place over the same time period, which has remained fairly consistent.

With an influx of extreme weather comes mounting costs for dealing with such events. The National Roundtable on the Environment and the Economy (2011) projected that costs associated with climate change could reach between $21 billion and $43 billion a year by the 2050s. Difference in scale relies upon the extent of action taken to reduce GHG emissions as well as other economic and population growth factors. However, predictions in the report extending to 2050 indicate that the impact of warmer weather to Canadian forests and the forestry industry could reach between $2 billion and $17 billion a year, with the Western provinces experiencing the most adverse effects. Flooding and rise of sea levels along Canadian coastal communities could cost between $1 billion and $8 billion a year. Similarly, a report by the Institute for Catastrophic Loss Reduction (ICLR) for the Insurance Bureau of Canada (IBC) outlines trends of insured losses from severe weather and natural catastrophes both internationally and within Canada. The report reveals that financial impacts have ranged from between $10 and $50 billion dollars a year internationally since 2002, and with levels exceeding $100 billion in 2011. Within Canada, property insurance claims resulting from severe weather-related events from 2010-2012 have cost roughly $1B a year. The report outlines a number of specific examples of such claims, including the following examples:

• A severe wind and thunderstorm that took place on in June of 2010 in and around Leamington in Southern Ontario caused approximately $120 million worth of insured losses to both business and residential properties

• Areas in Southern Alberta experienced a similar storm that resulted in excessive damage to private and commercial properties as well as automobiles that totaled over $500 million in losses

As the report details, claims resulting in both severe and smaller-impact weather events represent significant property damage for consumers, with losses driven in large part from aging sewage and water infrastructure that cannot handle the new higher precipitation levels; in fact, a rise in water levels for water-related insurance claims now “surpass[e] fire as the number one cause of home insurance losses in many parts of the country” (p. 7). The report also details projections running through the 2050s of extreme weather events in Canada, including hot days per year, wildfires, hail and ice storms, tornadoes, and heavy rainfall events, and includes recommendations for dealing with the expansion of insurance-related losses nationwide.

Speaking in no uncertain terms about the threat of climate risk to insurers, S. Leurig (2011) states that “This changing climate will profoundly alter insurers’ business landscape, affecting the industry’s ability to price physical perils, creating potentially vast new liabilities and threatening the performance of insurers’ vast investment portfolios”. Indeed, it is becoming increasingly recognized that soaring costs, coupled with the devastation to environments and infrastructure, are associated with severe weather and climate-related factors, and that, as the president of the roundtable David McGloughlin states, “Our report also shows that adapting to climate change makes economic sense. It can lower the costs of climate impacts by preventing damage, saving money and lives … now makes clear that getting global emissions down is both in Canada’s economic and environmental interest.”

**4. Increased risks to human health**

The impact of climate change on human health is no longer a contested issue, with major national and international organizations like the World Health Organization (WHO), Health Canada, the Centre for Disease Control and Prevention (CDC) and others recognizing both its existing impacts and its ongoing risks. The WHO, for example, asserts that “climate change is negatively affecting the health of populations around the world” and acknowledges the increasingly damaging impact of an ever-warmer climate on numerous social and environmental health determinants, including clean air, water, food and shelter (WHO, Climate change and human health, 2013).

The negative effects of climate change on human health can be traced back almost forty years. For example, a 2009 WHO report entitled “Global health risks: Mortality and Burden of Disease Attributable to Selected Major Risks” found that the modest increase in global temperature between 1970-2004 was the cause of over 140,000 deaths per year. A more recent study commissioned by 20 governments around the world estimates that this number has grown to approximately 400,000 climate-related deaths per year, with 100,000 million people at risk of death by the end of the century (Climate Vulnerability Monitor, 2012). The most significant impacts to human health driven by changes in climate are linked to temperature stress, extreme weather, rodent and water-borne diseases, ultraviolet radiation, and air pollution (Human Health in a Changing Climate, 2008).

It is generally accepted that the greatest impacts of ongoing climate change will be felt by people in low-income countries, as regions with weak health or governmental infrastructure will not have the capacity to respond to consequences of climate change appropriately. Particularly hard hit will be children, the elderly, people with illnesses or infirmities, and people with pre-existing medical conditions. As the WHO report details, a number of the fatal diseases already affecting these populations, such as diarrhea and other digestive ailments, malnutrition, and malaria, are “highly climate-sensitive and are expected to worsen as the climate changes”. Indeed, a growing body of literature is drawing attention to the incommensurate impacts of climate change on vulnerable and marginalized populations (Global Forum for Health Research 2010; Costello et al. 2009; Commission on Social Determinants of Health 2008).

In Canada, the relationship of health disparities to climate change impacts and adaptation is a newly emerging area of study, and is discussed briefly in **Section X.** Recent reports predict that hotter city temperatures will lead to between five and 10 additional deaths per 100,000 people per year by 2050 as well as contribute to increasing pressure on Toronto hospitals due to sickness and other heat-related conditions that could swell associated costs to between $3 million to $8 million annually by the 2050s (National Roundtable on the Environment and the Economy, 2011).

**5. Ecosystem collapse: salmon case study**

Myriad examples illustrate the threat that drastic changes in climate pose to delicate ecosystems. The dangers climate change poses to salmon are illustrative for a number of reasons: i.) fish serve as an extension of the discussion relating to threats to Canadian coastal environments described above; ii.) salmon fisheries in particular are significant contributors to the global economy and to the subsistence of large segments of the world’s populations; iii.) salmon play a critical role in the functioning of their marine ecosystems.

An assessment of harvests by Alaska’s Department of Fish and Game in 2007 showed that the salmon fishing industry contributed more than $2 billion to economies in Russia, Japan, the US and Canada and directly employed more than 35,000 people. Salmon are also harvested on a smaller scale, both for recreational and subsistence purposes. Many individuals, communities and small businesses are dependent on salmon to sustain their livelihoods and to provide a significant contribution of their diet. Reliance on salmon fisheries as both a source of food and income is especially important to communities along Canada’s Atlantic and Pacific coasts.

The International Union for the Conservation of Nature (IUCN) issued a report in 2009 responding to the need to study more closely the complex risks associated with climate change to delicate ecosystems and the species that inhabit them. The report, entitled, “Red List of Threatened Species: More Than Just the Polar Bear. Species Survival Commission” includes a detailed discussion about the problems that increasing global temperatures will pose to the safety of the world’s salmon populations. For instance, with respect to the role of this species to their natural environment, salmon provide food for a suite of predators and scavengers that live along the coasts of the ocean and beside the banks of streams and rivers that they traverse as part of their extensive migratory routes. Animals such as seals, whales, otters, bears, birds and many invertebrates feed on salmon, many at critical stages in their own yearly feeding cycles, as a vital source of protein and fat. Furthermore, throughout a salmon’s life cycle, it will transport essential nutrients from saltwater to freshwater areas as well as to the surrounding lands via the excretion of waste as well as through the decay of carcasses.

Increases in water temperatures concurrent with rises in global air temperatures impose a number of negative effects on salmon. Direct biological impacts include increased physiological stress, susceptibility and exposure to disease, and challenges and disruptions to breeding. These effects on the biology of salmon may potentially lead to impacts in the long-term. For example, because the development of salmon relies on water temperature, warmer waters could result in early migration of juvenile fish. Because natural patterns are timed with other important feeding phenomena such as planktonic blooms, early migrations could mean an insufficient source of food for salmon entering the oceans at a critical point in their development. Similarly, flows of warm freshwater can create thermal barriers to migrating salmon, requiring additional energy to navigate. Such barriers can also delay or even prevent spawning altogether. Moreover, increased winter flows can damage river beds, as well as the nests of salmon eggs dug into the sediment and gravel.

Warmer ocean temperatures have also been shown to reduce the abundance of other smaller fish into certain areas experiencing an influx of new warmer waters. Because the interaction of the multitude of biological factors that play a role in maintaining the balance of healthy ecosystems, scientists are hard-pressed to forecast specific predictions, let alone detail recommendations for large-scale strategies to deal with potential climate-related threats to salmon, as well as for the increasing range of at-risk species. Acceleration of climate change will exacerbate these difficulties, and can have profound environmental as well as economic impacts. The only sure means of maintaining the health of terrestrial and aquatic ecosystems is to significantly mitigate the release of greenhouse gas emissions into the atmosphere.

**6. Threats to First Nations groups and Indigenous cultures -**

Climate change threats to northern Canadian provinces, as well as the Aboriginal communities that live there, are becoming increasingly recognized. For example, Health Canada’s recently published national assessment “From Impacts to Adaptation: Canada in a Changing Climate 2007” states explicitly that “resource-dependent and Aboriginal communities are particularly vulnerable to climate changes,” and emphasizes that “vulnerability” to climate change risk is “magnified in the Arctic.” Similarly, the Arctic Council and the International Arctic Science Committee (IASC) issued a report in 2004 entitled the “Arctic Climate Impact Assessment” that aimed to synthesize knowledge on climate variability and to assess and predict the impact of climate change on Arctic regions and communities going into the future. The report contains contributions from over 300 scientists, professionals, and Aboriginal community leaders and reveals that future climate change could be devastating for numerous Inuit communities.

These findings are supported by a more recent study conducted by researchers from McGill University that focused on two separate Inuit communities (see Smith et al., 2007). As described in the study, researchers assert that “climatic conditions which currently pose risks are expected to be negatively affected by future climate change”, and indicate that “young Inuit and those without access to economic resources, in particular, are vulnerable” (Ford, Smit, Wandel, Allurut, Shappa, Ittusarjuats & Qrunnuts, 2008). Other sections of this brief address the issue of First Nations vulnerability to climate change impacts (**see Sections X and X.)**

**7. Threats to the infrastructure of cities, including Toronto.**

Today, more than half the world’s population live in cities and urban areas. As a first step towards addressing climate change, many cities have conducted assessments of their GHG emissions. In Canada, over 200 municipalities are taking part in the Partners for Climate Protection (PCP) program, which is the Canadian component of ICLEI’s Cities for Climate Protection (CCP) network. The Province of Ontario and the City of Toronto are among those actively implementing numerous plans and initiatives to reduce GHG emissions. The first attempt on behalf of the City to assess GHG levels came in 2004(IFC International, 2007). Follow-up reports detailing strategies for reducing emissions were published soon after (ICF International, 2007; Clean Air Partnership, 2009). Additionally, there is a growing body of literature that examines current trends and anticipated affects of climate change to Toronto and surrounding areas (e.g.Toronto Environment Office 2008; Wieditz & Penney, 2006; MacLoed, 2010).

It is now generally recognized that impacts of climate change are already being felt in Toronto and the GTA. As identified in a 2008 report commissioned by the City, Toronto has experienced extreme heat, floods, droughts, new insect pests, new vector-borne diseases and other problems worsened by climate change (Toronto Environment Office, 2008). In terms of fluctuations to regular weather patterns, Toronto has seen an average temperature increase of 2.7°C since the late 1800s (Wieditz & Penney, 2006). Record high temperatures, accompanied by smoggier skies, have also been recorded in recent summer seasons. For instance, 2005 saw the warmest June on record; 37 days had a maximum temperature greater than 30°C (more than double the average from 1971-2000); humidex values exceeded 35 more than 44 times; and 48 smog days were declared, the highest number on record. While precipitation patterns have not undergone such drastic changes (Wieditz & Penney 2006), it has been predicted that precipitation will likely arrive during heavy rainfall events. For instance, snowfall will decrease and rainfall will increase in its stead, accompanied by an influx of freezing rain episodes (Toronto Environment Office, 2008) and ice-storms (Cheng, et al., 2007). More freeze-thaw cycles in the City are also projected, which take a heavy toll on roads as well as urban green spaces (Toronto Environment Office, 2008).

*Increased Financial Burdens on the City*

High density cities such as Toronto are particularly susceptible to damage caused by extreme weather or natural disasters. Extreme weather events occurring as a consequence of climate change can also be extremely costly for municipalities that have to deal with the consequences and clean-up. For example, the intense storm that took place in the City on August 19, 2005 caused millions of dollars of damage. This storm’s heavy rainfall washed out a part of Finch Avenue, and caused flash flooding and widespread damage across the City. Parks and Recreation spent $12.5 million restoring damaged trees and urban parks. $600,000 was spent by Urban Forestry Services to clear fallen trees. Likewise, Transportation Services spent close to $5 million repairing Finch Avenue. The total damage, including public and private property, was estimated at approximately $547 million – the most expensive storm in Toronto’s history (MacLeod, 2010).

More frequent storms and severe weather will most certainly continue to cause damage to City infrastructure and put a strain on City resources. Indeed, the floods, storms, droughts and other weather-related phenomena that already occur annually in Canada can cost hundreds of millions, or even billions, of dollars (Health Canada, 2008, with reference to Public Safety and Emergency Preparedness Canada 2005). Furthermore, recent events such as Superstorm Sandy have revealed that even developed countries can be devastated by extreme weather events that are difficult to prepare for and which are unprecedented in terms of strength and geographic scope.

*Increased Health Risks to Vulnerable Populations*

While severe storms and extreme weather can be very costly, the longer-term impacts of climate change will have an adverse affect on the City and its residents in ways that “[go] well beyond the reported monetary costs” (Clean Air Partnership, 2006, p. 19).It is widely documented that certain populations in a particular city are more vulnerable to the adverse affects of climate change than others (Ebi 2009; McKeown et al. 2008;Marmot 2007; Public Health Agency of Canada, 2005). “Vulnerability” in this sense can be described as “the degree to which individuals and systems are susceptible to or unable to cope with the adverse effects of climate change” (Clean Air Partnership, 2006, p. 6). Determinants of health, such as income and social status, education and literacy, social and physical environments, or genetics, etc., can be used to assess a population’s vulnerability to the various impacts of climate change. For example, severe storm events can affect physical environments by causing extensive property damage; challenges linked with income and social status can be reinforced as those with inadequate employment or insufficient funds could have more difficulty acquiring financial resources to repair property, deal with displacement, or finance interim accommodation. Populations that are particularly vulnerable to climate change impacts in the City of Toronto, include the following: infants and babies, women, the elderly, those with preexisting or underlying conditions, first nations, those whose livelihood is reliant on natural resources, and those with low SES standings (The Clean Air Partnership, 2009; Health Canada, 2005; 2008).

The current and forecasted future makeup of the City of Toronto is one that is both highly diverse and increasingly expanding; indeed, the population of the Greater Toronto Area is estimated to reach 9.2 million by 2036 (Ontario Ministry of Finance, 2009). Toronto’s swelling population encompasses a number of the vulnerable populations identified above. For instance, according to Statistics Canada, the First Nations population of the city grew 20% from 2001, reaching a total of 13,605 people as of 2006. This figure represents over 0.5% of the total population in the City, and 43% of the First Nations population in the Greater Toronto Area (GTA). Moreover, Statistics Canada reports that the City of Toronto was home to over 350,000 seniors in 2006. This number constitutes 14% of the City’s population, and 53% of all seniors living in the GTA. The City’s Social Development, Finance and Administrative Division forecasts that seniors will make up 17% of the City of Toronto population by 2031. Finally, an increasing number of Torontonians are low-income. For instance, in 2005 there were 134,247 family households and 165,156 persons not living in family households that reported before-tax income levels below Statistics Canada’s Low Income Cut-off (LICO) in 2005. The size of the low-income population recorded in 2005 was greater than in the early 1990s, and represents almost double the size as in the rest of the GTA, Ontario and Canada. Literature on health equity in a Canadian context focus show a direct relationship between health and income (e.g. McKeown et al. 2008; Lightman et al. 2008; Raphael 2002). For instance, a recent study by McKeown et al. (2008) shows that people living in low SES areas in Toronto experience increased risk factors for illness, higher occurrence of disease, and early mortality than people who reside in more affluent areas. Such risks will most certainly be aggravated by the impacts of climate change on the City. Similarly, a Waterloo-based study exploring the connection between effects of climate change and the homeless population found that exposure to extreme weather was high for this segment of the population; furthermore, exposure exacerbated pre-existing illnesses such as drug and alcohol addictions, mental illness, cardiovascular and respiratory conditions, as well as feelings of isolation and increased stress (Wandel et al., 2010).

A more comprehensive examination of the various ways that the City of Toronto will suffer social, economic, and environmental injury as a direct result of climate change can be found in the Clean Air Partnership Report (2009), *Climate Change Adaptation and Health Equity*, including details about the affect of impacts on Toronto’s water supply and water quality, energy sources, transportation sector and services, buildings and infrastructure, urban ecosystem, tourism, and economy.

**8. The threat of abrupt and non-linear adverse climate impacts, arising from positive feedback effects and important thresholds in the climate system.**

The Arctic has been called the “canary in the climate coal mine”, as it is a focal point for some of the most severe and profound impacts of climate change to date.

**MORE NEEDED**

***-Info to Supplement Section which discusses Ontario and Quebec Acts:***

According to the 2009 report “Adapting to Climate Change in Ontario: Towards the Design and Implementation of a Strategy and Action Plan” produced by the Expert Panel on Climate Change Adaptation, predictions for Ontario show an increase in annual average temperature of 2.5°C to 3.7°C by 2050, compared to mean levels from 1961-1990 (Expert Panel on Climate Change Adaptation 2009). These projections are based on moderate assumptions about greenhouse gas reductions; however, estimates based on high emissions scenarios may be more realistic, and predict the a rise of temperature as high as 4.0°C or more annually by 2050. As outlined on the Ministry of the Environment’s website, the province of Ontario has laid plans based on its 2007 Climate Change Action Plan, to reduce its GHG emissions to “6%t below 1990 levels by 2014; 15% below 1990 levels by 2020; and 80% below 1990 levels by 2050”. As stated on the Ministry website, “All sectors of Ontario society must contribute to lowering our GHG emissions, including the agricultural industry, food processors and rural communities”.

**-ADDITIONAL INFO?**

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1. According to Munich Re, weather-related hazards can be described as a “great natural catastrophes” if it results in any one or a combination of the following attributes: i) number of fatalities exceeds 2,000; ii) number of homeless exceeds 200,000; iii) the country’s Gross Domestic Product (GDP) severely declines; and/or iv) the country is dependent on international aid (also see Environment Canada, 2011b). [↑](#footnote-ref-1)