Keeyask Generation Project

Environmental Impact Statement

Supporting Volume

Socio-Economic Environment, Resource Use and Heritage Resources

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KEEYASK
Hydropower Limited Partnership

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SECTION 5

PERSONAL, FAMILY AND COMMUNITY LIFE

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5.0 PERSONAL, FAMILY AND COMMUNITY LIFE

5.1 INTRODUCTION

This section examines the effects of the Project on personal, family and community life. Personal, family and community life plays a central role in the quality of life that people experience. This section responds to Sections 8.3 (Existing Environment) and 9 (Environmental Effects Assessment) of the Final EIS Guidelines for the Project, as issued by the Canadian Environmental Assessment Agency in March 2012.

The following Valued Environmental Components (VEC) are assessed in this section:

- Community governance, goals and plans;
- Community health;
- Mercury and human health;
- Public safety and worker interaction;
- Travel, access and safety;
- Culture and spirituality; and
- The way the landscape looks (aesthetics).

Many of these VECs are closely linked to each other and to other VECs in the Socio-economic supporting volume (SE SV). The dynamic nature of personal, family and community life is difficult to illustrate, however it is recognized that physical, ecological, social and economic factors play an important role in shaping these important contributors to quality of life. As Lawrence (2004) notes in the CEAA's Research and Development Monograph Series the *Significance of Social and Economic Impacts in Environmental Assessment*:

> Context is dynamic. Historical, current, likely and desired future social, cultural and economic characteristics and interaction patterns among people and between people and the physical (both natural and built) and ecological environments all need to be taken into account. Context operates at multiple levels. Contextual interpretations from multiple perspectives are essential.
>
> Social impacts can be physical (as experienced) and/or psychological (as perceived). Sometime proponents "play down" community perceptions of potentially significant impacts. Often those perceptions, once investigated, turn out to be "real", both because perceptions affect behaviour and because community knowledge of impact likelihood and magnitude is frequently underestimated (Lawrence 2004).

This is particularly true in relation to personal, family and community life as people's perspectives about current circumstances and possibilities for the future are a key consideration.

There are a multitude of approaches to assess the factors that contribute to or detract from people's quality of life. The common elements to most approaches include consideration of economic well-being (*e.g.*, employment and income to meet the basic needs of food, shelter, clothing, *etc.*), physical well-being (*e.g.*, personal health and safety), social well-being (*e.g.*, family stability and social supports), and the environment. The latter is particularly relevant to Aboriginal people who have been engaging in activities on the landscape such as hunting, trapping and fishing for traditional and domestic purposes throughout their history and who have strong relationships to the environment. The CNP Keeyask Environmental Evaluation Report notes "The customs, practices and traditions that are integral to our distinctive cultural identity and that are reflected in our social organizations are rooted in our relationships with Mother Earth."

This section recognizes that the additive effects of the Project have the potential to influence personal, family and community life. These effects are difficult to predict as they may vary considerably from the individual, to the family or to the community level. Such effects are equally difficult to describe succinctly as they may be experienced differently by different people. "Context is composed of multiple elements (*e.g.*, spatial, temporal, cultural, ecological, social, economic, institutional)" writes Lawrence (2003), and "what is important is highly dependent on a project and community characteristics." Context considers a community's "history, culture, social structure, patterns of life, access to resources, community control and cohesion, and values and perspectives" (Dale and Lane 1994; Harrison and Thomas 2003; Ross 1990; as quoted in Lawrence 2004). While the immediate effects of the Project may be described, the interactions between all of these effects and how they are experienced by individuals, families and communities are more challenging to characterize and at times impossible to predict with accuracy.

An important element of context for this section is the Cree worldview (see Chapter 2 of the EIS) that shapes the perceptions and experiences of the KCNs whose personal, family and community life will be most affected by the Project. The Cree worldview considers all components of the environment, both natural and socio-cultural as related and having the capacity to affect all levels of an ecosystem, temporally and spatially. Therefore, it is difficult for First Nation people to turn away from the historical events that have changed their lives and focus on events that may change their lives in the future. In considering the potential Project-interactions with personal, family and community life, it is important to acknowledge that the Aboriginal worldview differs from a technical perspective.

As the CNP note:

> Every culture is defined by its worldview. It is the lens through which someone sees and interprets the world. It is a set of fundamental beliefs that are so internalized as to go largely unnoticed and unquestioned – so much a part of everyday life as to be virtually invisible" (CNP Keeyask Environmental Evaluation Report).

CNP describe their worldview in saying:

> As a people, we are inseparable from our relationships with Mother Earth – relationships that have developed over thousands of years. This is the foundation of our worldview and is integral to our survival. Our relationships with Mother Earth are the basis of our language, history and spirituality – cumulatively, our culture (CNP Keeyask Environmental Evaluation Report).

YFFN worldview is reflected in "the things we do and why we do them. They are our beliefs and what we were taught when growing up" (YFFN Evaluation Report (*Kipekiskwaywinan*)). These things are grounded in their relationship with *Askiy*:

> *Askiy* is the whole of the land, water, people, plants, animals and all things. We are part of **Askiy** and we have relied on *Askiy* since we have existed. We respect Askiy and we are affected by even the smallest changes to *Askiy*. *Askiy* is beyond value (YFFN Evaluation Report (*Kipekiskwaywinan*)).

and in *Kiskinohamakaywina* (teachings):

> Cree teachings have been handed down through the generations, and continue to be passed on today. These teachings embody the values of our ancestors and today's Elders giving us daily guidance (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Important to FLCN's worldview:

> Embedded within *Ininewak* society is a philosophy referred to as *mino pimatisiwin*. *Mino pimatisiwin*, which is the overall health of a people and *Askiy*, is a fundamental *Ininewak* value. Human well-being is dependent upon the well-being of *Askiy*, including our perceptions of the well-being of *Askiy*. It is our responsibility to care for and nurture the well-being of *Askiy*, so that it can provide for the future *Inninuwak* (Chapter 2 of the EIS).

The KCNs respective experiences with past hydroelectric development have historically been at odds with their worldviews. CNP describes this in saying:

> Of all the changes imposed from the outside, the dams and diversions brought about the largest changes… Although we have adapted somewhat, and survived, our culture has been seriously damaged by these projects, as they have reduced our ability to sustain our cultural identity through traditional activities (CNP Keeyask Environmental Evaluation Report).

For greater detail on the KCNs' worldview, see Chapter 2 of the Response to EIS Guidelines.

The KCNs' experience with past hydroelectric development informs part of the context in which the effects of the Keeyask Project are being considered. Potential effects of the Project during the construction phase could arise from the following:

- Participation in construction employment and business opportunities by Members of the KCNs and residents of Gillam and Thompson;
- Potential worker-interaction issues in the Local Study Area, particularly during the peaks of construction activity and as a result of the south access road construction camp;
- Physical changes to the landscape as a result of clearing and construction activities;
- New access to the Gull Lake and Gull Rapids area;
- Construction related traffic; and
- Implementation of the KCNs' Adverse Effects Agreements (AEA).

During the operation phase, effects on personal, family and community life may stem from:

- Continued implementation of the programs and measures under each KCNs' Adverse Effects Agreements (AEA);

- The KCNs receive return on their respective investments to the benefit of their communities;
- Potential participation in operation phase employment and contracting opportunities;
- Physical and biophysical changes to the landscape (including the reservoir), and resources used by people, as a result of operation of the generating station;
- Water-related changes in the Keeyask reservoir;
- Elevated methlymercury levels in some species of fish in Gull and Stephens lakes as a result of flooding;
- Changes to the community of Gillam to accommodate the operational workforce;
- Increased access to the Keeyask reservoir; and
- Re-routing of PR 280 allowing for a shorter travel time between Gillam and Thompson.

This section focuses on the Local Study Area. Effects on personal, family and community life occur almost entirely in the Local Study Area. Regional Study Area effects are expected to be very small and would be difficult to discern and describe.

5.2 APPROACH AND METHODOLOGY

This section describes the approach and methodology used to assess the effects of the Project on each of the VECs for personal, family and community life. In addition to the approach and methods described below, KCNs' Aboriginal traditional knowledge (ATK) is also considered. For each VEC, the following information is presented:

- Relevant background about the scope, nature and importance of the VEC;
- Summary and highlights of the approach used to assess effects; and
- Identification of Project-related drivers of change that could contribute to Project induced effects on the VEC.

Additional details to frame the assessment are also presented in the relevant existing environmental setting and or effects sections where applicable. The approaches and methods selected to assess Project-related changes are built on pathways of effect that connect relevant features of the Project with the socio-economic environment in which the Project would occur. This serves as the baseline or existing conditions upon which effects of the Project could occur. The drivers of change presented in this section originate from these pathways.

The environmental setting and effects assessment drew heavily on community-based research including the following:

- **Key person interviews (KPIs):** A program of KPIs was undertaken to establish the existing environment, to identify issues potentially affected by the Project, to discuss potential means to enhance positive effects and mitigate negative effects. In the case of CNP, sample KPI guides were provided to CNP, who undertook the research independently and produced technical memos on various subjects. For FLCN and YFFN, the community-based approach involved the hiring and training of community coordinators and researchers who assisted in the coordination of research, completion of KPIs and gathering of other data.

- **Workshops:** Depending upon the interests of the KCNs, workshops were held with targeted groups in each community.
- **KCNs documents:** KCNs' respective Environmental Evaluation Reports were considered, as were other KCNs-authored reports. Materials from these documents were used with the permission of each community.

As Lawrence (2004) notes, an approach that involves the community in the research aids in "determining what is acceptable, what is unimportant, what is important and what is more important." The community-based research helped identify issues and concerns related to Project development. Past experiences with hydroelectric development are very relevant to the KCNs, since each of the communities has experienced first-hand how a project can affect the surrounding areas and the people – be it the physical changes to the landscape or as a result of Project activities. This information was also an important consideration in the determination of effects, as the KCNs have considerable first-hand experience on which to draw.

ATK plays an important role in understanding personal, family and community life as the collective knowledge of the KCNs is based upon first hand experiences with hydroelectric development. The ATK presented in this section is pulled from the KCNs' Environmental Evaluation Reports and other community-based documents and research. ATK is passed down through the generations and it reflects the ease by which certain understandings are recognized, organized and used. Although there are commonalities among this knowledge, each of the KCNs also draws from its own unique experiences. As such, the materials in this section may be supported by all of the KCNs statements, and in others it may be focused on a single community. This is not to say that each of the KCNs do not hold similar concerns, but rather that the information used to describe VECs reflects the issues and interests expressed by each community. For example, FLCN has considerable direct experience with worker-interaction issues as many Members reside in, or live in proximity to Gillam where Manitoba Hydro is headquartered in the north. WLFN does not have the same level of experience to draw upon as the community was not a hub of activity for workers during past hydroelectric projects. In such instances, the discussion is guided by the information provided by the communities. ATK, as documented in each of the KCNs' respective Environmental Evaluation Reports provides insights not only into the existing environment, but to an understanding of the factors that have contributed to each community's current characteristics. In addition to being able to describe the historic factors that have shaped the present, ATK can contribute to the understanding of the potential effects of the Project as the transformation and re-transformation of the Nelson River by hydroelectric development has been witnessed and experienced by each community. In addition to community-based research, this section considered other available data including the following:

- **Statistical data sources:** Where available, statistical data sources were considered. For example health indicators data was collected for the KCNs, the town of Gillam and the city of Thompson.

- **Literature:** Where available, reference material relevant to the Local Study Area was used to profile the existing environment. In addition, reference materials with respect to key issues and other experiences with resource projects in Canada were used in the analysis of effects, potential enhancement or mitigation measures, and monitoring. This includes consideration of other environmental impact assessments in Canada.

5.2.1 Community Governance, Goals and Plans

The Project was considered within the context of each of the Local Study Area communities' governance structures, goals and plans. Analysis of the effects to community governance, goals and plans considered the drivers of change associated with Project construction and operation. The existing conditions in the Local Study Area were determined through the KPI programs, and in reference to various KCNs documents and secondary sources regarding their communities. Each of the Local Study Area communities' overall goals and plans were considered in terms of compatibility with the Project.

The KCNs have described how hydroelectric development has placed demands on each community's respective Chiefs and Councils since the Lake Winnipeg Regulation (LWR) and Churchill River Diversion (CRD) projects were implemented. During the late 1970s and early 1980s some of those demands involved trying to address complaints by Band Members and resolve claims under the Northern Flood Agreement (NFA). In the late 1980s, focus shifted to negotiating comprehensive agreements with Manitoba Hydro for adverse effects arising from LWR and CRD and related hydro developments. Since the late 1990s and early 2000s, substantial community and leadership attention has been directed at establishing the basis for a partnership in the Keeyask Project. These initiatives have placed distinctive demands on the community leadership while at the same time increasing the community's capacity to deal with complex challenges. It is anticipated that the Project will place continuing demands on local governance, in addition to contributing to community goals and plans.

The assessment of effects on community governance, planning and goals identifies potential Project-related drivers of change and assesses how these would influence the ability of affected communities to govern themselves and achieve their goals, taking into account information gleaned from community-based research and the KCNs' own studies.

5.2.1.1 Construction Phase

During construction, the effects of the Project would stem from the capability of local governance to deal with the activities associated with a major development, employment and business opportunities, and the potential socio-economic effects that stem from these changes. The drivers of change during the construction phase considered several factors including:

- Activities of the KCNs Future Development and Negotiations teams with regard to Project implementation, including but not limited to increased strain associated with securing the necessary funds to enable equity participation in the Project.

- Implementation of the JKDA and AEAs, including:
  - Participation in the Keeyask Hydropower Limited Partnership (the Partnership), including representatives on the Board of Directors;
  - Participation in the Advisory Group on Employment, Construction Advisory Committee and the Monitoring Advisory Committee;
  - Negotiation and implementation of the DNCs; and
  - Implementation of offset programs.
- Continued demand on governance and local services associated with a potential influx of construction workers into the area.

5.2.1.2 Operation Phase

During operation, community governance, goals and plans are likely to experience effects of the Project in relation to the longer-term changes resulting from the Project. Among the drivers of change associated with Project operation are the following:

- Ongoing participation in the Partnership (including representation on the Board of Directors);
- Annual distribution of equity income resulting from the Project;
- Ongoing implementation of the AEA Offsetting Programs; and
- Continued pressure on governance and local services resulting from an increase in population in Gillam.

5.2.2 Community Health

The health of individuals, families and communities is shaped by a variety of factors or determinants of health, which include the social and economic environment, the physical environment, and the person's individual characteristics and behaviours (WHO 2009). The approach to understanding community health in the Local Study Area considered factors such as the state of the environment, access to resources to meet basic needs, exposure to risks and capacity to cope with them, income and education level, and social networks and relationships with friends, families, and neighbours that all contribute to health and well-being (Quigley, R.L. *et al.* 2006). Many of these factors are discussed in other volumes of this EIS, in addition to within sections of this Supporting Volume. The KCNs' Environmental Evaluation Reports also provide valuable insights to their overall perspectives on community well-being.

Health goes beyond the simple absence of disease. A full understanding of community health also requires consideration of a community's social, physical and economic environments as well as individual factors that contribute to overall health (*i.e.,* a more holistic approach). Table 5-1 describes some of the well-documented relationships between the social, economic, environmental and individual factors that can affect health.

Table 5-1: Factors Contributing to Health

Factor	Link to Health
Education	• Improves opportunities to access employment and income • Provides one with a sense of control over life's circumstances • Increased understanding of information related to maintaining health
Income	• Higher income is linked to improved living conditions • Higher income increases ability to access resources • Stressors such as job strain, financial problems, and marital problems are more common among lower income individuals
Social Networks	• Social support networks act as supports when family, friends and community contribute to problem solving, dealing with adversity, and sense of control over life's circumstances • Social supports act as a buffer against health problems
Physical Environment	• Exposure to contaminants through air, water, soil and food can result in a variety of adverse health effects • Quality of housing (including the density of dwelling requiring major repairs, average number of persons per room, and indoor air quality) are linked to overall health • Distance to services (*e.g.*, distance to nearest hospital) • Personal security (*e.g.*, incidents of personal and property crime)
Individual	• Genetic factors • Personal practices/behaviours (*e.g.*, diet, exercise, smoking, use of alcohol, *etc.*) • Coping skills

Sources: Health Canada 2003, Health Canada 2004, Health Council of Canada 2005, Hou and Chen 2003, Orpana *et al*. 2007, Atlas of Canada 2009, WHO 2009.

Beyond this, Aboriginal status itself is considered by some as one of the key determinants of health in Canada (Raphael 2004). Among the determinants of health described in Table 5-1, Aboriginal people are more likely than other Canadians to experience inequalities that affect health. For example:

- Education: Aboriginal people are less educated than their non-Aboriginal counterparts. Aboriginal youth are less likely to complete high school.
- Employment: Insufficient education diminishes the level of skills people have to enter the labour market. Aboriginal people are less likely to end up in positions where they have control over their working environment. Unemployment rates are higher for Aboriginal people than the general Canadian population.
- Income and Social Status: Aboriginal people are typically overrepresented in the low income bracket. Annual earnings are lower than other Canadians irrespective of whether they are working full-time or part-time.

- Social Support Networks: Colonialism resulted in losses of land (*e.g.,* changes associated with *The Manitoba Natural Resources Transfer Act* and registered trapline system [see Section 2.2.1.3]) , language, and socio-cultural resources. The residential school system furthered these losses by removing young children from their communities, which has been linked to Aboriginal people being unable to establish effective family relationships.
- Physical Environments: Aboriginal communities often face housing shortages and people are more likely to live in crowded conditions or in homes in need of major repairs. This can result in stressors such as children having little room to study or play, or adults lacking private space to relax.
- Personal Health Practices and Coping Skills: Among the most relevant health behaviours by Aboriginal people are the over or misuse of alcohol, smoking, and lack of exercise and diet. Aboriginal communities are less likely to have community facilities and infrastructure to promote.
- Healthy lifestyle choices/ behaviours (*e.g.*, recreation centers, playgrounds, swimming pools).

(Loppie Reading and Wien 2009; Health Council of Canada 2005)

The Cree concept of *mino pimatisowin* or living "a good and honourable life" (Chapter 2 of the EIS) is another way of characterizing health. Adelson (1998), in her work on Cree concepts of health and well-being, describes this in saying, "Someone is said to be *miyupimaatisiiun*[1] if he or she eats the right foods, keeps warm and performs the activities needed to accomplish one's goals, whatever they may be." Further, Adleson suggests that Cree concepts of health are ultimately linked to a community's social and political well-being. These concepts illustrate how health can be understood in much broader terms than those described by indicators.

Given the complexity of the factors influencing health, the approach to community health began by gaining a broad understanding of the factors influencing health in the Local Study Area. This included information from the KPI programs, community workshops, and the various KCNs' Environmental Evaluation Reports and documents. In addition to this, a review of health indicators data[2] from the First Nations and Inuit Health Branch, INAC, and Manitoba Health was undertaken. The discrepancies among these data sets and limitations of the data are explained in Appendix 5A.

The following indicators were chosen based on practicalities such as the availability of data at the community level, as well as to provide a comprehensive picture of health for the KCNs, Gillam and Thompson:

- Birth rates and infant health – including birth rates, pregnancy rates, high and low birth weights, and spontaneous abortion rates;

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[1] Adelson's work focused on the Whapmagoostui Cree of northern Quebec whose dialect translates mino pimatisiwin to miyupimaatisiiun. FLCN has identified Adelson's work as an accurate reflection of their community's ATK in relation to health.

[2] Data from the First Nations and Inuit Health Branch and Manitoba Health was provided with the permission of the KCNs.

- Hospitalization and physician visits – overall use of medical services including reasons such as chronic diseases (cardiovascular disease and diabetes), infections of skin and subcutaneous tissue, and injuries;
- Communicable diseases; and
- Mortality – including mortality rates, premature mortality, and potential years of life lost.

Based on analysis of these indicators, key trends related to health were identified and are presented herein. Wherever feasible, perspectives and insights of the communities are used to support the health indicator data.

The assessment of effects on community identifies potential Project-related drivers that could affect community health and examines their implications on the selected health indicators.

5.2.2.1 Construction Phase

During construction the effects of the Project on community health are likely to result from the various factors capable of influencing health, as opposed to as a result of Project activities. The exception to this is the safety, security and emergency response at the work site, which is addressed by Manitoba Hydro under provincial workplace safety regulations. The drivers of change with the potential to influence community health include:

- Increased income and the potential for both positive and negative spending by the KCNs and other construction workers in the area.
    - The increased availability of income may result in increased opportunity for spending on alcohol and drugs. This may have spinoff effects to the broader community including the potential for family instability.
- Worker interaction – in addition to those effects described under Public Safety, there is the potential for increases in sexually transmitted infections as a result of the presence of a non-local workforce.
- Increased demand for services – the presence of a large construction workforce could place pressure on local services (see Section 4.4).

Worker interaction also presents the potential for an increase in violence and associated injury within the community, which from past hydroelectric developments is often associated with the presence of a non-local construction workforce.

5.2.2.2 Operation Phase

During the operation of the Project, effects to health may stem from factors similar to those described under the construction phase, although issues associated with worker-interaction will no longer be of similar heightened concern. The factors with the potential to affect community health during the operation of the Project are:

- Increased income – positive and negative spending; and

- Additional health and social services may also be required to address the growing population in Gillam (see Section 4.3).

In the case of Project operation there is also the effect of physical changes to the environment from flooding resulting in the release of methylmercury into the environment. Due to the importance of the issues surrounding mercury and human health, it is considered as a VEC in its own right (and is addressed in Sections 5.2.3, 5.3.3 and 5.4.3).

5.2.3 Mercury and Human Health

Mercury is a metal found naturally in small amounts in rock, soil, water, living organisms, as well as in man-made products. Humans can be exposed to different forms of mercury including mercury vapor from dental amalgams, from occupational exposures (*e.g.*, dentistry, mining, fluorescent lamp factories), and through artisanal and small-scale gold and silver mining operations. Flooding of forested lands with soils with high organic content, or flooding of wetlands, commonly results in a temporary large increase in mercury (in the form of methylmercury) in the water, and subsequently in the organisms that live and use those environments. Methylmercury is the form of mercury discussed here, as it is a potent toxin that bio-accumulates through the aquatic food chain, placing people who consume fish at risk (Mergler *et al.* 2007).

The health effects of mercury depend on the form of mercury, duration and quantity of exposure. If the exposure is of elevated levels for an extended period of time, all forms of mercury may cause health effects to the nervous system (*e.g.*, motor skills, irritability, tremors, changes in vision/hearing, memory loss, decreased IQ). Generally, young children and women of child-bearing age are of primary concern with respect to mercury exposure, although persons of any age or gender may experience health effects if the exposure is great enough. Consequently, there can be different recommendations for minimizing exposures depending on which group of the population an individual falls (Wilson 2012).

Since the Project will result in flooding and the subsequent release of methylmercury into the Nelson River system, and in response to concerns expressed by the KCNs, the approach to understanding mercury and human health was twofold. First, efforts were placed on considering the KCNs' issues and concerns in relation to mercury contamination (in particular each communities' history with the issue). This was accomplished through the establishment and activities of a Mercury and Human Health Technical Working Group (hereafter the "Technical Working Group"), comprised of representatives of the KCNs, Manitoba Hydro and its consultants, and experts in the area of mercury and human health identified and retained by the group. Second, a human health risk assessment was undertaken.

It should also be noted that the effects of mercury to aquatic and terrestrial life are examined in those respective supporting volumes.

5.2.3.1 Construction Phase

The assessment of effects of mercury on human health is limited to the operation phase as there are no anticipated effects of construction of the Project in relation to mercury and human health. Although reservoir impoundment occurs in the latter stages of the construction phase, effects from the release of methylmercury do not reach peak levels until 3-7 years after impoundment; therefore, effects on human health are included under the operation phase.

5.2.3.2 Operation Phase

In order to characterize the effects of impoundment on mercury levels and subsequently human health, exposure to mercury considered both the current and post-impoundment conditions. Concentrations of mercury were measured or predicted for country foods identified by the KCNs, including fish, wild game, waterfowl, and surface water.

The methods used to estimate human health risks followed the following steps:

- Problem formulation – human receptors and relevant exposure pathways were identified;
- Exposure assessment – exposures to mercury were estimated based on a variety of assumptions relations to the use of Gull Lake and Stephens Lake and the surrounding area, and the dietary habits of people in the area;
- Toxicity assessment – toxicology literature was reviewed to identify exposure rates for mercury that have been determined by health agencies to be acceptable (*e.g.*, exposure rates without noticeable risks of adverse health effects);
- Risk assessment – estimated exposure rates were compared to the rates considered acceptable for humans for the various consumption scenarios considered in the assessment; and
- Uncertainty assessment – key assumptions or uncertainties that could affect the risk outcomes were identified (Wilson 2012).

In order to assess the risk of exposure to mercury as a result of the Project, the human health risk assessment considered both the current and post-impoundment conditions for Stephens Lake and Gull Lake. The area surrounding Gull Lake and Stephens Lake is used for a variety of purposes, including hunting, fishing, and gathering. The human health risk assessment evaluated the potential exposure to mercury for the KCNs, as these are the communities at greatest risk due to their use of country foods. Although the human health risk assessment focused on the KCNs, the baseline conditions and results of the risk assessment would also be generally applicable to non-First Nation individuals who use Stephens Lake and or Gull Lake for resource harvesting (*e.g.*, residents from Gillam).

Specific species were selected for evaluation based on KCNs' inputs through the Technical Working Group. The foods selected for evaluation included:

- Fish - whitefish, jackfish, pickerel and sturgeon;
- Wild game - beaver, muskrat and moose;
- Waterfowl - ducks and gull eggs; and
- Wild plants - northern tea, blueberries and Seneca root.

Modeling was not undertaken for gull eggs and wild plants because no reliable model exists for these foods (Wilson 2012). Details on the proceedings of the Technical Working Group and the details of the approach used in the human health risk assessment are found in Appendix 5B and 5C, respectively.

5.2.4 Public Safety and Worker Interaction

Public safety refers to the overall prevention and protection of people from issues that affect their personal and collective safety and security (*e.g.*, acts or activities that may cause harm). As a socio-economic VEC, the main focus of public safety is analysis of the effects related to interaction of non-local Project workers with local residents. These have been identified as the source of greatest concern with regard to the public safety implications of the Project. While this is the focus of the analysis, public safety in the Local Study Area includes discussion on the overall public safety trends within the area, as well as key interests and perspectives expressed by each of the communities.

Analysis of the effects to public safety considered the drivers of change associated with Project construction and operation. The existing conditions in the Local Study Area were determined through the KPI programs, annual crime statistics from the two RCMP units that police the Local Study Area, and consideration of public safety concerns witnessed at other major projects in Canada. Particular attention was paid to the KCNs' experience with past hydroelectric development.

Based on their experience with past projects, the assessment of effects focused on issues associated with the influx of non-local construction workers into communities and new income associated with employment on the Project. An assessment of worker interaction risks was carried out taking into account the size of the incoming workforce, availability of leisure time amenities at the construction camp and in Gillam and Thompson, travel distances and local resident knowledge of, and previous direct experience with, past projects and what might be done to avoid similar occurrences during Project construction. A worker interaction workshop was held with FLCN Members in January 2010 to better understand past experience and identify potential mitigation measures.

5.2.4.1 Construction Phase

It is anticipated that effects to public safety would be limited to the construction phase. The drivers of change during the construction phase considered several factors, all of which were identified by the KCNs as areas of potential concern. Among the drivers of change, the following were identified as the concerns most likely to result in effects to public safety:

- An influx of non-local construction workers and the potential for indirect effects stemming from having more people in the community. Factors considered in relation to this influx include:
    - The number, timing and location of non-local construction workers;
    - Working hours;
    - Leisure amenities at camps;
    - Travel distance from construction camps to communities; and
    - Services and amenities available within the Local Study Area.

- New income from Project employment providing workers with the ability to purchase alcohol and drugs and to participate in a "work hard, play hard" lifestyle. (Goldenberg *et al.* 2007) that has been associated with past project development. The KCNs have expressed concerns about alcohol and drug use by their Members, particularly as controlled and illegal substances might become more readily available with an influx of non-local workers, and potentially gangs.

5.2.4.2 Operation Phase

Effects of the Project related to public safety and worker-interaction are limited to the construction phase because the required workforce for the operation phase will be longer-term in nature and establishing residence within the community of Gillam.

5.2.5 Travel, Access and Safety

As a socio-economic VEC travel, access and safety considers two general forms of transportation and associated issues with access and safety: 1) water-based (or in winter, ice-based) travel; and 2) road-based travel. The existing conditions in the Local Study Area were determined through a variety of sources including traffic volume and collision data from Manitoba Infrastructure and Transportation (MIT) and the RCMP, through the KPI programs, and in reference to the KCNs Environmental Evaluation Reports. The approaches to understanding changes to travel, access and safety as a result of the Project were specific to the type of travel being examined; *e.g.*, specific methods were used to consider water-based transportation, and specific methods were used to understand road-related transportation. In both instances, the drivers of change associated with Project construction and operation were examined in relation to the VEC. The assessment of effects examined the implications of these drivers on future travel, access and safety arising from the Project.

The assessment of water-based travel effects took into account the extensive waterways management programs that have been established through the Comprehensive Implementation Agreements with TCN and YFFN and the JKDA. These programs along with anticipated access management plans address most of the potential effects of Project-related drivers on open water transportation. In the case of road travel, the analysis took into account the extensive improvements to PR 280 that are currently being carried out to meet the added traffic loads of the Keeyask Infrastructure Project (KIP) as well as the proposed Project. These improvements mitigate most of the potential effects on road travel of added traffic during Project construction.

5.2.5.1 Construction Phase

5.2.5.1.1 Water / Ice-Based Travel

During the construction phase, effects to travel, access and safety would stem from in-stream Project activities, in addition to changes on the landscape as a result of the Project's footprint.

Among the Project activities likely to impede the use of the Nelson River as a transportation corridor during construction are the following:

- Interference of natural flows as a result of the construction of an ice boom in the Nelson River upstream of the Project, construction of cofferdams and associated changes to water flows, and construction of the north and south dykes;
- Restricted access along the shoreline in proximity to construction activities; and
- Construction of the south access road.

5.2.5.1.2 Road Travel

During construction, the effects of the Project on road travel would stem from increased vehicular traffic servicing a variety of needs at the construction site (*e.g.*, delivery of materials, equipment and personnel). This increase in traffic has the potential not only to affect overall safety of the public travelling on PR 391 and PR 280, but also to the overall condition of the highways. There is limited potential for measurable effects to PTH 6, and as such while it is described in the baseline it is not carried forward to the effects assessment.

The effects assessment on road travel considered existing traffic levels along potentially affected road segments along with predicted Project-related traffic levels. The percentage increase in travel levels was estimated for each segment and the implications of the increase for traffic safety identified, taking into account anticipated improvements to PR 280. Data from MIT was used to estimate background traffic on the roadways in the Local Study Area. Average Annual Daily Traffic data (AADT) (the number of vehicles passing a point on an average day of the year) was used to describe the overall volume of traffic on particular segments of the road on a daily basis over a one-year period (Manitoba Infrastructure and Transportation 2009). Construction-related road traffic was estimated based upon the construction schedule and material delivery requirements. Three categories of traffic were considered including traffic hauling freight, traffic from support services, and traffic associated with personnel transport to and from the Project site.

Consideration was also given to travel on ice roads in the Local Study Area. Traffic volumes are not recorded on these roads, and as such, information relies on data collected during the community-based fieldwork research program, in addition to government reports on ice roads.

5.2.5.2 Operation Phase

5.2.5.2.1 Water / Ice-Based Travel

The operation of the Project is expected to alter various characteristics of the existing water and ice regimes within the Project's predicted open water hydraulic zone of influence which extends approximately 40 km upstream from the Project site (to the outlet of Clark Lake). The primary changes to navigation will be limited to areas upstream in the predicted open water hydraulic zone of influence and immediately downstream of the generating station (*e.g.*, the outlet immediately into Stephens Lake). The creation of a reservoir and operation of the generating station is expected to cause a backwater effect upstream of the generating station and result in changes to the water levels, velocities, water surface profiles and ice formation (see PE SV).

5.2.5.2.2 Road Travel

Operation of the Project is not expected to have a measurable effect on the number of vehicles travelling on roads in the Local Study Area. The driver of change during operation is the rerouting of PR 280 along the north and south access roads and across the generating station. This will reduce the overall travel time between Thompson and Gillam, and has implications for the use of roads in the Gillam area.

5.2.6 Culture and Spirituality

Culture and spirituality are considered a single VEC of particular importance to the KCNs when examining the effects of the Project. This section provides the results of a qualitative and quantitative study to assess the effects of the Project on the culture and spirituality of the KCNs.

Culture and spirituality represent a composite of values, beliefs, perceptions, principles, traditions and world views that are based on individual and collective history, experience and interpretation. These cognitive values can sustain cultural experience(s) and also act as a cohesive force to direct the flow of cultural change. One of many definitions describes “Culture” as the socially conditioned assemblages of activities and thoughts that are associated with particular social groups or populations (Harris 1994). Spirituality describes peoples’ relationships with their ecosystems and the awareness that goes beyond the immediate sensible world from which knowledge, ability, or medicine is derived. These complimentary modes of knowing, being and caring about the sensory and the spiritual realms reveal the essence of their knowledge and have been continually transmitted in the oral tradition from the spirits to the Elders and from the Elders to the youth through spiritual teachings (Battiste and Henderson 2000).

The culture and spirituality study conducted was focused on identifying linkages and pathways specific to each community, organized by cultural indicator, to illustrate the potential effects on the KCNs. Community-based studies and open dialogue provided a holistic cultural record, historic and current. Further detail on the data sources used in the analysis are provided in Appendix 5D. The assessment took into account ATK that describes potential effects during the construction and operation phases of the Project.

Basic methods were rooted in applied anthropological processes that were used to identify, record and understand certain aspects of culture unique to each of the KCNs. A participatory action research (PAR) approach was used in these studies which were mainly self-directed with minimal outside input. Training in oral history interviewing techniques was provided to YFFN and WLFN and interviewing of Band Members was conducted by the trained community researchers. FLCN and TCN also conducted independent cultural studies as noted in Section 5.2.2 which included interview processes and workshops with their membership. Further, a key person interview process was used with YFFN and FLCN as a part of the overall understanding of personal, family and community life.

5.2.6.1 Cultural Indicators

Cultural indicators were employed to facilitate a description and analysis of change of culture and spirituality. Cultural indicators of change developed for the Local Study Area represent characteristics of the VEC that can be used to help describe the amount, state or condition of the VEC; and that are measurable quantitatively and qualitatively. Cultural indicators also assist in illustrating linkages between culture and spirituality on one hand, and the pathway that may lead to an effect on the other.

Indicator measures can be understood as the amount, location, size, volume, frequency, distribution and or status that describe the indicator in quantitative or qualitative terms (for example, a decline in language or cultural practices). In addition, close attention was given to data and sources overlapping with other specialist disciplines conducting concurrent fieldwork. Research prepared by Lawrence (2004), supported by the CEAA characterizes socio-economic studies and suggests that "…impact significance should be interpreted from multiple perspectives and from several levels of social aggregation" (Lawrence 20044). In this regard, the studies conducted within the Local Study Area incorporated an anthropological perspective to contextualize culture and spirituality as a VEC, whereas older studies represent a baseline for comparison to the input provided by KCNs communities.

Nine indicators were used to facilitate the description and analysis of change of culture and spirituality in relation to the KCNs. The indicators highlight the relationships of people to their environmental setting and contribute to assessing cultural values and potential Project effects. Figure 5-1 developed as an adaptation from Whiting and Whiting's 1975 cultural system model (Petch 1999) illustrates the components that have been considered in the development of these nine cultural indicators. The nine cultural indicators used in the analyses, and their relevance to the KCNs are described in Table 5-2. Effects on culture and spirituality determined the implications of Project-related drivers of change on the nine cultural indicators. The assessment took into account programs flowing from the Adverse Effects Agreements negotiated between Manitoba Hydro and each of the KCNs. Most of these programs addressed effects of the Project related to culture and spirituality.

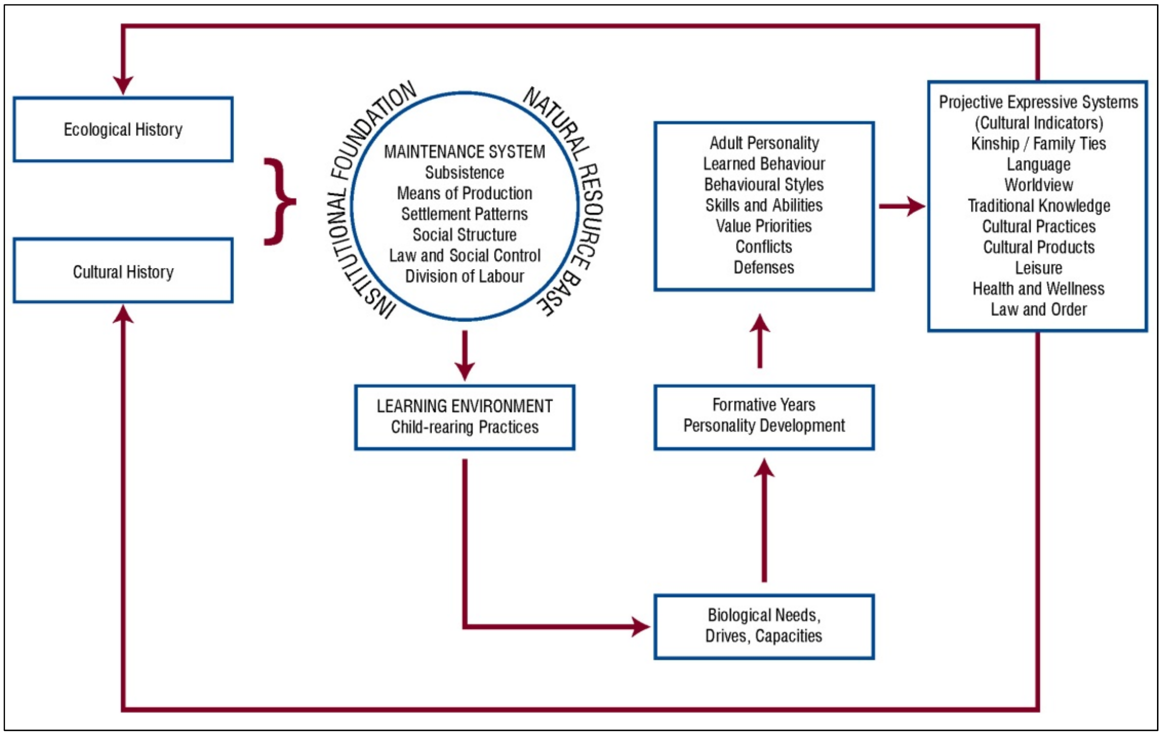

Figure 5-1: Cultural System Model

Table 5-2: Cultural Indicators

Indicator	Description	Relevance to the Local Study Area
Worldview	Encompasses the relationships and interconnectedness of the natural environment and people forming the spirituality as understood by a given community.	For the KCNs communities, worldview provides the ethics for living. In addition to providing guidance for interactive conduct between people and the natural environment, Worldview is based on the cognitive and perceptive interchange which forms the dynamics of culture.
Language	A vehicle for expression and can be spoken, written or signed and is critical to the transmission of cultural knowledge.	Provides insight into the daily use of Cree language as a means of communication. There is also an age relationship between Elders and children through the oral transmission of gender specific information.

Table 5-2: Cultural Indicators

Indicator	Description	Relevance to the Local Study Area
Traditional Knowledge[1]	Generally understood to represent the customary knowledge, innovations and practices of indigenous and local communities developed from experience gained over time and adapted to culture through environment, and is transmitted orally from generation to generation.	Reflects the extent to which KCNs community Members understand their own traditional practices as transmitted through oral narratives (oral traditions and oral history). This includes the KCNs perspectives on what is considered "specialized knowledge" or "common knowledge" within the communities, and the fact that some knowledge will be held by specific individuals who are qualified to hold and transmit knowledge.
Cultural practices	Modes of completion of activities that distinguish one cultural group from another. It entails a "way of doing." Cultural practices or "what people within the communities do" is a dynamic process within KCNs communities.	Reflects the extent of traditional practices and cultural activities undertaken by the KCNs.
Health and wellness	Health and wellness includes the physical, emotional, mental and spiritual qualities of life that instil a sense of well-being and security.	For KCNs communities, the health and wellness of Members is contingent upon the availability of both western modes of health and wellness programming and traditional health and wellness practices. Western modes include nursing stations, visiting doctors, dentists, pharmacists, psychiatrists or psychologists. Traditional health and wellness practices include midwives, healers and traditional medicines, such as plants, roots and herbs and shamanistic ritual.
Kinship	Social relations, both biological[2] and fictive[3], based on culturally recognized ties by descent, marriage and alliance; that is, who's related to who and what are the obligations of the relationship.	Incorporates both a western view of the nuclear family (family cohesion), and traditional views on extended families (what or who is family). Kinship as an indicator considers marriage patterns and the understanding that traditional kinship terminology assists with determining the obligatory role and status of individuals in community as well as understanding terms of reciprocity or sharing.

Table 5-2: Cultural Indicators

Indicator	Description	Relevance to the Local Study Area
Leisure	Recreation provided by the cessation of work or dutiful activities and is usually associated with enjoyment or pleasure.	Considers the types of activities KCNs Members undertake for relaxation or enjoyment during their time free from work or duties. For the KCNs, leisure may include the types of activities KCNs Members undertake for relaxation or enjoyment provided during their time free from work or duties. Examples of leisure time activities include bingo, skating and baseball. Leisure within KCNs communities is utilized as a time to share stories of past, present, and future during shared activities.
Law and order	The governance and systematic manner by which social harmony and balance are achieved. This can include customary law and unspoken agreements.	Illustrates the historic and current enforcement of western imposed laws, such as the *Indian Act*, the *Natural Resources Transfer Act*, *Migratory Birds Act*, Registered Trap Lines and *the Family Allowances Act*. Customary laws are those traditional mores and folkways that determine social sanctions. They are the result of certain successful ways of dealing with difference, discrepancies and argument that have maintained social harmony and balance.
Cultural products	Cultural products can be understood as expressions of culture that represent the essence of self-identity. Included in this theme are various forms of artistic endeavours (painting, music, literature-oral and written), crafts and cultural landscapes.	This indicator is illustrative of the number and type of cultural products that KCNs Members produce or create.

Notes:

1. Traditional Knowledge is the general term for any indigenous population's knowledge and is used here as a cultural indicator.
2. Biological kinship is a term used to identify relationships of a consanguinal (by birth) or affinal (by marriage) nature.
3. Fictive kinship is a term used to identify relationships such as god-parents, clan or other customary convention rather than consanguinal or affinal.

5.2.6.2 Construction Phase

During the construction phase the following pathways of change from the Project as they relate to each indicator were considered:

- Worldview: is linked to physical effects, construction camp effects and employment and business effects. This is due to the fact that Worldview as an indicator provides guidance for interactive conduct between people and the natural environment. It acts as a cognitive and perceptive coping mechanism for cultural change and defines a measure of the relationships and interconnectedness of the natural environment, people and spirituality as understood by the KCNs communities.

- Language: This indicator is linked to mechanisms of cultural transmission and stewardship. Living away from home, leisure time and the presence of non-Cree speakers within the construction camp presents effects on Cree language through intercultural and intracultural interactions.
- Traditional knowledge: This indicator is linked to the changes to culture and spirituality and a connection to the land where physical changes including clearing, drilling and excavation; changes to water levels and water flow[1]; access; and borrow areas all potentially affect the communities' understanding and experience vis a vis heritage resources, resource use and the cultural landscape.
- Cultural practice: This indicator is linked to the construction camp through pathways that derive from living away from home, leisure activities and long-term interactions with non-Cree cultural components. Cultural practices can also be found during the construction phase under the pathway of health and wellness with changes to sharing practices and the reduction of country foods as a cultural practice.
- Health and wellness: This indicator is linked to changes to cultural practices and the reduction of country food use that may arise from KCNs Members being employed on the Project. It is also present as a pathway through mechanisms of cultural transmission and stewardship.
- Kinship: This indicator is a mechanism of cultural transmission and a contributor to health and wellness. It is linked to the worker interaction at the construction camp and pertains to potential effects initiated by intercultural and intracultural processes. Traditional interaction between Elders and children and other community members are also critical to understanding the transmission of **fictive kinship** and gender roles. As a pathway for health and wellness, kinship is seen as potentially affecting cultural practices and can manifest as changes to sharing practices.
- Leisure: This indicator, as a measure of, for example, family cohesion, may be reduced by family absences due to the potential construction employment opportunities on the Project for KCNs Members.
- Law and order: This indicator represents a mechanism for achieving social harmony and balance aided by customary law and unspoken agreements. During the construction phase, law and order would be relied upon by KCNs communities to reconcile intercultural and intracultural dilemmas that arise due to the Project.
- Cultural products: This indicator is primarily linked to the physical changes that the Project may potentially cause. Cultural products are linked within indicators that involve changes to cultural practices as a mechanism of cultural transmission or to sharing practices.

[1] Initial flooding of the reservoir will occur in the latter stages of the construction phase. Effects related to flooding are described in the operation phase.

5.2.6.3 Operation Phase

During the operation phase the following pathways of change from the Project as they relate to the nine cultural indicators were considered:

- Worldview is linked to the physical changes associated with the operation of the Project and will provide guidance to the interactive conduct between people and the natural environment. Worldview acts as a cognitive and perceptive coping mechanism for change.
- Language as an indicator may be affected, however the various AEA Offsetting Programs are designed to address the expected physical changes.
- Traditional knowledge: Changes to traditional knowledge may occur as a result of changes to the physical environment, which are linked to the connection people have to the land.
- Cultural practice, as an indicator, is linked to employment and business. Changes may be manifested by enhancing social stratification. Changes in physical and cultural landscapes will additionally change cultural practices, either by adaptation, abandonment or relocation.
- Health and wellness represent both physical and mental aspects and are linked to the physical changes that may result from the Project.
- Kinship could be affected through employment as it pertains to potential effects initiated by intercultural and intracultural processes. Long-term employment may reduce the opportunities for interaction among family members, cultural practices and sharing practices.
- Leisure: Project operation may result in long-term employment and an associated reduction in all forms of leisure.
- Law and order would be relied upon by the KCNs communities to reconcile intercultural and intracultural dilemmas that arise due to the Project.
- Cultural products may be affected by the physical changes caused by the Project through potential disruptions to resource use, heritage resources, aesthetics, and long-term income opportunities.

5.2.7 The Way the Landscape Looks - Aesthetics

Aesthetics provide a sense of what people consider beautiful or suitable, and may vary between individuals and cultural groups. "The essence of aesthetics is that humans experience their surroundings with multiple senses" (BEST 2007). The aesthetics of natural environments and urban or 'built' environments are considerably different. The approach to the analysis of aesthetics considered the physical changes to the Local Study Area that result from the construction and operation of the Project. Visual impacts are the focus of this assessment; however, consideration is also given to the auditory effects resulting from the Project. The KCNs in particular, characterize aesthetics as "the way the landscape looks."

The locations considered in the assessment of aesthetic effects were determined on the basis of where physical changes would occur. Characterization of these locations (*e.g.*, the existing environment) relied upon the KPI program, in addition to inputs from various document from the KCNs, and KCNs perspectives on past development. The assessment covers the following types of areas and locations where aesthetic effects could be relevant:

- Scenic areas that are likely to be affected by Project activities, in particular Gull Rapids;
- Locations that are not necessarily considered scenic, but that will be altered by changing from a natural area to one with man-made features; and
- Developments in Gillam in response to increased population that have the potential to alter the overall appearance and character of parts of the community.

The characterization of effects from Project construction and operation on the aesthetic environment included the following:

- **Project description:** All site alterations arising from Project activities, including the development of access roads and trails, use of granular and impervious borrow areas, the actual development of the dam infrastructure, and flooding of the area between Gull Rapids and the outlet of Clark Lake;
- **Project visibility within landscape context:** The characteristics that make a location distinctive in contrast with the presence of the Project with consideration of the number and types of viewers; and
- **Viewer value and sensitivity levels:** Consideration of the viewer's expectations and cultural values (*e.g.*, the KCNs' worldview would result in a different appreciation of the area's aesthetics than an average resident from Gillam or southern Manitoba).

The assessment of aesthetic effects also gives consideration to the reversibility of an effect; *e.g.*, whether a change to the landscape is likely to be temporary (*e.g.*, borrow areas that will later be rehabilitated) or permanent (*e.g.*, flooding of the rapids and creation of a reservoir).

5.2.7.1 Construction Phase

The drivers of change to the aesthetic environment will include a physical alteration of the landscape, physical changes in the Nelson River, noise, dust, and increased human presence. Perceptions of the aesthetic effects of construction may vary depending upon an individual's worldview and perspective and is considered in describing the Project effects.

5.2.7.2 Operation Phase

Upon completion of construction and final commissioning of the generating station, several outcomes of the Project have the potential to affect the aesthetic nature of the area. This will stem largely from the creation of a reservoir with the flooding of 45 km^2 between the generating station and Clark Lake. The drivers of change associated with Project-operation include:

- The change from a riverine to a reservoir environment;

- The loss of Gull Rapids;
- The replacement of the rapids with a physical barrier (*e.g.*, the dam) (*e.g.*, transition from a natural to built environment);
- The changes to the landscape from the potential re-routing of PR 280 via the north access road, over the dam, and via the south access road into Gillam; and
- Changes within the town of Gillam to accommodate the growth of the community (*e.g.*, new housing/neighbourhoods).

5.3 ENVIRONMENTAL SETTING

5.3.1 Governance, Goals and Plans

Community governance, goals and plans are linked, as it is typically a community's leadership and associated administration that is responsible for the execution of activities to achieve its goals and plans. The following section provides an overview of the governance systems of the communities in the Local Study Area, in addition to describing the goals and plans of each community.

5.3.1.1 Keeyask Cree Nations

GOVERNANCE

For thousands of years First Nations in Canada lived in accordance with traditions rooted in the land. Traditional laws encouraged people "to be wise, humble, respectful, truthful, brave, loving, and honest in (one's) dealings with others" (Borrows 2008). Leaders emerged or were selected based on their knowledge and skills (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a). The relationships between people and the land were an integral component of governance (NCFNG 2009). The arrival of Europeans fundamentally changed the way of life for First Nations across Canada, including the social, economic and political structures that governed people and their lands (Missens 2008). Among such changes identified by the KCNs are participation in the fur trade, the signing of Treaties, the development of the Bayline railway, the implementation of the registered trapline system, and above all the onset of hydroelectric development (see Section 2.2).

Today, First Nations governments across Canada are endeavouring to find "a balance between First Nations' culture, custom, tradition and protocol and Canadian social, economic and political systems" (Missens 2008). Governance goes beyond a set of elected decision makers and represents an integrated system of political, social and economic institutions (Missens 2008).

Effective governance has been identified as the single greatest contributing factor to a community's socio-economic progress and its overall well-being as it allows First Nations to:

- "Take greater control over the decisions that affect their lives;
- "Carry out effective relationships with other governments;

- "Take advantage of economic development opportunities;
- "Improve programs and services; and
- "Enhance their social and economic well-being" (INAC 2009a).

The primary institution for community governance for each of the KCNs is a Chief and Council and their supporting administration, as described in subsequent sections. These entities are responsible for making decisions for their community in regards to the allocation of Band financial resources to support community needs. A continuing challenge for each of the KCNs' respective Chiefs and Councils is to allocate funding, which is often considered inadequate in addressing all of their communities' needs.

Since LWR and CRD were implemented, hydroelectric development has placed substantial demands on the Chiefs and Councils of some of the KCNs (see Section 2.2.1.4). During the late 1970s and early 1980s some of those demands involved trying to address complaints by band Members and resolve claims under the NFA[1]. For signatories to the NFA, the late 1980s saw a shift to negotiating NFA comprehensive implementation agreements with Manitoba Hydro for adverse effects arising from LWR and CRD and related developments. For others, the late 1990s and early 2000s saw the negotiation of settlement agreements for adverse effects stemming from these same developments. The implementation and negotiation of these agreements has overlapped with the partnership negotiations for Keeysak since the late 1990s and early 2000s. These initiatives have placed substantial and distinctive demands on the community leadership while at the same time increasing the community's capacity to deal with complex challenges.

NFA implementation and other settlement agreements have increased the KCNs' influence over decisions affecting their communities through the creation of Resource Management Areas (RMAs) and Resource Management Boards (RMBs). As described in Section 2.2.3.1, the Spilt Lake RMA and York Factory RMA and associated RMBs resulted from implementation agreements under the NFA, while the Fox Lake RMA and RMB resulted from their Settlement Agreement with Manitoba Hydro and the Province. WLFN does not have an RMA, although their traditional territory is included within the southern-most section of TCN's RMA (CNP Keeyask Environmental Evaluation Report, CNP 2010e) WLFN also has a representative on the Split Lake RMB to represent its community interests. The role of these RMBs is to provide advice on resource use allocation and issues including policy and programs in their respective RMAs.

The KCNs are also members of the Keewatin Tribal Council (KTC) and the Manitoba Keewatinowi Okimakanak (MKO), both of which have offices located in Thompson and Winnipeg. MKO is the political organization that represents 30 Chiefs and Councils from First Nations in northern Manitoba and is headed by an elected Grand Chief. The KTC represents 11 northern Manitoba communities (including the KCNs) and is mandated to "maintain, strengthen, enhance, lobby for, and defend the rights of northern Manitoba First Nations within its jurisdiction" (KTC 2008a).

Each of the KCNs also has governance structures unique to their community, as described below.

[1] WLFN and FLCN were not signatories to the NFA (see Section 2.2.1.4).

GOALS AND PLANS

The KCNs share certain common goals, as are reflected in the JKDA and their respective AEAs (described in Section 1.2.1). Among the common goals are the following:

- To increase each First Nation's influence over decision making regarding development activities in their respective RMAs;
- To increase the benefits flowing to communities as a result of development activities in their respective RMAs;
- To increase access to financial resources to support community development (both economic and social);
- To increase employment opportunities for their respective memberships; and
- To maintain and renew traditional culture and associated activities.

(CNP *et al.* 2009; TCN and Manitoba Hydro 2009; WLFN and Manitoba Hydro 2009; FLCN and Manitoba Hydro 2009; and YFFN and Manitoba Hydro 2009)

Although the AEAs and the JKDA may enable the KCNs to achieve these goals, a similarity among the communities is their sense of internal conflict and uncertainty in regards to becoming partners with Manitoba Hydro on the Project. These reservations are best expressed by the KCNs' own perspectives, as demonstrated by the following quotations:

CNP: "By negotiating the *Joint Keeyask Development Agreement* (JKDA) and separate *Adverse Effects Agreements* (AEAs) and by partnering with Manitoba Hydro for the Keeyask Project, CNP are seeking to restore and enhance the capacity of our homeland ecosystem to sustain our people both physically and culturally. Knowing that the Keeyask Project would irreversibly alter our homeland ecosystem already affected by hydroelectric development, we nevertheless came to see an opportunity to ensure it would come closer to meeting its original purpose of sustaining us than it does today" (CNP Keeyask Environmental Evaluation Report).

YFFN: "We have chosen to join the Partnership and make the best that we can of the Keeyask Project, but we do so with caution and uncertainty. We still have misgivings about identifying ourselves as partners with Manitoba Hydro and we are conflicted about supporting a project that will cause more damage to our lands. We recognize that our children will live with the consequences of our decisions and we are determined not to let them down" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

FLCN: "Fox Lake views all Hydro projects, including Keeyask, as one continuous staged process of development with long-term and cumulative impacts. Unlike in the past, Fox Lake now has an opportunity to participate as a partner and to educate, inform and influence the Keeyask Project. This partnership serves as a way to ensure the protection of *Askiy*.…Through the signing of the JKDA in May of 2009, Fox Lake Cree Nation (FLCN) decided to engage in the Keeyask Partnership to maximize benefits for the people of FLCN" (Chapter 2 of the EIS).

The KCNs' level of unease and uncertainty is also more fully described in Chapter 2 of the Response to EIS Guidelines.

5.3.1.1.1 Cree Nation Partners

TATASKWEYAK CREE NATION – GOVERNANCE

Traditionally, TCN maintained a way of life in which the family was the main governing unit, with certain members of a clan emerging as leaders based on their knowledge and skills. The people "followed the practice of selecting peacekeepers to maintain in their own customary fashion the peace, order and mutual respect that was central to the way of life" (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

The role of Chief and Council emerged after the signing of treaty in 1908, although did not alter the earlier approach to community leadership of respect for those with skills and knowledge, respect for Elders, and respect for the peacekeepers. TCN's "ancestors approached the Treaty discussions based on our cultural imperative of sharing, and so viewed the Treaty as a means to improve their economic condition in exchange for access to the land and resources by the Crown, with only minor limitations on (their) rights to continue historical pursuits throughout (their) homeland ecosystem" (CNP Keeyask Environmental Evaluation Report). From this time, TCN felt the effects of a series of external influences and decisions (post-Treaty health care, education (including residential schools), technology, *etc.*) that ultimately resulted in a loss of the sense of control over activities in their ancestral homeland (CNP Keeyask Environmental Evaluation Report).

In the mid-twentieth century the pressures of resource extraction and development in northern Manitoba began to change the role of leadership, as younger generations became more actively involved in governance. The negotiation of the NFA in the 1970s "marked a formal beginning to reclaiming the power and authority (the community) once held" (CNP Keeyask Environmental Evaluation Report). Subsequent negotiation of an implementation agreement in the late 1980s into the 1990s, strengthened the community's ability to adapt to their changing environment (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a). CNPs Environmental Evaluation Report states that "The NFA was an empowering revitalization of our connection to our lands and waters" (CNP Keeyask Environmental Evaluation Report). By the late 1990s, TCN "believed our rights and interests could be advanced by building upon the terms of our past agreements and being a participant in the proposed Keeyask Project" (CNP Keeyask Environmental Evaluation Report).

The efforts required to participate in the Project are highlighted by the following quote:

> For more than two decades Tataskweyak Cree Nation sought a more inclusive role in participating in future hydro developments being contemplated by Manitoba Hydro. The increasingly complex technical and legal issues associated with Manitoba Hydro project planning and development, including regulatory approvals processes, coupled with the advent of s.35 Treaty and Aboriginal rights in 1982 and their subsequent delineation by the Supreme Court of Canada, have placed enormous demands upon Chief and Council to ensure Members' best interests were being served throughout negotiations with Manitoba Hydro (CNP 2010c).

A Chief and six Councillors elected under Section 74 of the Indian Act govern TCN. A custom election code has been developed and is pending ratification by community vote prior to formal submission to the Minister of Indian Affairs (CNP 2010c). Currently the Chief and six Councillors serve a two-year term. "Chief and Council are mandated to provide leadership, guidance, service and accountability to TCN Members (on and off-reserve) in an impartial and just manner. Council follows the roles and responsibilities as defined in the Indian Act and has adopted a portfolio method of management, providing each Councillor with specific areas of responsibility and accountability" (CNP 2010c). Each Councillor is generally responsible for a portfolio, as well as between six and eight departments.

Council is supported by an administrative structure with departments providing material community functions/services as follows:

- **Intergovernmental Affairs:** Responsible for Band Office administration, including Membership registration, the Tataskweyak Housing Authority, and social income assistance programs;
- **Finance and Administration:** Provides appropriation of various sources of funding for the benefit of Members, including funding through the Tataskweyak Trust Authority;
- **Public Works:** Operates a diverse set of public works, which are detailed later in this section;
- **Health and Wellness**: Responsible for the delivery of a variety of healthcare and social services, which are detailed later in this section;
- **Economic Development:** Responsible for developing business opportunities with the two-fold goal of increasing investment revenue and employment opportunities for Members (including the TCN Gaming Commission);
- **Education:** Provides education policy and curriculum through the Tataskweyak Education Authority (TEA);
- **Employment and Training:** Provides a variety of training, upgrading and employment opportunities to qualified Members through the Community Employment and Training Program (CETP) and regional coordination of courses offered by University College of the North (UCN);
- **Natural Resource Management:** Responsible for the protection of natural resources, including commercial and domestic resource use, in the Split Lake RMA and is active on the 12-person Split Lake RMB;
- **Future Development:** Responsible for directing all business activity with Manitoba Hydro, including management of DNCs;
- **Culture and Recreation:** The Tataskweyak Recreation Committee provides cultural and recreational activities for youth and adults, including sports programs and more traditional cultural programming such as hunting, fishing and trapping. Annual plans and budgets guide activity, and the community has a long-term development plan and five year capital plan; and
- **Policing and Emergency Response Service:** Responsible for local constabulary and volunteer fire department, including ambulance and medivac services (CNP 2010c).

In addition to the administration described above, staff was hired specifically in relation to the Project to manage the OWL (Our Lands and Waters) process. This staff was responsible for, among other things, providing support to Chief and Council in negotiations with Manitoba Hydro.

A Junior Chief and Council are also part of TCN's governance structure, although at present this group is not very active. Community Elders continue to play an important role in the community, in particular in regards to decisions regarding resource and land use.

TATASKWEYAK CREE NATION – GOALS AND PLANS

Tataskweyak Cree Nation's community planning and capital planning processes have been in place for over four decades. Plans are updated periodically in consultation with the community to reflect the overall status of infrastructure, facilities and services. "The most recent Plan, Tataskweyak Cree Nation Community Plan Update, recorded all completed buildings and infrastructure to date. The 2003 Plan also reported on future development including cost estimates for all anticipated buildings and infrastructure projects for the next 20 years" (CNP 2010c).

As with all TCN community planning, TCN recognized that control over the development of lands within its traditional resource area are key to future economic sustainability. The 1992 NFA Implementation Agreement established the Split Lake RMA and the Split Lake RMB. This provided TCN with influence over resource allocation decisions within the RMA as the RMB is able to provide recommendations to the federal and provincial governments on activities in the area. The vision of being a self-sufficient community requires "shared use of resources with the Split Lake (RMA) according to a long-term regional economic development strategy. This strategy is based on sustaining the natural environment through careful management, with an understanding of the inter-relatedness of all things" (TCN 2001).

The TCN land use objectives, as approved by Chief and Council in 2002, relate to the natural environment, the interrelatedness of all things, the capacity of the Split Lake RMA to sustain TCN, to domestic harvesting, traditional lifestyles, protection of TCN gravesites, protection of sacred sites, protection of traditional sites, benefits from resource development, protection of TCN development options, recognition of spiritual values, and shared use of the RMA (CNP Keeyask Environmental Evaluation Report).

The NFA Implementation Agreement also established an Economic and Social Development Account, and identifies how monies paid into a Trust can be used. Appropriate uses of monies from the Economic and Social Development Fund include:

- Economic development;
- Employability and employment development;
- Cultural and recreational enhancement;
- Social development initiatives; and

- Community infrastructure development, capital development, and the related operations and maintenance costs.

Investments (permitted both on and off-reserve) can be made with the approval of Chief and Council and the Split Lake Cree Trustees to further enable TCN to achieve the goals and plans. The Keeyask AEA provides additional monies to the Economic and Social Development Account ($3 million as full Residual Compensation), which may enable decisions/activities that TCN leadership believe to be of benefit to the community.

WAR LAKE FIRST NATION – GOVERNANCE

The predecessors of the WLFN are Members of the Split Lake Band (or today's TCN), although its membership has affiliation with many First Nations. WLFN achieved Band status in 1980, when reserve lands in Ilford were acquired as part of its TLE selection. A Chief and two Councillors govern WLFN under a custom electoral system that was implemented in 2005. The Chief and two Councillors serve a three-year term.

"Chief and Council are mandated to provide leadership, guidance, service and accountability to all WLFN Members in an impartial and just manner" (CNP 2010e). They are supported by an administrative structure with departments including finance and administration, health and social services, education, and public works. Each department follows established policies and procedures, adheres to plans and budgets, and is managed by a designated employee or committees, and reports to Chief and Council A five year capital plan is in place for the community and a long-term economic strategy is being developed (CNP 2010e).

Services are delivered to WLFN Members by various departments and organizations including:

- Public Works;
- Future Development;
- Awasis Child and Family Services;
- The Mooseocoot Housing Authority;
- The Mooseocoot Education Authority; and
- The Recreation Committee.

As described in Section 2, when the NFA was signed, WLFN was not a separate community, but rather a part of the Split Lake First Nation (now TCN). Since the NFA was not successfully implemented in the years post-signing, the First Nation signatories pursued negotiations for independent implementation agreements, specific to their impacts. During this same timeframe, the WLFN received status as an independent Band and community. As such, when the 1992 Split Lake Comprehensive Implementation Agreement was signed, WLFN Members were excluded from any benefits of the agreement, as they were not considered among the original signatories. The comprehensive agreements that were signed established specific relationships/responsibilities among the signatory First Nations, the province, the federal government, and Manitoba Hydro. WLFN pursued their own interests relevant to their community and in 2005 signed the War Lake Past Adverse Effects Agreement with Manitoba Hydro and the Province of Manitoba. The agreement establishes the Moosecoot Trust, which is administered by three trustees appointed by Chief and Council.

War Lake First Nation is located at Ilford, which is a Northern Affairs Community represented by a Mayor and Council under the *Northern Affairs Act*. Ilford is governed by a Mayor and five Councillors, some of whom are also Members of the WLFN Band. Ilford has a community Council office, and provides service to WLFN including water and sewer, a pumper truck for fire fighting, and maintenance of roads.

There are negotiations underway between the provincial and federal governments for additional parcels of land within Ilford to be transferred to WLFN through the TLE process. This includes lands with additional housing and infrastructure.

WAR LAKE FIRST NATION – GOALS AND PLANS

In 2008, WLFN submitted a long term development strategy to INAC, which identified the following priorities:

- Further development and implementation of an accountability structure for program and service delivery;
- The development and implementation of a new housing policy;
- The recruitment of a band manager responsible for financial management; and
- The implementation of the human resource policy manual (completed in 2008) (CNP 2010e).

Negotiations with Manitoba Hydro resulted in WLFN's 2005 NFA Implementation Agreement that provides compensation and benefits to assist in development opportunities and resources to improve the quality of life in their community. As part of this 2005 agreement, the Mooseocoot Trust was established to address past adverse effects, and provides for a community development fund for the associated income. Funds from the Trust are intended to benefit the entire community (and not individuals) and spending must be approved through a community approval process. Each year, War Lake Members and community organizations may submit proposals for approval, and the community is able to vote on how the funds are spent. Proposals must be in line with the intent of the Implementation Agreement, and funding can be awarded for plans related to the implementation of the agreement, for the economic, social and cultural development of the community, for compensatory, mitigatory and remedial programs, or for other undertakings deemed beneficial to the community (WLFN *et al.* 2005). Additional monies as full Residual Compensation are part of WLFN's Keeyask AEA, whereby $255,000 is to be paid into the Mooseocoot Trust for projects the community has determined are beneficial.

5.3.1.1.2 Fox Lake Cree Nation

GOVERNANCE

In 1912, FLCN established a permanent settlement at Kettle Rapids, which had traditionally been a meeting place of some Fox Lake families. This marked the beginning of a continuous relationship between FLCN and what is now the town of Gillam (FLCN 1997). In 1947, Indian Affairs officially recognized FLCN as the Gillam Band, with a population of 95 Members. At this time FLCN began a lengthy process to establish a reserve in the Gillam area where Members had resided "for many years prior to the establishment of the LGD of Gillam" (FLCN 1997). It was not until 1985 that a reserve was created in Bird (approximately 53 km north-east of Gillam) and many FLCN Members feel that "the Bird Reserve was created as a community primarily as a result of the inability to secure a reserve in the vicinity of Gillam" (FLCN 1997). In 2009, FLCN established the A Kwis Ki Mahka Indian Reserve on Kettle Crescent in Gillam, as is described in Section 4.3.2.

Today, FLCN is governed by a Chief and three Councillors under a custom electoral system. Chiefs and councillors do not have a set term in office. The portfolios of the current Councillors cover a broad range of subjects. One portfolio is focused more towards social programming including daycare/Headstart, membership, education, training and employment, health, Awasis (child and family services), youth, gaming, land and trust, TLE, and the FLCN Final Settlement Agreement. The second portfolio addresses housing, operations and maintenance, economic development, justice, Fox Lake contracting, fire prevention and emergency measures organization, Framework Report (past grievances), treaties, research and specific claims.

There are also several FLCN institutions that support community decision making:

- Fox Lake Housing Committee;
- Local Child Care Committee;
- Fox Lake School Education Authority;
- Lowland Cree Development Board; and
- Fox Lake Resource Management Board.

For each of these, FLCN provides notice of vacancies to Members and requests individuals who want to participate to submit a letter of interest to Chief and Council, who then appoints Members to the committee, authority or board.

Until recently, the majority of FLCN Members (over 75%) resided off-reserve, with a large portion (over 500) of these Members located in Gillam. With the creation of the A Kwis Ki Mahka Indian Reserve in Gillam in 2009, this proportion shifted somewhat, with about a third of residents in Gillam now residing on-reserve on Kettle Crescent. The community, irrespective of whether they live in Gillam or Fox Lake (Bird) is administered by the Band Office at Fox Lake (Bird). Although there are no plans to increase the number of positions on FLCN's Chief and Council or administration at present, it is expected that the creation of the new reserve will result in additional administrative duties (*e.g.*, applying for CHMC housing programs to develop further housing on-reserve in Gillam) (FLCN KPI Program 2009-2011). Fox Lake Cree Nation also has an administrative presence in the town of Gillam. Examples of this include the Fox Lake Negotiations Sub-Office (the main office is located in Winnipeg), the Awasis Agency (child and family services), and a placement home for the elderly.

In recent years, FLCN has asserted its role as a long-term resident of the town of Gillam, by ensuring that its presence is acknowledged in town signage (*e.g.*, at the airport and upon driving into the community), and other monuments (*e.g.*, the memorial monument in front of the Gillam Hospital). Among the processes in which Fox Lake and Manitoba Hydro participate jointly, is the Harmonized Gillam Development (HGD) process (see Section 5.3.1.1) which also involves the Town of Gillam and the province on an "as-necessary" basis (Gillam KPI Program 2009-2010).

Recent involvement with Manitoba Hydro has resulted in the potential for improved governance as Members develop skills, knowledge and resources (FLCN 2009c).

GOALS AND PLANS

Fox Lake Cree Nation was not part of the NFA (signed in 1977) and concerted efforts and negotiations to resolve Fox Lake's outstanding grievances with Manitoba Hydro did not start until 1993. In 1997, FLCN formally identified the scope of impacts and grievances in their 1997 Grievance Statement: Forgotten Nation in the Shadow of the Dams. In 2004, the Fox Lake Settlement Agreement was completed with Manitoba Hydro and the Province, resulting in compensation for past and future hydro development adverse effects and provisions for a Nikanihk Itapowin (Future Vision) Trust to be established to promote the economic, spiritual and cultural well-being of Fox Lake citizens, civic improvement and recreation. Each year, FLCN Members, community organizations or Chief and Council may submit proposals for approval by the Trustees. If a proposal is large in nature or large in amount, a community meeting is held to seek community consent prior to approval. Proposals must be in line with the intent of the agreement. Following the meeting of FLCN Members, the Trustees are empowered to make a decision on the allocation of available funds.

A long time goal of FLCN has been to establish a reserve in Gillam, which was realized in 2009 with the establishment of the A Kwis Ki Mahka Indian Reserve on Kettle Crescent. This may intensify the demands on the community's leadership and administration, as the new reserve has created a challenge of accommodating FLCN Members in Gillam and Bird in an equitable manner. Some community Members feel there is a disconnect created by their geography, as Members in Fox Lake and in Gillam are not only separated by distance, but have access to different services and amenities (FLCN KPI Program 2009-2011).

The establishment of a reserve in Gillam provides several opportunities for FLCN. First, it will allow for more land for housing and access to funding through the CMHC. It will also allow for economic development as it provides a tax free basis for business development. In addition, it may allow access to programming that would otherwise only be available to Members residing in Fox Lake (Bird), such as social assistance. Perhaps most importantly, reserve status offers FLCN a sense of place, as the establishment of a reserve recognizes officially that Gillam is "home" (FLCN KPI Program 2009-2011).

Despite the establishment of an urban reserve in Gillam, FLCN have continued ambitions to acquire additional parcels of land to set aside as reserve lands. Three of these parcels were identified under the FLCN 2004 Settlement Agreement to be transferred as fee simple lands to the FLCN Land Corporation:

- The Angling Lake Site;
- The Sundance Site; and
- The Limestone Construction Camp (when Manitoba Hydro no longer requires the site for the potential Conawapa Generation Project).

In addition to this, FLCN has requested the transfer of 80 acres of land called the Kettle River Site from INAC to FLCN for the purposes of reserve land, as a partial fulfillment of their outstanding TLE selections (Fox Lake Settlement Agreement 2004). Many Fox Lake Members also reside in the Gillam Trailer Court, resulting in an interest of FLCN in ownership of the land related to FLCN units in the Gillam Trailer Court. No decisions have been made by INAC on additional transfer of Crown land (beyond the A Kwis Ki Mahka Reserve).

Another long time goal for FLCN has been to improve its relationship with Manitoba Hydro, which plays a dominant role in the community's economy and contributing to the community's overall size/population through its workforce requirements. Progress is being made towards this goal through the Gillam Harmonization Process, which was formalized by an agreement to facilitate joint initiatives in Gillam between FLCN and Manitoba Hydro (see Section 4.3.3.2).

The Joint Statement on Harmonized Gillam Development (HGD) was signed by FLCN and Manitoba Hydro in 2007. Key features of the statement include:

- "Clarification on sharing of long-term goals and objectives of FLCN, Manitoba Hydro, the town of Gillam and, where applicable, Manitoba in the Gillam area;
- "Identification of challenges and issues, which have arisen in the past and with future developments, and of opportunities to implement planning and development activities that provide for mutual gain; and
- "A regular process of interaction to discuss mutual interest" (FLCN and Manitoba Hydro 2007a).

Prior to the establishment of the HGD there was no regular process for Gillam-area stakeholders to discuss issues of mutual concern and interest. The HGD has focused on building a community where residents work, play and prosper together. One of the most important outcomes of the process has been improved relationships and more open communication among stakeholders (FLCN KPI Program 2009-2011; Gillam KPI Program 2009-2010).

The HGD provides a forum for FLCN to express its interests and concerns to other local stakeholders. Issues under discussion may evolve and change. Among the current interests of FLCN in the HGD process are:

- Building better business relationships with Manitoba Hydro;

- Developing cultural training for Manitoba Hydro (which is now mandatory for Generation North employees and also provides spaces for Gillam residents not associated with Manitoba Hydro);
- The development of the Via Rail Station as a tourist attraction; and
- Youth and recreation opportunities in the community (FLCN KPI Program 2009-2011).

5.3.1.1.3 York Factory First Nation

GOVERNANCE

In 1910, YFFN signed an adhesion to Treaty 5 at York Factory. In 1957, the Government of Canada relocated YFFN Members to York Landing (*Kawechiwasik*), as described in Section 2.2.3.3. Only one year after their arrival at York Landing, Manitoba Hydro started the construction of the Kelsey Generating Station, followed by the LWR and CRD projects, which reversed seasonal flows on Split Lake and along the Nelson River. Hydroelectric developments were met with a sense of loss of control over the community's ability to influence and address concerns for the community (YFFN Evaluation Report (*Kipekiskwaywinan*)). YFFN eventually became Members of the Northern Flood Committee as a means to assert their rights. This was a time when community governance shifted towards younger generations that were educated in English and capable of negotiating and bargaining with provincial and federal authorities.

Today, YFFN is governed by a Chief and four Councillors under a custom electoral system. Chief and Councillors serve a two-year term, although some discussion has occurred in recent years about extending this term to three years. Portfolios typically held by Councillors include management/community development, health, community infrastructure, education and housing, and social development.

There are also several YFFN institutions that support community decision making:

- York Factory Housing Authority;
- York Factory Education Authority;
- York Factory Daycare Board;
- Learning Institute Board; and
- York Factory Resource Management Board.

Members of these organizations are either elected or appointed by Chief and Council. There is also a volunteer recreation committee. The York Factory RMB was formalized by YFFN's Comprehensive Implementation Agreement in 1995.

GOALS AND PLANS

In York Landing (*Kawechiwasik)*, YFFN envisions future community planning to include a focus on improving their Members' connection to Cree culture, customs and traditions, while enabling successful and active participation in modern society (YFFN Evaluation Report (*Kipekiskwaywinan*)). A focus on children and youth means ensuring there are meaningful opportunities within the community at York Landing (*Kawechiwasik)* for those who choose to live there. There is an awareness within the community that children and youth should "be able to retain their Cree culture and language and be proud of who they are and where they have come from." (YFFN 2004a). Among the initiatives underway are activities associated with "nation-building, governance and institutional strengthening that could contribute to improved community wellness and sustainability, *e.g.*, the various economic development and social services portfolios of the Band Council and Administration, Future Development Office initiatives and operations, the Awasis Centre… the Annual Goose Camp where traditional knowledge and skills are shared with youth, the York Factory Learning Institute and the modern school and recreation facilities. These and other such initiatives may help to redress the stresses felt in the current socio-economic environment of YFFN" (YFFN 2004b).

The YFFN community has a desire to connect fully with their history at York Factory and in their RMA along the Hudson Bay coast. Many YFFN Members "choose to live York Landing (*Kawechiwasik*) and come together for traditional dances, goose camps, and feasts, and return to [their] territory at York Factory (*Kischewaskahekan*) as often as [they] can" (YFFN Evaluation Report (*Kipekiskwaywinan*)). Although the area is more difficult and costly to access from York Landing (*Kawechiwasik)*, the community believes this area is important to their future well-being (YFFN 2004a). The York Factory RMA offers not only resource harvesting opportunities for its Members, but also potential for ecotourism development (YFFN KPI Program 2009-2010). Cultural camps, sites and programs have been established to reclaim and maintain their Cree language and traditional relationship with the land, water, fish and wildlife, and help intergenerational relationships in the community (York Factory website).

York Landing (*Kawechiwasik)* and YFFN remain geographically isolated from the outside world and have identified the need for infrastructure to assist in achieving their community goals and plans (YFFN 2004a). Among the things the community has identified it would like to see to improve its overall well-being are:

- A water treatment facility capable of addressing community concerns about the colour, smell, taste, and associated boil water advisories; and
- Infrastructure to improve the community's accessibility (*e.g.*, a reliable ferry landing in the short-term, and the longer-term ideal of an all-weather road).

York Factory First Nation is hesitant about its partnership in the Keeyask Project but recognizes that long-standing sentiments of distrust will not change quickly. "We have been working with our partners to develop and manage the Project in accordance with our Cree values and worldview. As a First Nation, and as a Partnership, we need to make a strong commitment to stewardship and to maintaining our relationship to the land" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

5.3.1.2 Gillam

GOVERNANCE

In 1966, the Province and Manitoba Hydro entered into agreement to create the Local Government District (LGD) of Gillam, in which the Town of Gillam is located. This decision was made when FLCN was awaiting approval for a reserve in Gillam (FLCN 1997). It was mandated, among other things, to oversee the development of Gillam and to ensure that essential services and infrastructure were in place to serve the population arriving in the area to construct the Kettle Generating Station. At this time, there was a shift in governance from an area with limited political structure to a town with an elected council, and considerable inputs from Manitoba Hydro. A Town Planning Scheme was developed in 1968, a Development Plan created in 1979, and a Zoning By-Law implemented in 1984; although there is acknowledgement that these documents need to be updated to respond to the existing conditions (Gillam KPI Program 2009-2010).

The Town of Gillam operates under an agreement signed with Manitoba Hydro in the 1960s, as the town has a limited tax base or tax revenues to fund its activities. Manitoba Hydro covers 100% of the Town's capital costs. Operational budgets are negotiated annually. The Town or Manitoba Hydro has the ability to cancel this agreement at any time and generally speaking the relationship between the two entities is amicable (Gillam KPI Program 2009-2010). Today, Gillam is governed by a Mayor and four Councillors who are elected for a four-year term.

Although the Town of Gillam and Manitoba Hydro are linked through their existing funding arrangements and are in regular communication, in recent years the Town of Gillam has begun to recognize the importance of interaction with FLCN, in particular as the First Nation worked towards the establishment of a reserve in the community. In recognition that the creation of a reserve within the town limits could create jurisdictional challenges in terms of basic service delivery for residents, the Town of Gillam and FLCN entered into a Municipal Services Agreement. The Agreement identifies facilities and services subject to cost sharing, as well as processes that both parties must adhere to for changes to land use in the community. The Agreement is intended to address jurisdictional issues as land is transferred to federal jurisdiction as reserve land, and to ensure that all of the residents of Gillam have equal access to the services the Town provides.

GOALS AND PLANS

The Gillam land use planning study undertaken through the Gillam Harmonization process identified the following community needs:

- The need to develop housing (in particular to attract long term employees);
- The fact that certain services, including the school and the day care, are already operating at capacity;
- The potential need to relocate the RCMP detachment to accommodate growth of the unit;
- The potential for the Co-op for example to develop a new site for its gas station; and

- The fact that the Gillam Mall is dated and requires redevelopment (HTFC 2008).

The development frameworks, partnerships and funding required to address these needs may place greater than normal demands on the municipal government in Gillam in the next decade.

Despite current efforts to improve relationships between Gillam stakeholders, communication between groups such as Manitoba Hydro, FLCN, and the Town of Gillam historically were irregular and at time adversarial. As noted in the previous section, the HGD process was designed to accommodate growth in Gillam while considering the interests of different stakeholders. Under the HGD process, the Town of Gillam has expressed interest in developing a community culture and a sense of permanence for the community. It supports development that can accommodate growth in the residential, commercial, industrial and recreational sectors.

The HGD has identified the following areas requiring further joint efforts between MH, FLCN and the Town of Gillam:

- Re-plan the commercial area including Railway Street and the train station area with consideration of the immediate needs for a new mall, FLCN government building, and Hydro accommodation requirements;
- Re-plan the trailer court with consideration to FLCN's ambitions for reserve land; determine development program for lot size, distribution, services, performance standards, *etc.*;
- Develop qualitative development standards that are supportive of private development;
- Identify areas suitable for higher density residential development;
- Develop service and infrastructure expansion plans;
- Develop options to make the community more pedestrian friendly (pathways, trails, *etc.*);
- Update the Community Development Plan and Zoning By-law in a matter the reflects all parties needs;
- Develop railway crossing options that integrate the community in a safe manner and apply to all rail crossings; and
- Consider private investment and management opportunities for Manitoba Hydro employee housing as a means to integrate Hydro's needs within the fabric of the community rather than as separate developments (HTFC 2008).

As a result of these discussions, the Town of Gillam has drafted an updated community development plan. The plan provides a vision for the community to be "a safe, family oriented, close-knit community where residents and visitors enjoy a vibrant historic full service town, unique natural beauty, and outdoor adventure" (Dillon Consulting 2012).

5.3.1.3 Thompson

GOVERNANCE

Thompson is governed by a Mayor and seven Councillors who are elected for a four-year term. The current Mayor and Council consist of individuals who grew-up in Thompson and witnessed the changes that have shaped the community over the years, including the city's industry-centred development. The current leadership and administration have a positive outlook for the community and are taking greater control over planning and future development of Thompson as a regional centre (Thompson KPI Program 2008-2009).

Mayor and Council have roles related to representation, policy-making, and management of the municipality's resources. The standing committees of council are as follows:

- Recreation and Community Services Committee;
- Finance and Administration Committee;
- Legislative and Intergovernmental Affairs Committee;
- Human Resources Committee;
- Public Safety Committee; and
- Public Works and Infrastructure Committee.

Development Review Committee (City of Thompson 2010).There is usually little in the way of formal public participation in decisions; participation in community hearings or other public events is typically low, although Council are responsive to community inquiries and complaints. The exception to this trend is when large projects or controversial issues arise, whereby the Mayor and Council will consult with the public prior to making a decision. If a community member contacts the Council with a concern about a policy or bylaw, Council makes attempts to address that concern (Thompson KPI Program 2008-2009).

In the past five years, Thompson has experienced rapid growth from an expanding local economy and population. This has created substantial demands on the elected council to address infrastructure needs and social challenges that have accompanied this growth.

GOALS AND PLANS

According to the Thompson Planning District Development Plan (the Plan), the City of Thompson is experiencing dramatic economic opportunities on a number of fronts. The Plan specifically highlights the mining industry, which is currently going through a period of transition as well as hydroelectric power development in the region. The Plan acknowledges that these opportunities will have a major impact on the community in the immediate future and that they do not come without challenges (Thompson Community Planning Services Office 2008). Given Vale's announcement in 2011 that the smelter and refinery will be closing in 2015, it is likely that aspects of the Plan will be revisited by the community. The Plan outlines primary goals in the areas of the environment, sustainable development, social development and economic development. The Plan notes that increased pressure may be placed on existing residential, commercial, industrial and recreational inventories. It also points out that with the changing demographics of the community, there is an increased demand for a variety of residential housing choices, as well as demand to accommodate different commercial formats as the retail sector evolves (Thompson Community Planning Services Office 2008).

The City of Thompson has committed to a sustainable future by developing a sustainable community plan (SCP). The SCP provides a vehicle through which long term community sustainability goals can be met, to develop future land use and infrastructure policies and to assist in the coordination of policies and actions. In addition, the SCP lays out strategies for growth management and sustainable asset management for the City of Thompson. The plan includes key themes such as diverse housing opportunities, protection of natural environments and the development of a major City Park Network to be used as a "building block" for local sustainability. The SCP is a starting point to achieving Thompson's 2010 vision for sustainability, which will be attained through short, mid and long-term actions and partnerships of a vast group of stakeholders. The SCP will be implemented by adopting the best practices related to land use planning and development. It was noted in the plan that while "innovative practice by municipalities and partner organizations could be used to develop or implement a SCP"; in some cases the Best Practices will depend on Provincial enabling legislation (City of Thompson 2010a).

There are numerous projects planned for Thompson (and surrounding areas) by the City of Thompson, industry, and others. Among the known developments planned over the next five years are:

- Construction of a cold weather aerospace engine testing plant;
- Development of Phase 3 of the Regional Recreation Centre;
- UCN campus, dormitory house and childcare facility;
- Renewal of water sewer and streets;
- Low income housing units; and
- New water treatment plant on north side of the river.

Potential Projects that may be developed include:

- New subdivisions and commercial development with expansion of city boundaries; and
- New airport terminal (Thomson KPI Program 2008-2010).

Amidst the planned developments, there are also potential closures of existing facilities. As noted above, Vale announced in the fall of 2010 that the smelter and refinery will be closed and demolished in 2015. The City of Thompson has since joined with Vale to create the Thompson Economic Development Working Group, which is designed to help the city develop an economic diversification strategy in light of the closure (Flanagan 2011).

In addition to the above projects/plans, the City of Thompson recognizes that the Aboriginal population is an important attribute of the community. As such, the city has been working with the MKO, which has been contracted to provide administrative support for a Thompson Urban Aboriginal Strategy. The strategy prioritizes improving life skills, supporting Aboriginal women, children and families, and promoting job training, skills and entrepreneurship. The strategy is lead by a steering committee consisting of 15 people from various social services and health organizations, Aboriginal organizations, the City of Thompson, Vale Inco, and the provincial and federal governments. Two successful projects implemented under the strategy to date include the creation of eight affordable housing units (targeted for families with children attending schools in Thompson), and the creation of an additional 20 spaces in home daycares (Thompson KPI Program 2008-2010).

5.3.2 Community Health

The communities in the Local Study Area fall within the Burntwood Regional Health Authority (BRHA). The BRHA delivers health care to residents of a large geographic area spanning more than half the province's land mass. Among the challenges faced in the delivery of health care services is the fact that many communities, including two of the KCNs communities (WLFN and YFFN), are not accessible by all-season roads. Transportation can be a consequential barrier to accessing health services (BRHA 2009a) (see Section 4.3.3 for a description of the health facilities and services available in the Local Study Area).

The BRHA is also unique in that 72% of its population is Aboriginal. First Nation Members residing in the region who live on-reserve receive health care services on-reserve through the federal First Nations and Inuit Health Branch (FNIHB). These residents also access services off-reserve through the BRHA as necessary (*e.g.*, physician services as required, screening services, and hospitalization). Jurisdictional challenges exist relating to access to health services and are addressed through strong relationships with Aboriginal organizations such as the MKO and KTC, as well as through dialogues with First Nation communities and FNIH (BRHA 2009a).

As described in Section 5.2.2, health is influenced by a wide variety of factors, which makes it challenging to describe the overall health status of a community. Drinking water quality, food choices, behaviours such as smoking, level of physical activity and air quality all affect health. Socio-economic factors such as housing, income social status, education, early childhood development, and family and community supports must also be considered. Measuring these determinants of health can be challenging due to the breadth of factors that can contribute to health and the availability of data. Data on some indicators are not routinely collected and may be only available through sources such as surveys or community consultation. For example, while incidences of lung cancer may be collected, statistics on smoking rates among young adults are not readily available. Further, a full understanding of community health requires consideration of both health indicators, (*e.g.*, determinants such as birth rates and infant health, hospitalization and physician visits, communicable disease and mortality), and community perspectives on health and well-being at the individual and community level. This section presents health indicator data for the KCNs communities, Thompson and Gillam, as well as information on community-based understanding of health and well-being.

5.3.2.1 Keeyask Cree Nations

5.3.2.1.1 Perspectives on Health and Well-being

Mino-pimatisiwin means living a good and honourable life. *Mino-pimatisiwin* includes many things such as being a good person, respecting *Askiy*, harvesting and consuming healthy *Ininewak* foods, and following Cree values (see Chapter 2 of the EIS for further detail). Adelson, in her work on Cree concepts of health and well-being, describes this in saying "Someone is said to be *miyupimaatisiiun*[1] if he or she eats the right foods, keeps warm and performs the activities needed to accomplish one's goals, whatever they may be" (1998). "Indeed, from a Cree perspective, health has as much to do with social relations, land, and cultural identity as it does with individual physiology" (Adelson 2000).

Adelson argues that the Cree concept of health "cannot be understood outside of the context of colonial and neo-colonial relations in Canada. Aboriginal people in Canada continue to live with the effects of displacement, discriminatory legislation, failed attempts at assimilation, forced religious conversion, and pervasive racism" (Adelson 2000). The KCNs have described such circumstances in different ways.

For CNP, this is expressed as they evaluate harmony and balance in their ancestral homeland ecosystem (see CNP Keeyask Environmental Evaluation Report). Before contact with Europeans, the ancestral homeland ecosystem was intact and capable of sustaining their population. Upon contact, activities/policies such as the *Indian Act*, cash payments to First Nations, the signing of Treaties, schooling, the construction of the Hudson Bay Rail line, the *Migratory Birds Convention Act* , the Natural Resources Transfer Agreement and the implementation of the registered trapline system, slowly began to erode the ancestral homeland ecosystem and created an unbalanced system. The onset of Manitoba Hydro's activities placed further pressure on this system, and at present the communities feel as though the vital relationships that sustain the community are "the weakest in (their) history" (CNP Keeyask Environmental Evaluation Report).

FLCN's history describes numerous events, activities and policies that affected their community, who before contact with Europeans lived with intimate familiarity with their surrounding environment, guided by concepts such as *pimatisowin* and *oochinehwin*[2]. Events that transformed the community in one way or another include the signing of the adhesion to Treaty 5, the construction of the Hudson Bay Railway, the Indian residential school system, the closure of York Factory in 1957, settlement at Gillam, and struggles to secure reserve land, among others. Some of these changing circumstances were complimentary with FLCN's lifestyle (*e.g.*, people were able to incorporate seasonal employment with the rail line along with traditional pursuits), while others often had negative consequences (*e.g.*, the Indian residential school system). Perhaps the most profound of all these experiences was the construction of three hydroelectric

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[1] Adelson's work focused on the Whapmagoostui Cree of northern Quebec whose dialect translates mino pimatisiwin to miyupimaatisiiun. FLCN has identified Adelson's work as an accurate reflection of their community's ATK in relation to health.

[2] The Cree term oochinehwin refers to known consequences for inappropriate behavior as described in Ninan (FLCN 2009 DRAFT).

generating stations in FLCN's traditional territory. Not only did this affect FLCN's relationship with the land and waterways "but also with each other and with the town of Gillam" (FLCN 2009a Draft).

YFFN describes their experiences in saying, "Our First Nation has been subject to successive forms and practices of colonialism since the 17th century" (YFFN Evaluation Report (*Kipekiskwaywinan*)). Major events that have shaped the community include its role in the fur trade at York Factory, joining the Anglican Church, signing Treaty 5, and relocation to York Landing in 1957. Just as the community was becoming familiar with their new surroundings resulting from the forced relocation to York Landing, hydroelectric development resulted in profound changes to their surrounding environment. Of particular concern to the community in this regard is the decline to water quality the community has witnessed over time. However, YFFN remains certain that the community's ability to adapt to imposed changes is likely to prevail once again. This perspective is reflected in YFFN's Evaluation Report, which states: "The people of York Landing have seen many changes over the years and yet they have maintained their proud cultural traditions adapting to major disruptions such as relocation, the loss of their traditional lands, and the impacts of major hydro-electric projects. Today, the people of York Factory First Nation are preparing for the future by re-establishing their connection with the land, and becoming more self-reliant again" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Adelson's understanding of *pimatisowin* "has everything to do with life on the land" (2000) and is "inseparable from being able to hunt, pursue traditional activities, live well in the bush, eat the right foods, keep warm and provide for oneself and others" (Adelson 2000). Traditional foods from the land and water, which have sustained communities over the centuries, are acknowledged today as providing a better diet than what store-bought food typically provides (CINE 2006). Traditional foods are also acknowledged as providing for "strengthened cultural capacity and well-being" (CINE 2006). The ties between health/well-being and the land have been experienced firsthand by the KCNs, who maintain that the advent of hydroelectric development in northern Manitoba resulted in devastating effects to their abilities to pursue activities on the land and subsequently on community health. The factors affecting traditional food consumption patterns include but are not limited to:

- Loss of traditional ancestral hunting, trapping, and fishing locations;
- Unfamiliarity with the land and associated safety hazards and concerns;
- Need to go further afield to access traditional food sources;
- Concerns about water quality;
- Changes to the taste and texture of fish; and
- Concerns about mercury in fish.

(Split Lake Cree – Manitoba Hydro Joint Study Group 1996a; CNP Keeyask Environmental Evaluation Report; FLCN 2009a Draft, FLCN KPI Program 2009-2011; YFFN Evaluation Report (*Kipekiskwaywinan*); YFFN KPI Program 2009-2010).

These factors resulted in changes to diet and increased reliance on store-bought food, in addition to a shift to a more sedentary lifestyle. Such factors are thought to be linked to deterioration of health and increased incidences of modern illnesses (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a; FLCN KPI Program 2009-2011).

5.3.2.1.2 Community Health Assessment

Many northern and First Nations communities have undergone major changes over the past decades. While some of the changes have been beneficial, some of the changes have had negative impacts on health such as the decrease in physical activity; increasing high fat, high caloric, high sugar diet; access to cigarettes, alcohol, and motor vehicles, which can increase risks of injuries, diabetes, heart disease, obesity, and cancer. There have also been major changes in the socio-cultural-economic lives of First Nations people.

Health is influenced by the interaction of a wide variety of factors including physical, mental, emotional and spiritual components. Understanding KCNs' concepts and realities of health and well-being requires a holistic approach to considering the total health of a person within the total environment. A community health assessment recognizes the many layers of health and well-being and the things that make the community unique, including its social systems, environmental factors, and demographics. Many of these aspects are discussed in different sections of this document, in Section 3 on the economy, and Section 4 on population, infrastructure and services. An important component to the assessment is the development of a set of key community indicators or measures that will help describe the baseline state of health in the community. Criteria for selecting indicators include availability, timeliness of the indicator, validity, stability, reliability, and responsiveness. This often means that certain types of data (such as administrative data collected through births and deaths registries, hospitalizations and medical appointments) are included to a much greater extent than other types of data that may be more difficult or costly to collect.

After consultation and review of available data, this community health assessment includes information obtained through community visits and key person interviews along with administrative health data that was requested from Health Canada, the First Nations and Inuit Health Branch, and Manitoba Health (with permission received from each of the KCNs). Technical health documents were prepared for each of the KCNs separately. Due to the sensitivity of the contents of these documents, the information is summarized here for the KCNs collectively, in addition to reports for Gillam and Thompson.

A holistic picture of health status includes physical, mental, emotional and spiritual health issues. The scope of this section includes a review of broad health indicators as well as common health conditions and chronic diseases.

SELECTION OF HEALTH STATUS INDICATORS

The broad indicator areas in the KCNs' Community Health Assessment include Population, Births and Infant Health, Communicable Diseases, Hospital and Physician Visit Data and Mortality. Appendix 5A provides a brief description of some of the International Classification of Disease[1]classifications that may

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[1] The International Classification of Disease (ICD) is the international standard diagnostic classification for all general epidemiological, many health management purposes and clinical use. It is used to classify diseases and other

be reported on through the physician billing, hospitalization and mortality data. This disease classification system is endorsed by the World Health Organization (2010) and is used for all physician and hospital billing.

These broad ICD-10 disease classification areas are presented in this chapter if they were a "leading cause" of physician visits, hospitalization or death. In addition, specific indicators ("conditions of interest") within each area were chosen based both on practicalities such as availability of the data at the community level and providing the most comprehensive picture of health in each community. In some cases, data were not available for every community (for example information about chronic diseases). The results of the analysis were shared with each of the KCNs' respective health professionals in order to confirm whether the findings were consistent with experiences in the communities and to identify other issues not captured in the data.

Other important indicators and facets of health, including education, employment, income, services, language, culture, and spirituality are considered in other sections of this document.

Population

Information about population size and change helps identify how quickly communities are growing and if there are certain age groups growing at a faster rate than other parts of the population. Communities with largely young populations tend to have high birth rates, fewer people available for employment (proportionally as many are under age 15) and may experience specific health risks such as more injuries and fewer chronic diseases. From a First Nations perspective, population projections "suggest a growing demand for services – social, educational and health" and also "point to the impact on Bill C-31 on the future diminishing resources of the communities as their populations grow" (First Nations Regional Health Survey 2005).

Births and Infant Health

Information about births and infant health such as infant mortality and low and high birth rates provide very good information about the health of the community in general. For example, infant mortality rates have often been found to be one of the single best measures of health in a community, with communities that experience higher rates of infant mortality also experiencing higher rates of poor health overall. This is due in part to the fact that "Infants are considered to be vulnerable to adverse underlying social, economic, and environmental conditions. It is this vulnerability that makes infant health measures sensitive 'sentinels' to underlying population health determinants" (First Nations Regional Health Survey 2005).

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health problems recorded on many types of health and vital records including death certificates and health records. In addition to enabling the storage and retrieval of diagnostic information for clinical, epidemiological and quality purposes, these records also provide the basis for the compilation of national mortality and morbidity statistics by WHO Member States.

Communicable Diseases

Transmission of some communicable diseases is related to lifestyle, general health of the population and availability of resources to aid with personal hygiene. That is, certain communicable diseases are spread due to poorly cooked food, or lack of hand washing. Some general risk factors that can increase the burden of communicable disease include:

- Lack of access to safe water, sanitation and cooking facilities can put a population at increased risk of outbreaks of waterborne and food borne diseases;
- An overcrowded population increases the risk of transmission of communicable diseases, particularly respiratory diseases;
- Poor nutrition can impact a person's natural immunity and lead to more frequent, severe and prolonged episodes of infections; and
- Poor access to health services may mean that people do not receive treatment in a timely manner, which can impact that disease course and increase risk of transmission to others.

Selected Conditions of Interest

Most conditions of interest were selected based on several criteria including the relationship of the condition to water, conditions identified through research that are likely to be of importance to a northern community (such as diabetes or injury) as well as conditions identified by the KCNs as relevant to their communities. The specific conditions chosen for review include:

- Injury;
- Cardiovascular Disease;
- Infections of Skin and Subcutaneous Tissue;
- Mental Health Disorders;
- Diabetes;
- Congenital Anomalies diagnosed in newborns;
- Intestinal Infectious Diseases;
- Disorders of the Thyroid Gland;
- Hepatitis A;
- Noxious influences affecting newborns; and

- Mercury-related illnesses[1].

Physician visits data can provide information on how many people in a community are living with certain illnesses or experiencing certain events (such as injury). However, there is generally no administrative database used to record visits and diagnoses with a nurse at a nursing station (unlike physician visits where such data are generally available). Therefore these data can be of limited value for First Nations communities. While the physician visit rate can under-represent the true numbers of events in a community, it is still reported as an indicator to provide a picture of a community's health status.

Hospitalization data provide information about residents who were admitted as in-patients to a hospital (regardless of which hospital). This indicator provides information about illnesses that become severe enough for hospitalizations and what resources might be needed in the community to help people better manage their health. For example, if hospitalizations due to diabetes are increasing, it can be an indicator that the number of people living with diabetes is increasing but it can also suggest there may not be enough resources in the community to help people manage their diabetes before complications occur (as most people should not need to be hospitalized for this illness). Because these data include only people who have been admitted to hospital, it is reasonable to assume that in most cases the patient was ill enough to require hospitalization. However, in some cases, nurses in the community may determine that they have the resources to deal with a particular situation or to diagnose a problem and then refer the patient to hospital. Because the patient is transported from the community, they may be more likely to be admitted to hospital for tests or observation when a local community member may be more likely to be treated as an outpatient. Therefore, it is important to consider both acuity of illness and local resources in interpreting the hospital data.

Mortality

Mortality data are another set of information that can contribute to the understanding of the health status of the community. For example, the premature mortality rate (deaths before age 75) has been identified as one of the best single measures of health status and many researchers rely on this indicator above others to measure the health of the community. Communities with higher premature mortality rates also tend to have higher rates of illnesses, hospital utilization and poorer health overall. Mortality data by cause also provides information with respect to how many deaths may have been preventable (for example, those due to injuries).

LIMITATIONS OF THE DATA

The following sections describe the results of the community health assessment, which is based largely on available indicator data and community-based research results. One of the challenges in interpreting the data is that while each indicator presents information on a specific aspect of health, it is challenging to portray the concept of overall wellness. According to the First Nations Regional Longitudinal Health

[1] International Classification of Disease code 985.0 was used. 985.0 is a subcomponent of code 985 which is Toxic Effect of Other Metals. 985.0 specifically refers to Mercury and its Compounds and more specifically Minamata Disease. Minimata Disease is a neurological (brain) disorder caused by high levels of mercury poisoning.

Survey 2002/03 (2005), wellness "is a very complex and multilayered philosophy." The study goes on to explain that for First Nations, "human beings are connected to the natural world and thus to Creation, through many different levels or layers…all levels are interconnected" (First Nations Regional Longitudinal Health Survey 2005). Describing the overall interconnectedness between factors is a challenge, particularly as certain determinants of health have limited available data at the community level.

For example, one area of limitation in using a determinant of health indicator approach is an ability to consider the influence of certain risk factors. Information on risk factors includes personal health practices such as smoking, diet and exercise, which have important linkages to current and future health status of the population. While some risk factor data are available at the national level through tools such as the First Nations Longitudinal Health Survey, risk factor data specific to the Local Study Area are not readily available.

Generally, data used in the community health assessment were available for the years 1984-2006. Data are presented for this time period for population, infant health, physician visit and hospitalization data. In cases where data are collapsed into 10-year time frames, the two most recent time periods are usually chosen -1987-1996 and 1997-2006. In some cases, in order to present changes over time the earliest and latest time periods are chosen. Data presented are from Manitoba Health with the exception of some mortality data that was provided by FNIHB. In this case, the time period covered is not the same for each community and is not as lengthy as the time frame presented for the other health indicators as it was not available.

Data for Manitoba First Nations (as a whole) and the province of Manitoba are provided for comparison purposes where appropriate.

CAUTIONS IN INTERPRETING THE DATA

With individual communities, the size of the population can also be a limitation in identifying potential health issues because of the wide confidence intervals that result during the analysis. A change or impact needs to be fairly large in order to confidently say there is a statistically significant difference.

Several graphs presented in this section include the actual rates as well as the upper and lower 95% confidence intervals. Confidence intervals gives the range of rates in which are likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval.

The small size of the KCNs' population relative to Manitoba First Nations and the Province as a whole may result in more pronounced peaks and valleys in some of the graphs. This may not be indicative of an erratic trend, but rather may be a reflection of the small size of the communities whereby a relatively small number of incidents results in large changes from year to year.

Finally, when attempting to determine whether there are actual changes over time in disease burden or deaths as well as when attempting to compare different populations, rates are required. These may be presented as "per 1,000" residents or "%" (which is the same as "per 100 residents") *etc*. This means that comparisons can be made. However, it is often important when considering resources needed at the community level to also consider the actual number of patients, hospitalizations, deaths or other events.

This can assist in planning for health care resources, particularly in populations that may also be increasing (for example, if a community population is growing at the same rate as a certain illness, then there won't be an increase in "rates" shown even though the number of actual people requiring health care services for a disease has actually increased). This is why, in many cases, the actual number of events for community residents may be presented as well as rates for comparison over time as well as between the community and other comparison areas.

5.3.2.1.3 Health Characteristics Associated with Population Characteristics

An understanding of population lays the foundation for interpreting the health of First Nations communities (First Nations Regional Longitudinal Health Survey 2005). As discussed in Section 4.3.1, the KCNs have a young population with at least 40% of residents under the age of 20. This is a much different and younger population distribution than seen in Manitoba overall where only about 25% of residents are under the age of 20. KCNs communities are young and growing; according to Manitoba Health population data[1], overall they have grown by 40.5% between 1984 and 2006 (slightly higher than all Manitoba First Nations living on-reserve at 36%). Although the KCNs communities have a large population of young people, the population make-up of KCNs communities has changed over the past 25 years with an increasing proportion of the population in the 25 to 69 year age group and a decrease in the proportion of residents under 25 years.

Communities with larger numbers of young people like the KCNs may be more likely to have higher rates of illnesses or health needs related to younger people (such as issues related to pregnancy, immunization, child health and injury) than Manitoba overall. A younger community may also appear to have lower rates of illnesses such as chronic diseases or deaths because these issues typically happen later in life.

While only 4.7% of KCNs residents are over age 65 (compared to 13.8% of Manitobans), this group is growing (see Figure 5-2). This has an impact on the types and numbers of illnesses seen in the communities today compared to 1984. When more people in a community start living longer, this means that the community might start seeing some diseases that they have not seen in the past. For example, many chronic diseases such as diabetes, heart disease, and cancers are typically found in older people. Increases in rates of these types of illnesses are being seen in some First Nations populations. The prevalence of these conditions and the prevalence of individuals experiencing multiple conditions increases with age (First Nations Regional Longitudinal Health Survey 2005) and other risk factors such as diet, exercise and smoking.

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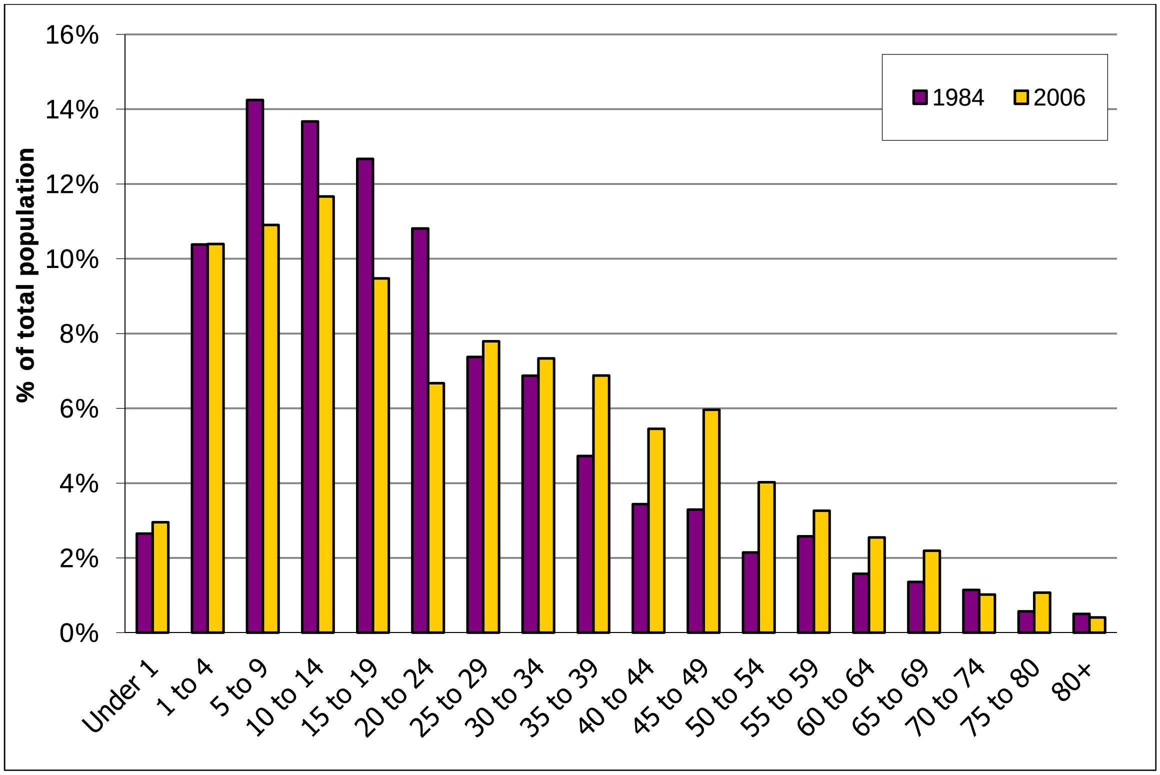
[1] Manitoba Health population data are presented in this section, as these figures are used to calculate rates for all health data provided by this source. For accuracy, it is important that both the number of health events, and the population used to calculate the rates, come from the same source. In cases where INAC has provided health or mortality data, population figures from the same source are used to calculate rates.



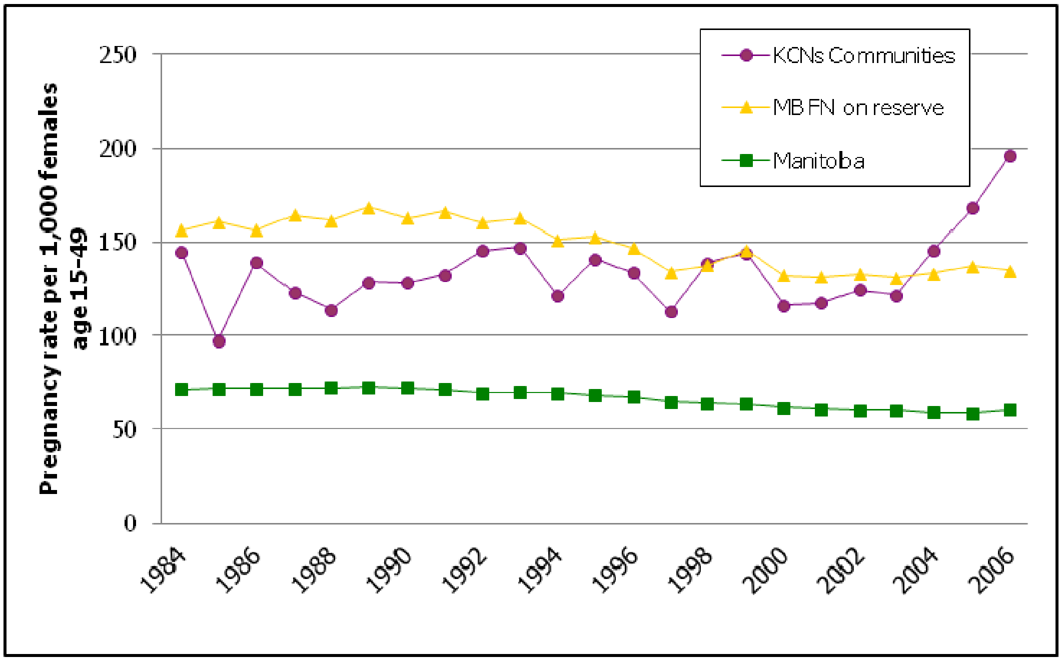
Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-2: Keeyask Cree Nations Communities Change in Population Structure (1984 and 2006)

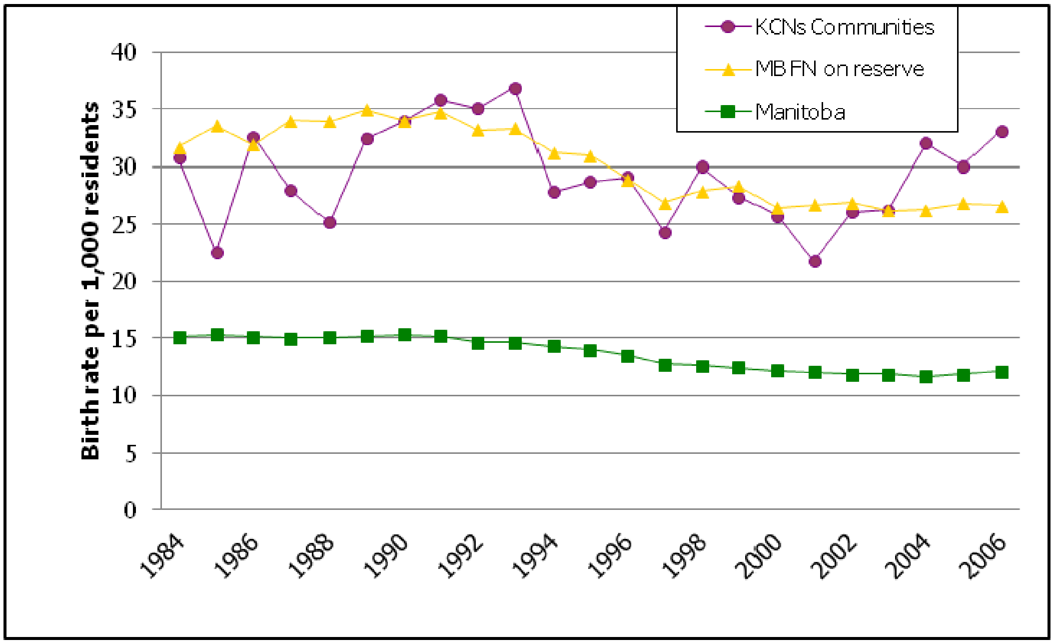
Since 2004, pregnancy and birth rates in the KCNs communities have been higher compared to Manitoba and to other First Nations residents living on-reserve. According to Manitoba Health data, in 2006 the pregnancy rate for residents of KCNs communities was 195.8 pregnancies per 1,000 females age 15 to 49 compared to Manitoba First Nations rate of 135.1 per 1,000 and Manitoba at 60.7 per 1,000 (see Figure 5-3 and Figure 5-4).



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-3: Pregnancy Rates Over Time, Females Age 15-49 (1984-2006)



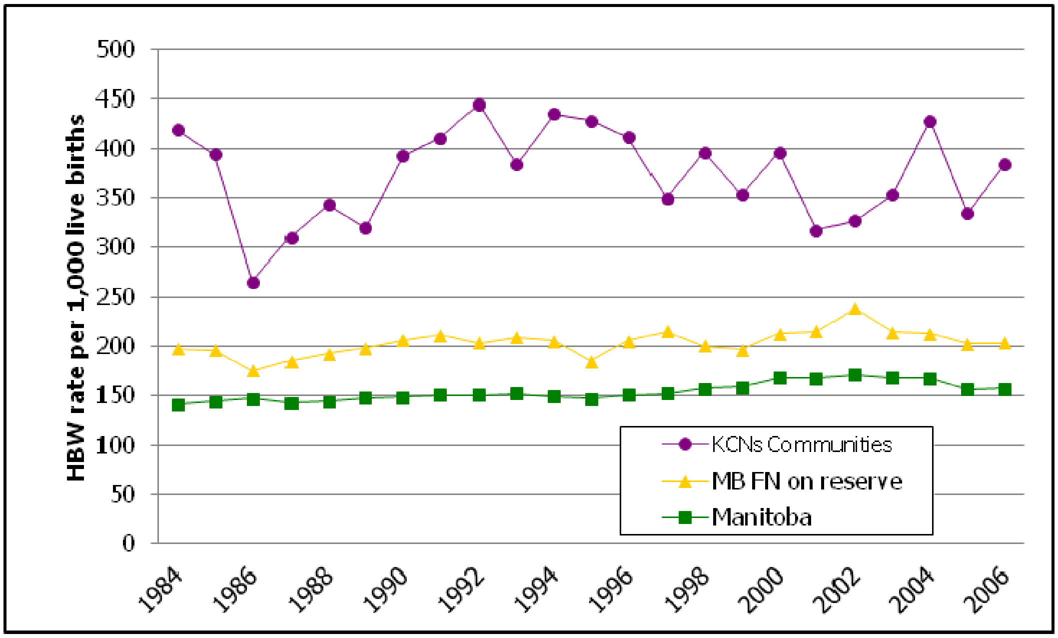
Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-4: Birth Rates Over Time (1984-2006)

Birth and pregnancy outcomes reviewed included low (LBW) and high birth weight (HBW) rates. International definitions of birth weight are used; low birth weight is defined as a birth weight of less than 2,500 grams and high birth weight is defined as a birth weight of more than 4,000 grams. These are medical definitions used for classifying the normal range of births. Risk factors for high birth weight infants include diabetes in the mother; and babies born at high birth weight are then themselves at increased risk for developing diabetes (Stene *et al.* 2001).

However, it is important to note that although there are increased health risks associated with both LBW and HBW infants, not all infants in these weight categories will have negative health impacts. In First Nations communities, HBW infants are typically much more common than LBW infants. For example, in 2006 there were 25 babies born weighing more than 4,000 grams to KCNs community Members (compared to fewer than five born at LBW). The 25 HBW infants among KCNs community Members can be converted to a rate for comparison to other areas. The KCNs' HBW rate of 384.6 infants per 1,000 live births was higher than Manitoba First Nations rate of 202.4 per 1,000 and the provincial rate of 156.4 per 1,000 in 2006. This means that in 2006, just over one in three babies born to a KCNs community resident had a high birth weight. While HBW rates among Manitobans appear relatively consistent, it does appear that there may be an increasing trend in HBW infants among KCNs residents (see Figure 5-5).



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-5: High Birth Weight Rates (1984-2006)

5.3.2.1.4 Diseases of Interest to the Keeyask Cree Nations

Specific diseases of interest were identified by the KCNs through the community-based research programs. Many of these are represented on the chronic conditions lists that were provided by the nursing stations for KCNs communities. Data about both physician visit and hospitalization were collected and reviewed for each of these conditions. However, for some conditions there were no cases as illustrated in the physician visit data in Table 5-3 and the hospitalization data inTable 5-4.

Note that obstetrics data related to routine deliveries are not included as this is typically the most common reason for hospitalization but is not related to illness. It is also important to note that the data were provided by year so that the patients may be counted multiple times when summarizing the time trend data as illustrated in the table.

These tables concur with the community Chronic Disease Lists, which are kept by the nurses in many communities. That is, in both the community Chronic Disease List as well as the data retrieved from physician visit and hospitalization administrative data sets, cardiovascular diseases and diabetes were ranked highly in terms of numbers of residents living with the disease (Chronic Disease list) as well as being treated for the disease (physician visit and hospitalization data). This agreement between different data sources is important when evaluating reliability of data. While injury was ranked low on the Chronic Conditions list and accounts for the most patients and physician visits, this is because injury is usually an acute event and does not always lead to chronic conditions.

In the following sections, each chronic condition is examined, with further detail on time trend and comparison data for selected illnesses provided where sufficient data are available. Sufficient data were not available to review Hepatitis A (seven hospitalizations between 1980 and 2006), Disorders of the Thyroid Gland (nine hospitalizations) or Intestinal infectious disease (28 hospitalizations) in further detail.

Table 5-3: Physician Visits by Selected Cause, KCNs Community Members (1984-2006)

Selected Cause of Illness	Total patients	Total visits
Injury	7,587	14,253
Cardiovascular Disease	2,963	8,202
Diabetes	2,797	7,826
Mental Health and Behavioural Disorders	2,398	5,307
Infections of Skin and Subcutaneous Tissue	1,950	3,125
Congenital Anomalies diagnosed in newborns	488	831
Disorders of the Thyroid Gland	222	425
Intestinal Infectious Diseases	93	121
Noxious influences affecting newborns	0	0
Mercury-related illness	0	0
Hepatitis A	0	0

Source: Manitoba Health, special data run 2011.
Notes:
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- Patients can be counted multiple times from year to year and do not represent unique individuals over the time frame.

Table 5-4: Hospitalizations by Selected Cause, KCNs Community Members (1984-2006)

Selected Cause of Illness	Total hospitalizations
Injury	1,571
Cardiovascular Disease	742
Infections of Skin and Subcutaneous Tissue	326
Mental Health Disorders	341
Diabetes	307
Congenital Anomalies diagnosed in newborns	73
Intestinal Infectious Diseases	28
Disorders of the Thyroid Gland	9
Hepatitis A	7
Noxious influences affecting newborns	0
Mercury-related illness	0

Source: Manitoba Health, special data run 2011.
Notes:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- Patients being hospitalized can be counted multiple times from year to year and do not represent unique individuals over the time frame.
- Obstetrics data are not included.

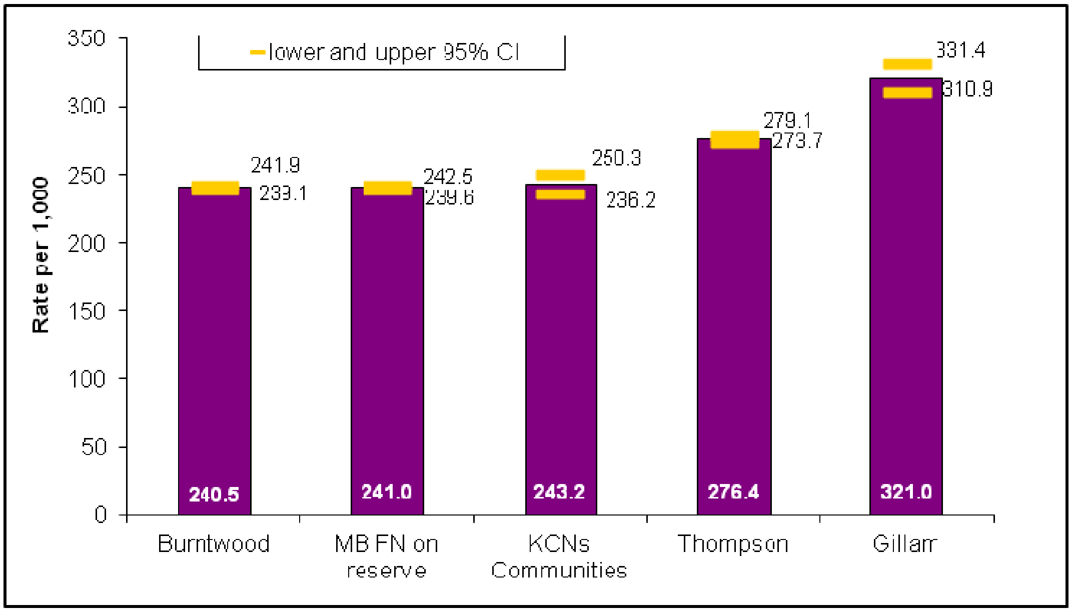
CARDIOVASCULAR DISEASE

Cardiovascular disease includes a wide range of diseases involving the heart and blood vessels. Angina, narrowing of the arteries, heart attack, congestive heart failure and stroke are examples of cardiovascular disease. Many of the risk factors for cardiovascular disease (such as obesity, lack of physical activity and stress) are common to Type 2 Diabetes and many cancers. KCNs communities indicated that diabetes, hypertension, stroke and heart conditions are current health issues among adults (CNP KPI Program 2009-2010; YFFN KPI Program 2009-2010; FLCN KPI Program 2009-2011).

The 10-year average annual rate of physician visits between 1997 and 2006 was 243.2 visits per 1,000 residents (see Figure 5-6). This is statistically lower than rates in Gillam and Thompson but statistically similar to the BRHA and Manitoba First Nations on-reserve.

The 10-year average annual physician visit rate for cardiovascular disease for KCNs females appears to be the lowest among comparison populations at 226.9 visits per 1,000 residents. This rate is statistically lower than all comparison populations with the exception of Manitoba First Nations living on-reserve. Among KCNs males, the average annual physician visit rate for cardiovascular disease between 1997 and

2006 was 258.7 visits per 1,000 residents. This rate is statistically lower than the rate in Gillam[1] but higher than the rates of the BRHA and Manitoba First Nations living on-reserve.



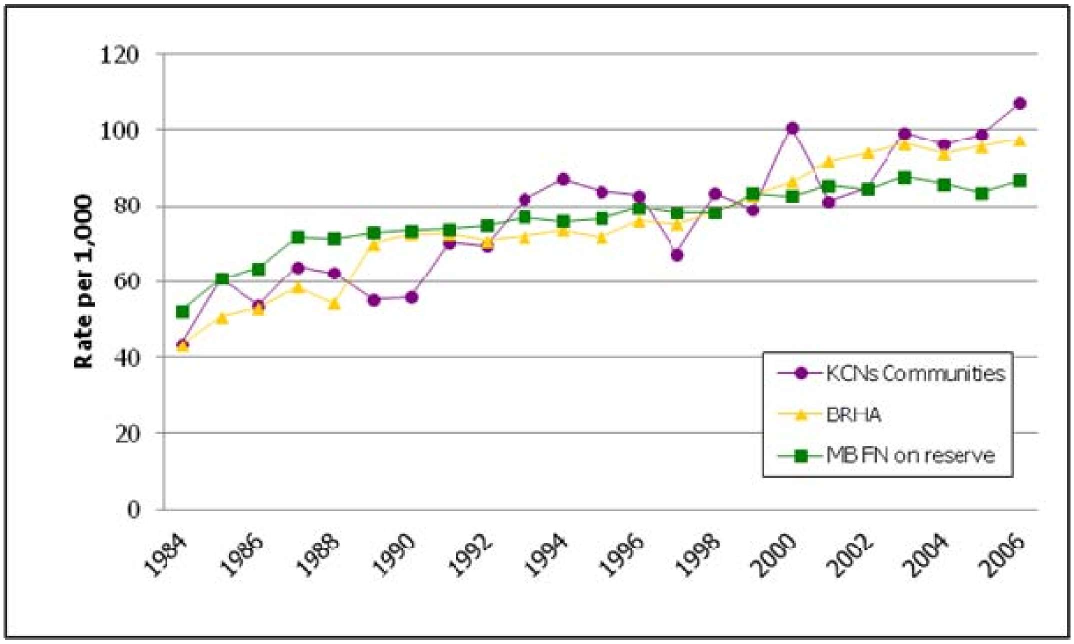
Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- CI refers to confidence interval. The confidence interval gives the range of rates in which it is likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval (CI).

Figure 5-6: Average Physician Visit Rates For Cardiovascular Disease by Area (1997-2006)

As illustrated in Figure 5-7, treatment rates for cardiovascular disease appeared to be increasing for all comparison areas reviewed. While rates are presented in the graphs to allow for comparison of different areas, the actual number of patients and physician visits among KCNs community Members is also useful to help for resource planning. The actual number of KCNs residents who were treated by a physician for cardiovascular disease increased by 244% from 61 unique patients in 1984 to 210 in 2006. This is the highest rate of change among the comparison areas. The number of physician visits for these patients (where individuals can be counted more than once if they make multiple visits to the doctor) increased at a similar rate from 118 visits in 1984 to 468 visits in 2006 (an increase of 296.6%).

[1] Note that all data are based on community of reported residents, not community of service or Band affiliation. For example, "Gillam" refers to all residents who have provided Manitoba Health with a mailing address in Gillam, regardless of where they received services and regardless of Band affiliation. A member of TCN, WLFN, FLCN or YFFN who lives in Gillam would be recorded under "Gillam" in this analysis.

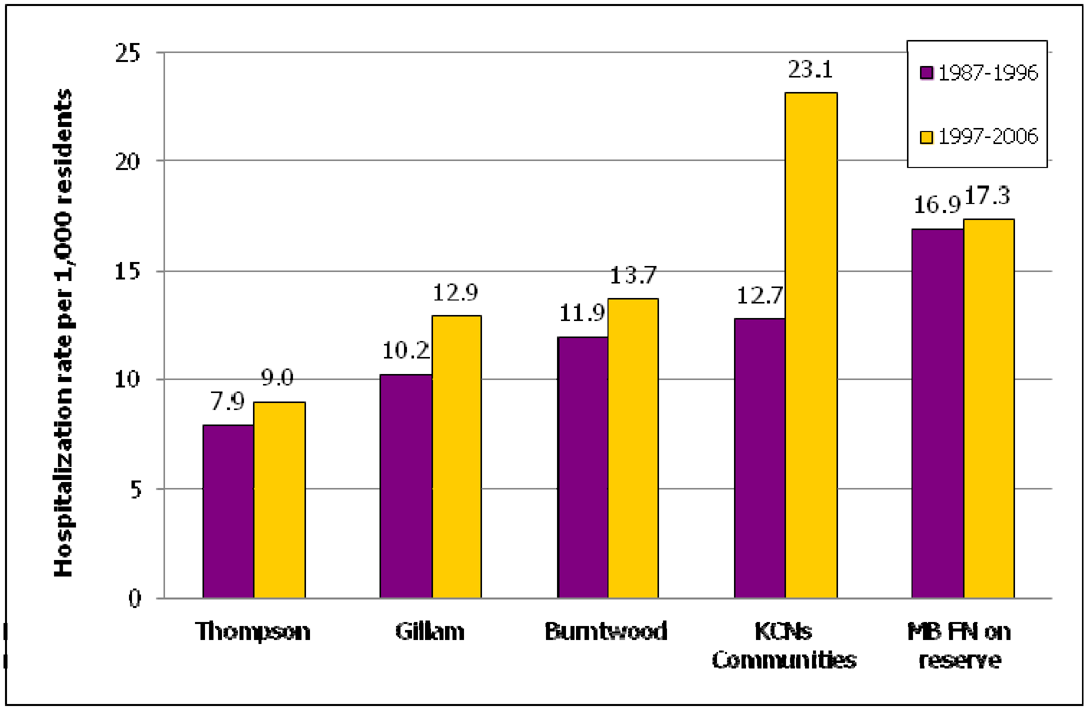


Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-7: Patient Treatment Rates for Cardiovascular Disease by Year, All Residents (1984-2006)

Generally, cardiovascular disease tends to be a disease among older residents and this is also the case for KCNs community Members. KCNs residents age 50 and older accounted for 83.7% of hospitalizations for cardiovascular disease. It is important to consider the hospitalization data with respect to the physician visit data. The physician visit data shown in Figure 5-6 showed KCNs residents as having the lowest or second lowest rates of physician visits for cardiovascular disease, yet hospitalization rates are the highest among the comparison communities (see Figure 5-8). This may be due to a variety of factors including data quality. Ongoing care or treatment that occurs at the nursing station would not be included in the physician visit data. In addition, any physicians that provide services in the community and are paid through a contract or other arrangement may not provide the diagnostic data to Manitoba Health, so these visits would not be captured. It is also possible that there are more hospitalizations due to more acute level of illness or because the staff at the nursing station determine that there are not resources at the community level to manage a condition, which in another community may be managed on an out-patient basis.



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-8: 10-year Hospitalization Rates for Cardiovascular Disease by Area (1987-1996 and 1997-2006)

DIABETES

Diabetes and related complications were identified by the KCNs as a priority health concern in KCNs communities. The availability of places to exercise and programs to participate in were also noted. Concerns about the loss of traditional lifestyles, ability to safely eat traditional foods, the high cost of food in communities, and the convenience of 'prepared or processed foods' may be leading residents to eat in a way that puts them at higher risk for certain health conditions, including diabetes. The KCNs indicated that several people, particularly Elders, already have diabetes and there is concern about late diagnosis of diabetes. There was also agreement that although there are other risk factors, diet and lifestyle are major contributors to diabetes (CNP KPI Program 2009-2010; YFFN KPI Program 20092010; FLCN KPI Program 2009-2011).

Diabetes is an important chronic disease that has a major impact on the health of Canadians and on the health care system. According to the Public Health Agency of Canada , 40% of Canadians with diabetes develop long-term complications such as high blood pressure, vision loss, cardiovascular disease, lower limb amputation or kidney disease. The Public Health Agency of Canada also reports that there are a disproportionate number of First Nations people who are being diagnosed with type 2 diabetes. Rates among Aboriginal people in Canada are three to five times higher than those of the general Canadian population (Public Health Agency of Canada 2009).

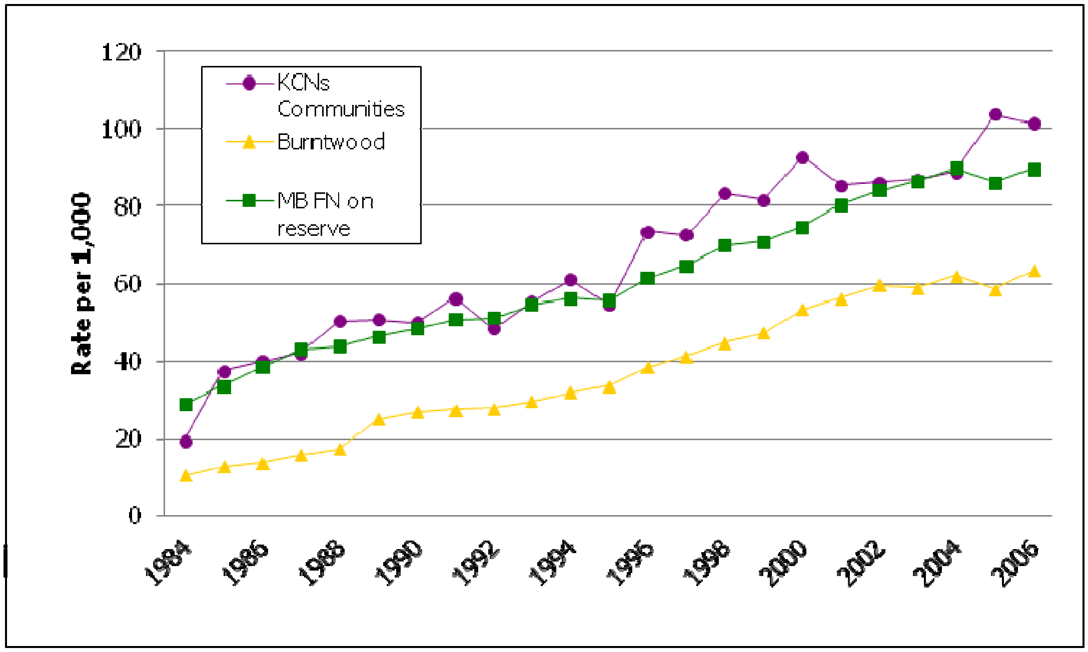
Canada's Public Health Agency identifies several risk factors for type 2 diabetes (see Table 5-5) and the more risk factors an individual has, the greater his/her likelihood of developing type 2 diabetes.

Table 5-5: Risk Factors for Diabetes

Risk Factor	Description
Obesity and 'Apple-shaped' figure	A high body weight increases diabetes risk. People who carry most of their weight in the trunk of their bodies (*e.g.*, above the hips) tend to have a higher risk of diabetes than those of similar weight with a 'pear-shaped' body (excess fat carried mainly in the hips and thighs).
Inactive lifestyle	Being overweight can be prevented by regular physical activity. A second benefit of regular physical activity is improved blood sugar control in people who already have type 2 diabetes.
Age	Age increases the risk of type 2 diabetes. According to PHAC, in 2006/07, the prevalence rate (people living with the disease) of diabetes in those aged 65 and over (21.3%) was three times as high as the rate in those 35 to 64 (7.1%).
Ethnic Ancestry	Being of Aboriginal, African, Latin American or Asian ethnic ancestry increases the risk of developing type 2 diabetes. Risk levels for these groups are between two and six times higher than for Canadians of Caucasian origin.
Family History	Having a blood relative with type 2 diabetes increases risk. If that person is a first-degree relative (*e.g.,* a parent, sibling or child), the risk is even higher.
History of Diabetes in Pregnancy	Almost 40% of women who have diabetes during their pregnancy go on to develop type 2 diabetes later, usually within five to 10 years of giving birth.
Impaired Glucose Tolerance	Impaired glucose tolerance or impaired fasting glucose is often seen before the development of type 2 diabetes.

Source: Public Health Agency of Canada (PHAC) 2009.

The number of people treated for diabetes among all KCNs residents increased by 637% from 27 people in 1984 to 199 people in 2006. This is the highest rate of change in numbers of patients among the comparison areas. The number of physician visits associated with these patients increased from 101 in 1984 to 614 in 2006, which is an increase of 507.9%. Figure 5-9 shows the patient numbers as rates per 1,000 to allow for comparison to other areas. This figure shows that patient treatment rates are increasing in all areas and that while KCNs community rates are very similar to the rates seen among all Manitoba First Nations living on-reserve, rates are consistently higher than for the BRHA population overall.



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-9: Patient Treatment Rates for Diabetes by Year, All Residents (1984-2006)

Trends in Diabetes

Diabetes is a very important cause of illness as well as a driver of medical service use in KCNs communities. Between 1984 and 2006, diabetes accounted for 7,912 or 20% of all physician visits for KCNs community Members. KCNs residents age 50 and older accounted for 68.1% of these visits.

In this same time period, diabetes accounted for 258 or 8.3% of all hospitalizations for KCNs community Members compared to 4.8% of hospitalizations for all residents of the BRHA among conditions of interest reviewed[1]. Overall, KCNs residents accounted for 7.9% of all BRHA hospitalizations for diabetes, which is higher than the 3.8% of the BRHA population that they represent[2].

Among KCNs residents, those age 50 and older accounted for 61% of hospitalizations for diabetes.

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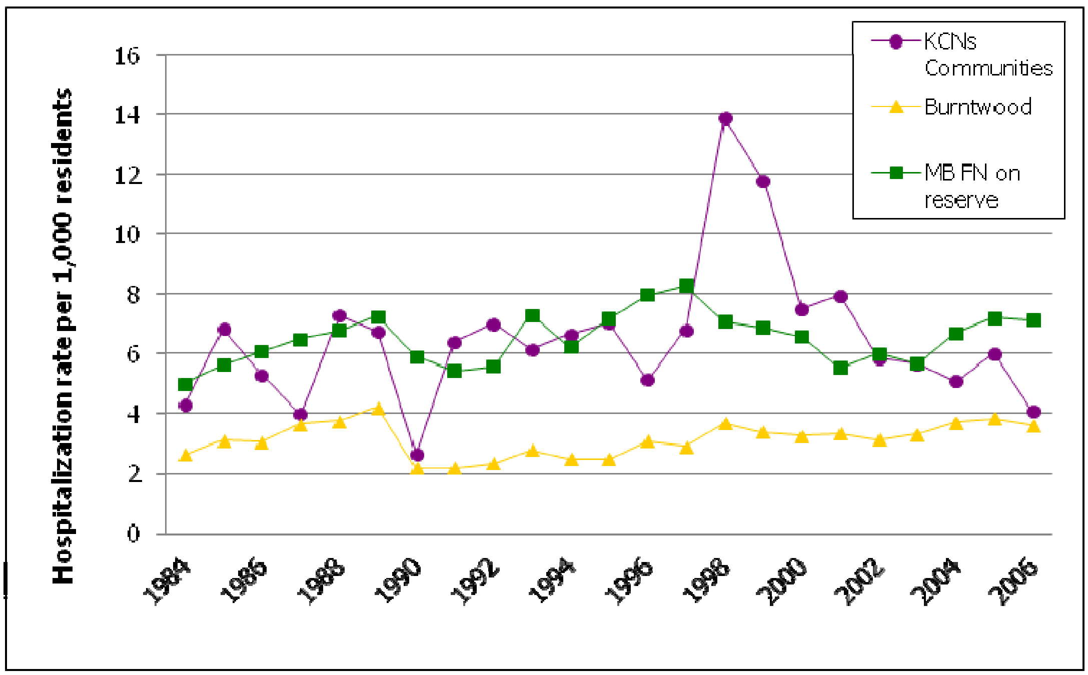
[1] A list of conditions for physician visits and hospitalizations were identified as key “conditions of interest.” When conditions of interest are referred to, it means that for example, diabetes accounted for 8.3% of all hospitalizations for those conditions on the list, but not necessarily 8.3% of ALL hospitalizations. This is a way of identifying, which of the conditions of interest resulted in greatest burden of illness and need for treatment.

[2] Throughout this section, there will be comparisons of the percentage of an event (such as hospitalizations or physician visits) in relation to the entire BRHA population. This gives the reader an idea as to whether the rate of the event seems out of line with the amount of the population accounted for by that community. If a certain illness, is more of a burden in the community we may see that it is out of proportion to the population.

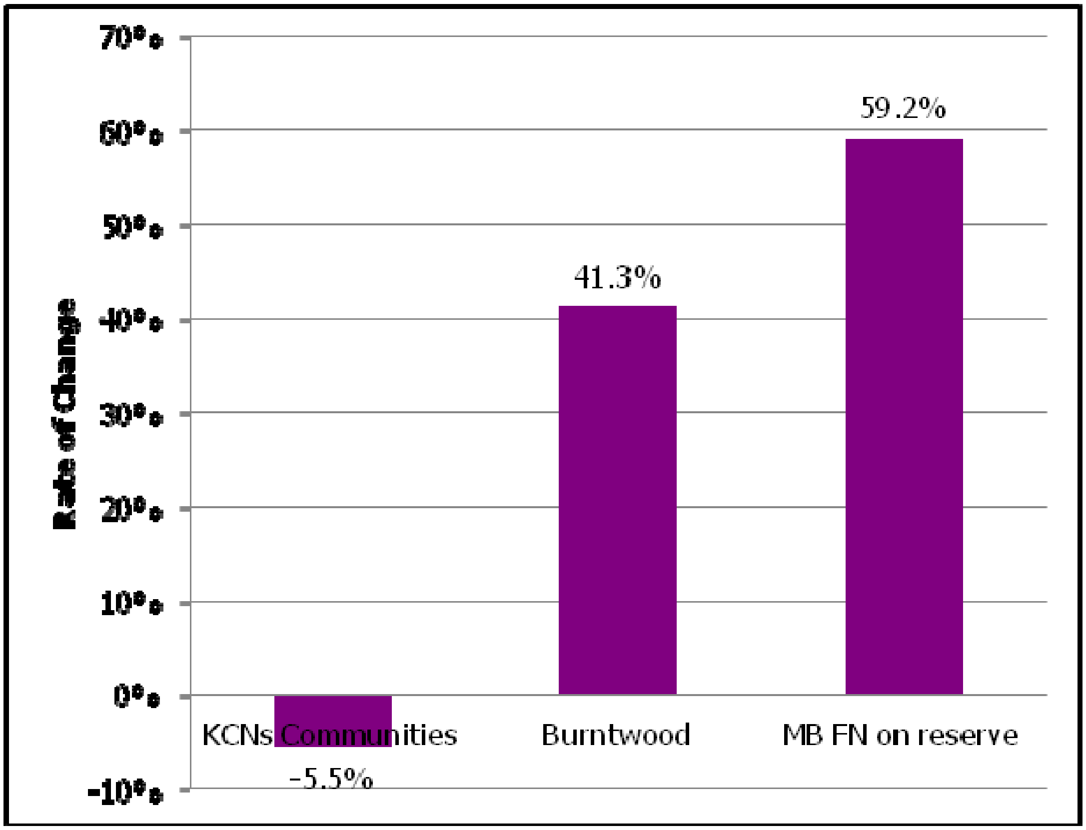
Figure 5-10 illustrates the hospitalization rates per 1,000 residents (to allow for comparison) by year between 1984 and 2006 for KCNs, Manitoba First Nations living on-reserve and BRHA residents. Figure 5-11 presents the percentage change in the actual number of hospitalizations between the first and last five year time periods. Due to extreme variation from year to year (due to small numbers), it is difficult to identify any meaningful trends from Figure 5-10 aside from the observation that diabetes hospitalization rates among KCNs residents are consistently higher than for BRHA residents overall. Figure 5-11, which compares two five-year time periods (and allows for more stability in numbers), shows that the number of hospitalizations for Burntwood residents have increased by only 3% compared to 26.8% for KCNs residents. This may indicate that although there has been a demonstrated increase in treatment prevalence rates (through the physician visit data), there may not be enough other resources available in KCNs communities to help residents manage their diabetes. Other BRHA communities such as Thompson may have more community resources available so that people living with diabetes remain healthier and do not require hospitalization for their diabetes.



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-10: Hospitalization Rates for Diabetes by Year, All Residents (1984-2006)



Source: Manitoba Health, special data run 2011.
Note:
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-11: Percentage Change in Numbers of Hospitalizations for Diabetes (1984-1988 and 2002-2006)

INJURY

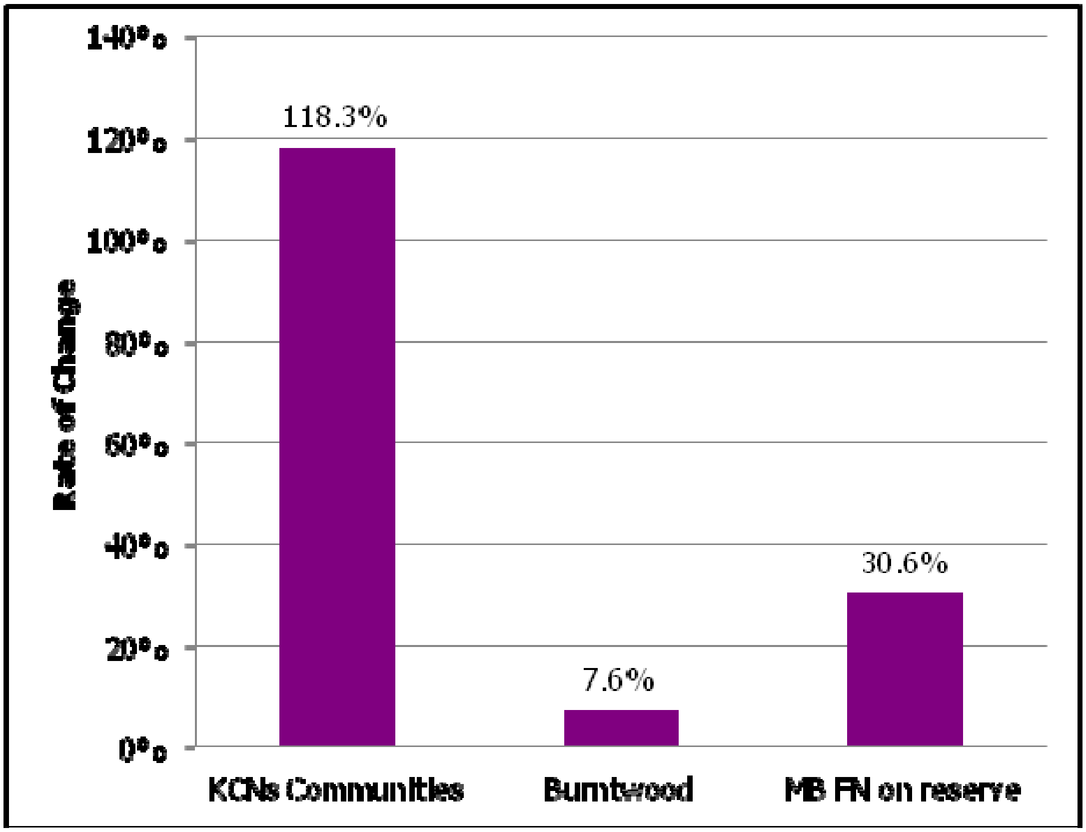
The First Nations Regional Longitudinal Health Survey (2005) notes that "Injuries are a serious public health problem in Canada, and even more so in many First Nations communities…First Nations injuries tend to follow a similar pattern to the rest of the Canadian population but occur with much greater frequency. Falls, sports, motor vehicle crashes and violence are all frequent causes of injury. Alcohol contributes to some types of injuries, particularly suicide attempts and violence." These findings are consistent with trends experienced by the KCNs, where injury is seen as an important health issue. The KCNs indicated that youth in particular are perceived to be taking more risks and that it is not uncommon to see children and or youth with a broken arm or ankle. Participants indicated that injuries tend to be more common for those under the age of 30. As well, there is the perception that alcohol can contribute to accidents and injury (examples of different types of accidents were discussed such as snowmobile and car accidents related to alcohol use) (CNP KPI Program 2009-2010; YFFN KPI Program 2009-2010; FLCN KPI Program 2009-2011).

Just over one in four physician visits for the conditions of interest in 2006 was for injuries (27.2%). In that year there were 313 patients accounting for 606 physician visits for injuries. Overall, between 1984 and 2006, injuries accounted for 14,255, or 36% of all physician visits among KCNs community residents.

As indicated by KPI participants, data shows that younger residents and younger men in particular, tend to be at high risk for injury. For example, KCNs residents age 19 and under accounted for about one in five (20.8%) physician visits for injuries. Looking at the numbers of visits specifically by gender and age group, the highest number of physician visits was among male residents ages 15 to 29.

Although physician visits for injuries among KCNs residents were statistically lower than all of the comparison populations, this was not the case for hospitalizations. Between 1984 and 2006, injuries among KCNs residents accounted for 6.9% of all injury hospitalizations for BRHA residents while accounting for only 3.8% of the BRHA population. Among KCNs residents, people age 19 and under accounted for 41.4% of hospitalizations for injuries, with the highest number of hospitalizations seen among male residents ages 15 to 19.

For planning purposes, the actual number of hospitalizations for injuries among all KCNs residents increased from 224 hospitalizations between 1984 and1988 to 454 between 2002 and 2006. This represents an increase of 102.7% between the two five year time periods and is by far the highest rate of change among the comparison areas (see Figure 5-12).

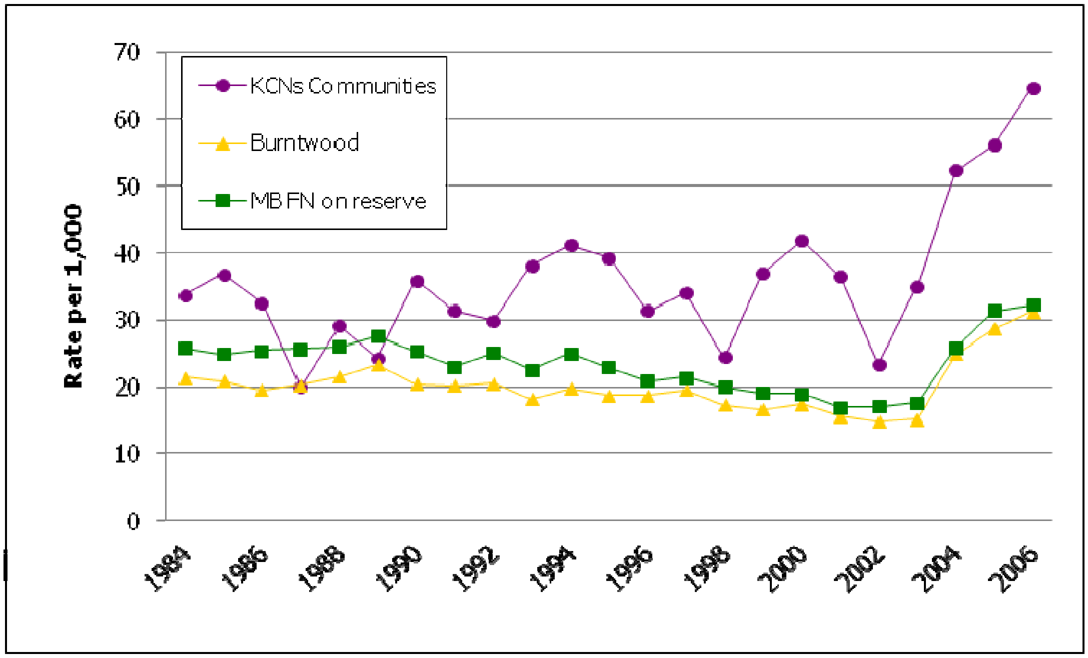


Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-12: Percentage Change in Numbers of Hospitalizations for Injuries (1984-1988 and 2002-2006) Averages

Although physician visits for injuries among KCNs residents were consistently lower than the comparison areas, hospitalization rates for injuries were higher in almost every year and show a clearer trend towards a sharp increase in the most recent five years. This may reflect lack of reporting of treatment for injuries (for example if treated by the nurse and not a physician who notifies Manitoba Health), or it may reflect that when there are injuries they may be more severe, or are severe enough that they cannot be managed in the community and require hospitalization outside the community. Figure 5-13 illustrates injury hospitalization rates per 1,000 residents to allow for comparison over time and between comparison areas. The hospitalization rate for KCNs community residents increased from 33.6 hospitalizations per 1,000 residents in 1984 to 64.7 per 1,000 in 2006.



Source: Manitoba Health, special data run 2011.
Note:

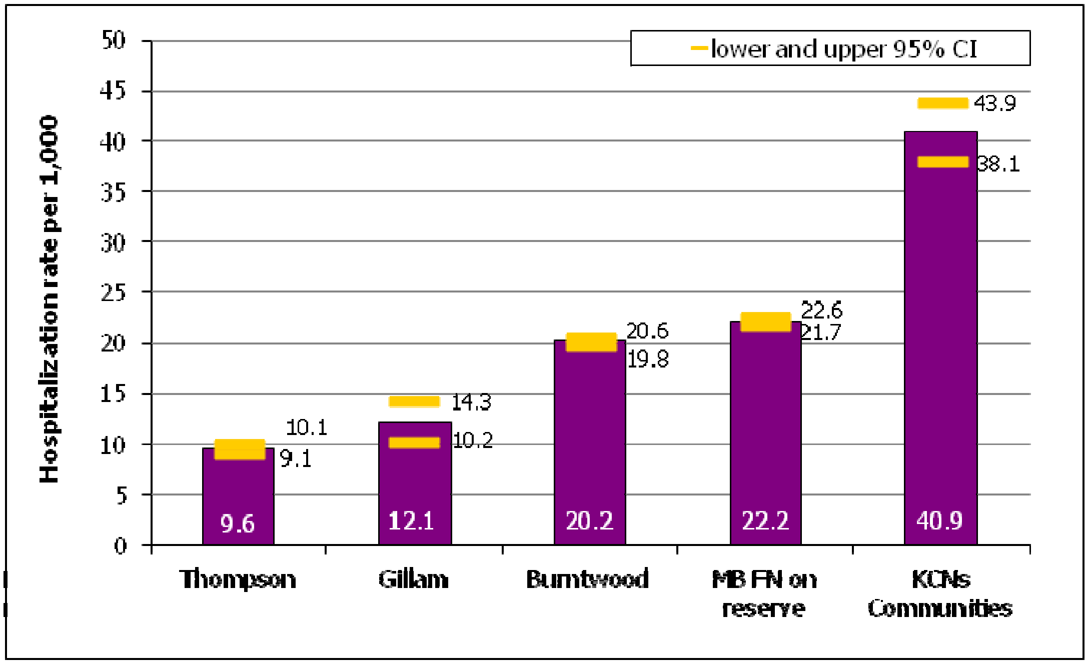
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-13: Hospitalization Rates for Injuries by Year, All Residents (1984-2006)

The 10-year average annual injury hospitalization rate of 40.9 per 1,000 for KCNs community Members was statistically higher than for all comparison populations (see Figure 5-14). The next closest rate to KCNs is Manitoba First Nations living on-reserve where injury hospitalization rates between 1997 and 2006 were 22.2 per 1,000.

The 10-year average annual hospitalization rate for injuries among KCNs females was the highest among comparison populations at 36.2 hospitalizations per 1,000. The KCNs rate is statistically higher than all other comparison areas. The next highest rate is Manitoba First Nations living on-reserve and that rate is about half the KCNs rate at 19.6 hospitalizations per 1,000 females.

Among KCNs males, the average annual hospitalization rate for injuries between 1997 and 2006 was higher than the rate among KCNs females at 45.4 hospitalizations per 1,000 residents. As with females, this rate is statistically higher than the other comparison areas.



Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- CI refers to confidence interval. The confidence interval gives the range of rates in which it is likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval (CI).

Figure 5-14: Hospitalization Rates for Injuries by Area (1997-2006) Average

MENTAL HEALTH

According to a survey conducted by the Canadian Mental Health Association, approximately 3.4 million Canadians have experienced a major bout of depression at some point in their lives. Women and those between 25-54 years of age are more likely to have experienced depression or anxiety (Canadian Mental Health Association 2011). A Statistics Canada survey reported that half a million Canadian workers experience depression and almost 80% of them indicate that the symptoms they experience interfere with their ability to work (Statistics Canada 2007b). The high incidence and prevalence of mental illness that often goes untreated means the human and economic costs of mental illness are considerable.

The First Nations Regional Longitudinal Survey (2005) notes that various types of trauma contribute to First Nations peoples' mental health and wellness, and attributes some of this to the intergenerational effects of colonialism. Kirmayer *et al.* (2000) note "the high rates of suicide, alcoholism, violence and the pervasive demoralization seen in Aboriginal communities can be readily understood as a direct consequence of (a) history of (dislocation) and disruption of traditional subsistence patterns and connection with the land." This is consistent with the histories of the KCNs (see Section 5.3.2.1), and their observations of current health challenges.

The KCNs have expressed concerns about mental health issues. Residents and health care workers have indicated that social problems in the community such as addictions and low self-esteem may limit people's ability to access permanent employment. Concerns were raised about social problems observed during previous hydro development including increased alcohol and drug use among community Members. With respect to youth, participants in several community focus groups indicated there is a perception of an increase in suicides among young people in recent years and that drug and alcohol use is already common among youth (CNP KPI Program 2009-2010; YFFN KPI Program 2009-2010; FLCN KPI Program 2009-2011).

Mental health is an important area to track and ensure appropriate services and supports are in place for KCNs residents. The KCNs indicated that although people are becoming more aware of issues associated with mental health (such as anxiety and depression), there is still a lack of awareness about services that are available. It was also noted that adults may be more open to talking about mental health compared to youth and Elders. Although men have typically been less willing to discuss mental health, there is a perception that this is slowly changing. Community Members indicated that alcohol abuse contributes to a variety of mental health related issues, including family stability and violence in the community (CNP KPI Program 2009-2010; YFFN KPI Program 2009-2010; FLCN KPI Program 2009-2011).

Rates are presented for comparison between areas but for KCNs planning, numbers of patients and visits are presented first. The number of patients treated for mental health and behavioural disorders among all KCNs residents increased by 130.2 % from 53 patients in 1984 to 122 in 2006. This rate of change is higher than for BRHA but lower than for Manitoba First Nations living on-reserve. The number of physician visits increased from 111 in 1984 to 349 in 2006 — an increase of 214.4%. Given that mental health patients often require multiple appointments and support, this increase could have considerable impact on local community resources. It is also important to note that hospitalizations among KCNs residents for mental health and behavioural disorders were seen among residents as young as 10 to 14 years of age.

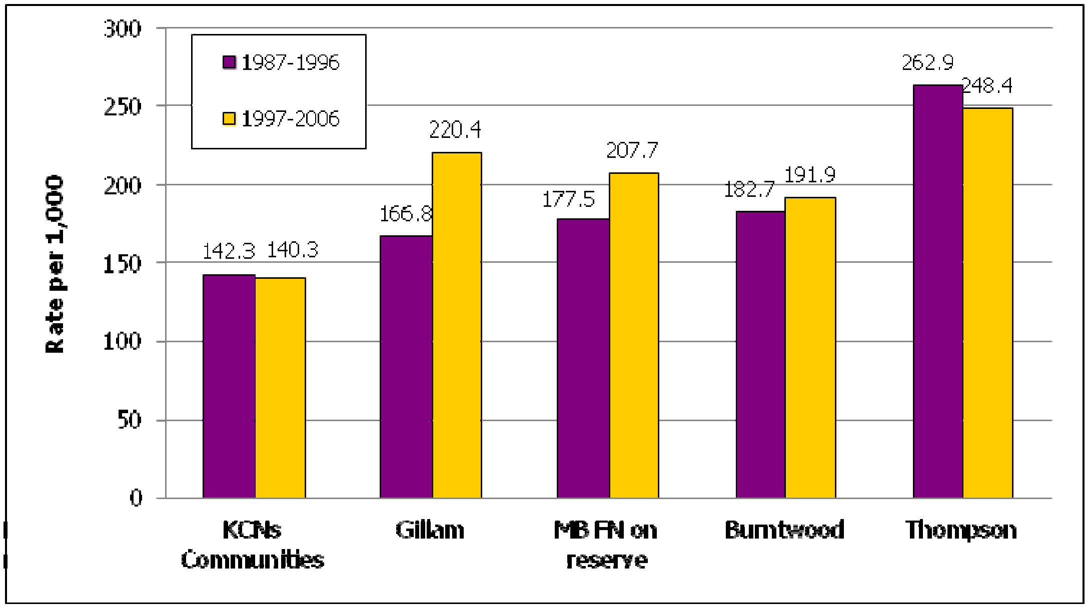
In 2006, there were 122 patients accounting for 349 physician visits for mental health disorders recorded among KCNs residents. These visits accounted for 15.6% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, mental health disorders accounted for 5,307, or 13.4% of all physician visits among KCNs residents.

Figures 5.3-14 to 5.3-16 illustrate the changes in physician visit rates (per 1,000 residents) for mental health disorders by area for two 10-year periods. Data are presented for all residents (Figure 5-15), females (Figure 5-16) and males (Figure 5-17). The 10-year rates offer additional stability and more confidence in interpreting changes over time and differences between areas.

Figure 5-15 shows that for all residents, the 10-year physician visit rates for mental health disorders among KCNs community residents remained almost unchanged at 142.3 and 140.3 visits per 1,000 between 1987-1996 and 1997-2006. These rates appear to be lower than all comparison areas. Among KCNs residents, the total number of physician visits actually increased from 2,257 to 2,656 between 1987-1996 and 1997-2006; however the increase in number of visits is not reflected in the most recent rate due to the higher increase in population (an example as to why it is important to consider both absolute numbers and rates if possible).

Among KCNs females, the 10-year physician visit rate for mental health disorders increased from 96.8 to 154.2 visits per 1,000 females between 1987-1996 and 1997-2006 (see Figure 5-16). The rate in the most recent time period appears to be much lower than for all comparison areas; in fact, the KCNs rate is approximately half the rate of several of the other areas. The actual number of physician visits among KCNs females increased from 759 to 1,425 between 1987-1996 and 1997-2006.

The physician visit rate among KCNs males decreased from 186.6 visits per 1,000 males to 127.1 per 1,000 between 1987-1996 and 1997-2006 (see Figure 5-17). As with females, the most recent rate appears to be lower than all other comparison areas. The actual number of physician visits among KCNs males for mental health disorders decreased from 1,498 to 1,231 between 1987-1996 and 1997-2006.

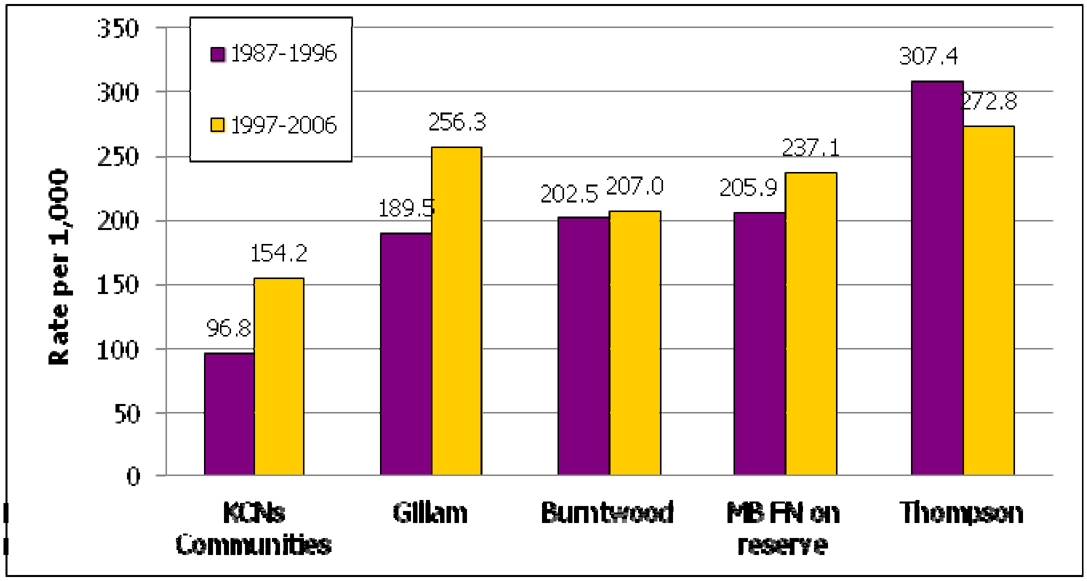


Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

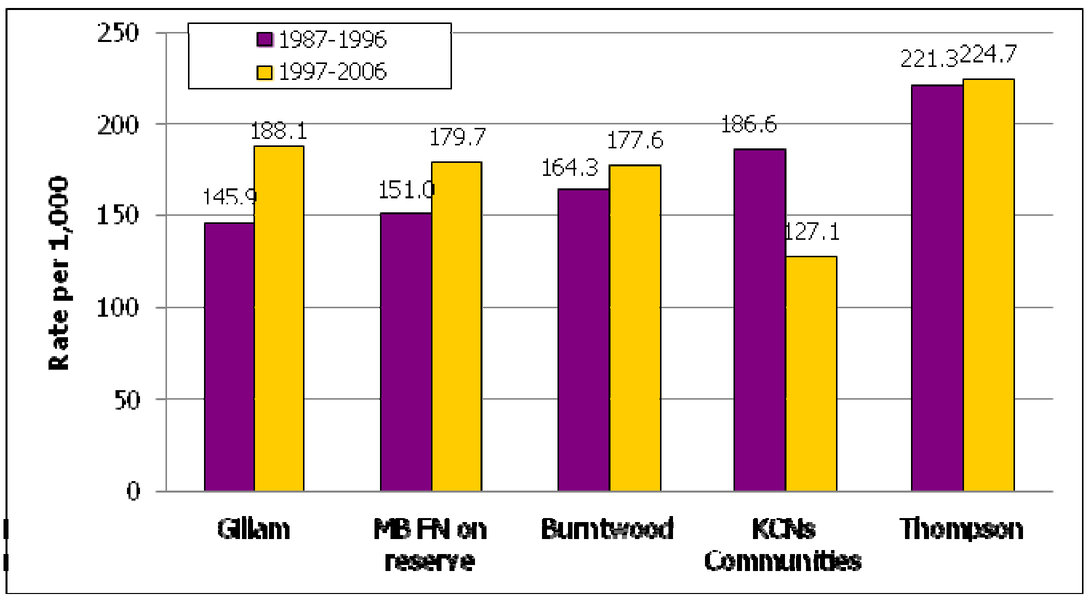
Figure 5-15: 10-Year Physician Visit Rates for Mental and Behavioural Disorders by Area, All Residents (1987-1996 and 1997-2006)



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-16: Female 10-year Physician Visit Rates for Mental and Behavioural Disorders by Area (1987-1996 and 1997-2006)



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-17: Male 10-year Physician Visit Rates for Mental and Behavioural Disorders by Area (1987-1996 and 1997-2006)

KCNs residents age 50 and older accounted for 26.4% of physician visits for mental health disorders, with the highest number of physician visits seen among male residents ages 50 to 54 followed by males age 15 to 19. Table 5-6 shows the number and per cent of physician visits by age group and gender for all visits for mental and behavioural disorders between 1984 and 2006 for KCNs residents. Some physician visits occurred in very young children and infants under the age of one. It is important to note that this International Classification of Disease (ICD-10) category (for reference see Appendix 5A) includes the diagnoses of "mental retardation" as well as "behavioural and emotional disorders that are diagnosed in childhood and adolescence." This means that although these data may appear to be erroneous at first, there are valid reasons for inclusion of the younger age groups.

Table 5-6: Physician Visits for Mental and Behavioural Disorders by Gender and Age Group, Keeyask Cree Nations (1984-2006)

	Female	%	Male	%	Total	%
< 1	5	0.1%	7	0.1%	12	0.2%
1 to 4	40	0.8%	74	1.4%	114	2.1%
5 to 9	45	0.8%	138	2.6%	183	3.4%
10 to 14	85	1.6%	100	1.9%	185	3.5%
15 to 19	266	5.0%	220	4.1%	486	9.2%
20 to 24	276	5.2%	436	8.2%	712	13.4%
25 to 29	282	5.3%	517	9.7%	799	15.1%
30 to 34	280	5.3%	372	7.0%	652	12.3%
35 to 39	289	5.4%	429	8.1%	718	13.5%
40 to 44	260	4.9%	191	3.6%	451	8.5%
45 to 49	197	3.7%	128	2.4%	325	6.1%
50 to 54	166	3.1%	180	3.4%	346	6.5%
55 to 59	67	1.3%	47	0.9%	114	2.1%
60 to 64	25	0.5%	55	1.0%	80	1.5%
65 to 69	13	0.2%	30	0.6%	43	0.8%
70 to 74	5	0.1%	34	0.6%	39	0.7%
75 to 79	11	0.2%	23	0.4%	34	0.6%
80 +	4	0.1%	10	0.2%	14	0.3%

Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

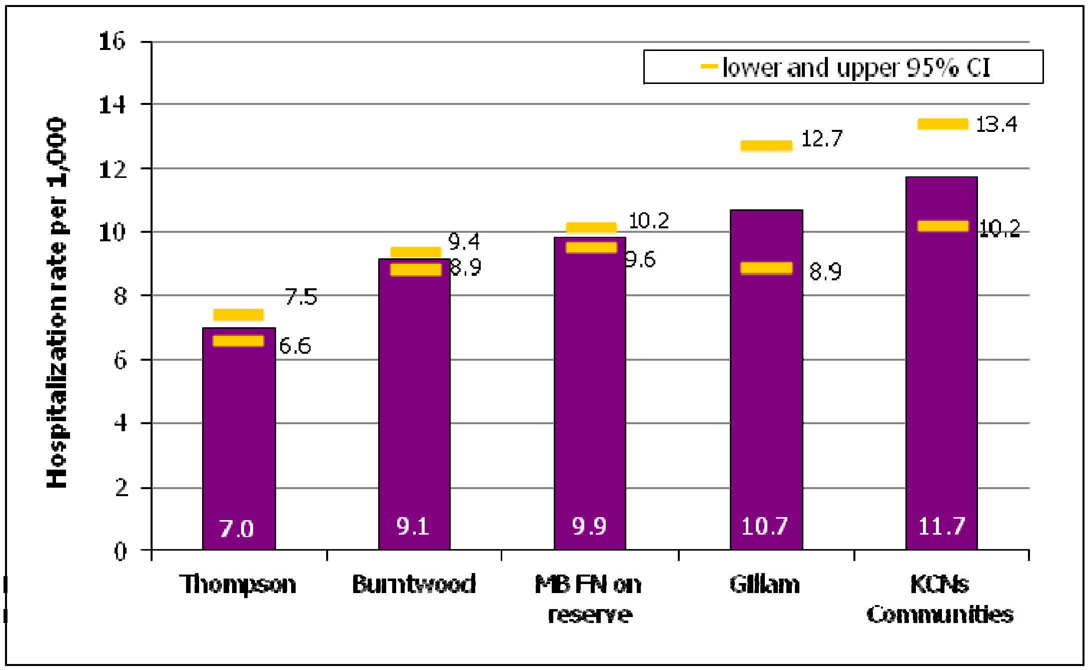
Due to the small numbers of hospitalizations for mental health disorders by year, only 10-year average annual hospitalizations rates were reviewed to assess whether there were statistical differences between the areas examined.

The 10-year average annual rate (between 1997 and 2006) of 11.7 hospitalizations per 1,000 KCNs residents is statistically higher than all comparison populations with the exception of Gillam, which is statistically similar at 10.7 hospitalizations per 1,000 residents (see Figure 5-18).

The 10-year average annual hospitalization rate for mental health disorders for KCNs females was 11.7 per 1,000 females. The KCNs female hospitalization rate between 1997 and 2006 was not statistically different from any of the comparison areas with the exception of Thompson (at 7.4 hospitalizations per 1,000 residents) and the BRHA (at 8.9 hospitalizations per 1,000 residents).

Among KCNs males, the average annual hospitalization rate for mental health disorders between 1997 and 2006 was also 11.7 hospitalizations per 1,000 residents. This rate was statistically different only from Thompson, which is lower at 6.6 hospitalizations per 1,000.

The fact that the Thompson hospitalization rate (7.0 per 1,000 residents) for mental health disorders was the lowest among the comparison areas and yet physician visit rates were very high indicates that perhaps with more support at the community level (and availability of physicians for ongoing treatment and monitoring), hospitalizations could be avoided.



Source: Manitoba Health, special data run 2011.
Note:
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- CI refers to confidence interval. The confidence interval gives the range of rates in which it is likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval (CI).

Figure 5-18: Average Hospitalization Rates for Mental and Behavioural Disorders by Area, All Residents (1997-2006)

SKIN INFECTION

Skin infections are becoming a greater public health concern in Canada, occurring both in the community and in health care settings. The increase in infection rates can be partly attributed to improved and more actively used screening techniques; however, another issue is the misuse of antibiotics, which can make infections more resistant and more difficult to contain and treat (Public Health Agency of Canada 2008).

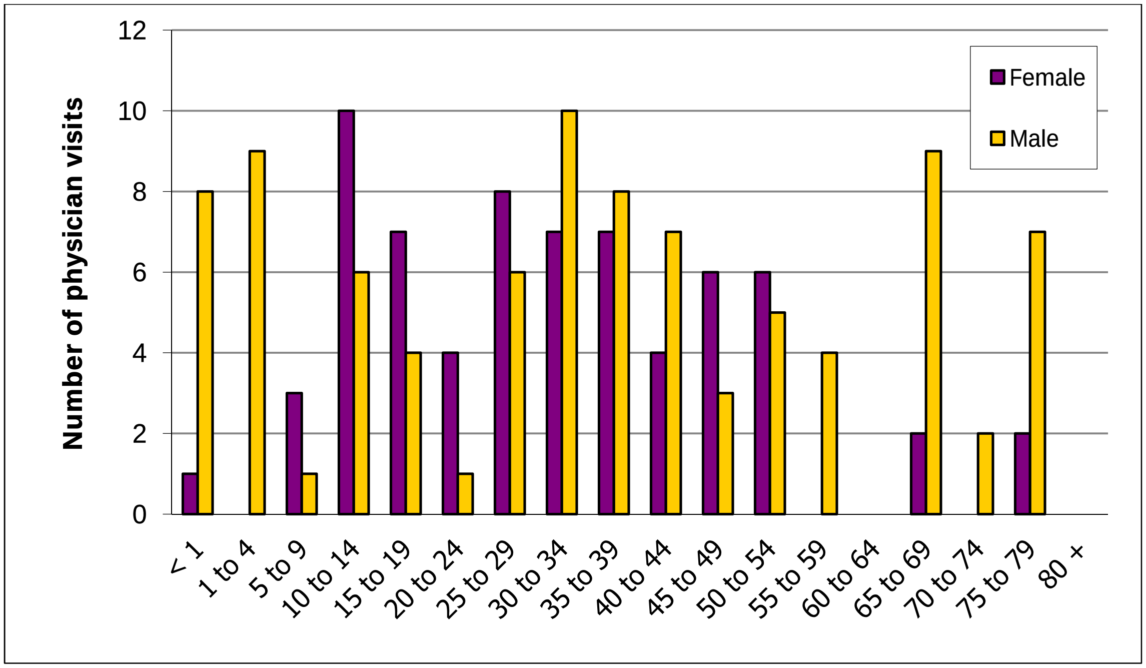
Children and those with weakened immune systems are particularly susceptible to these infections. Public health and infection control officials have underlined the importance of access to a clean water supply, hand washing and the use of hand sanitizers as a way to avoid infections.

For the KCNs, skin infection concerns exist in relation to water quality. In York Landing (*Kawechiwasik)*, for example, there are concerns about skin rashes and itchy skin believed to be caused by the community's water supply. The same types of concerns are noted by individuals who swim near the community (YFFN KPI Program 2009-2010, CNP *pers. comm.* 2012).

Treatment prevalence rates for skin infections overall were among the lowest among comparison areas but hospitalization rates were higher. This may be due to treatment at the nursing station and a lack of recording of all treatment due to limited physician services, or it may be due to other risk factors that indicate skin infections can become more acute and require hospitalizations. For example, KCNs residents age 50 and older accounted for 40.9% of hospitalizations for infections of skin and **subcutaneous tissue** and given that there is a higher incidence of diabetes among this age group, there may be a relationship between the risk factor of diabetes and the outcome of more acute skin infections.

Between 1984 and 2006, skin infections accounted for 3,125, or 7.9% of all physician visits among KCNs residents. In this time period, KCNs residents accounted for 4.2% per cent of all BRHA physician visits for infections of skin and subcutaneous tissue, which is slightly higher than the 3.8% of the BRHA population that they represent.

Within KCNs communities, residents age 50 and older accounted for almost one in four (23.6%) physician visits for skin infections. Looking within specific age groups however, the highest number of physician visits is seen among male residents ages 30 to 34, followed by females age 10 to 14 (see Figure 5-19). It is important to note that the numbers of physician visits within each age group are quite small (10 and under) so it would not be appropriate to attempt to draw conclusions about reasons for higher numbers of visits within certain age groups.



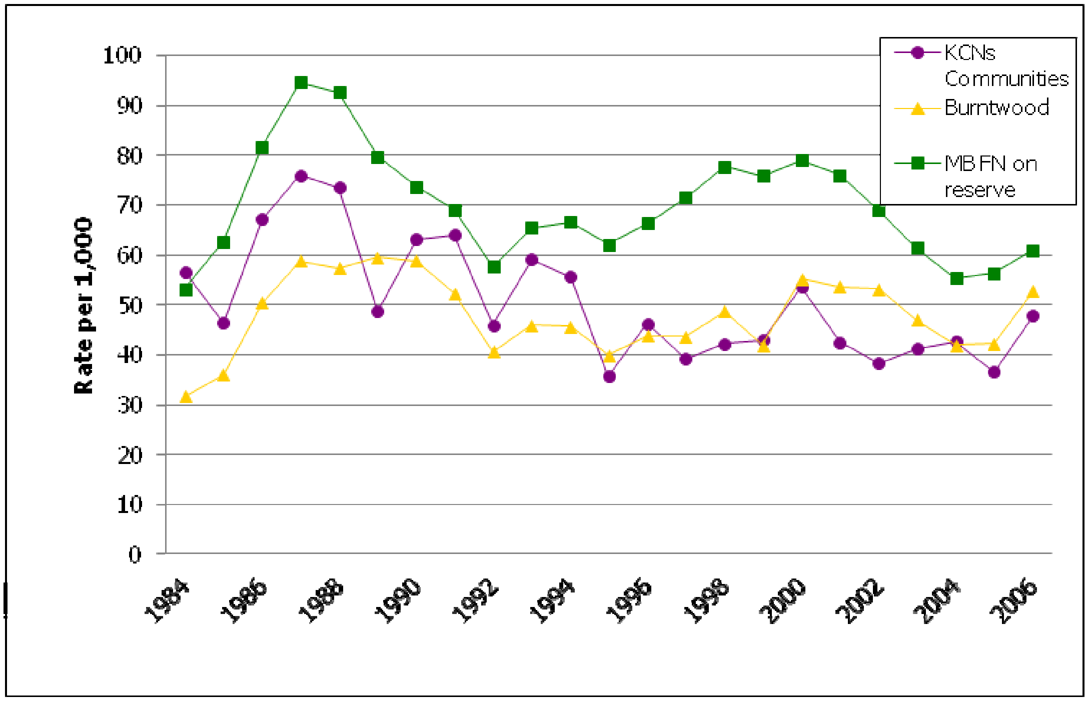
Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-19: Physician Visits for Infections of Skin and Subcutaneous Tissue by Gender and Age Group, Keeyask Cree Nations (2006)

Figure 5-20 illustrates the patient rates by year between 1984 and 2006 to allow for comparison between KCNs, Manitoba First Nations living on-reserve and BRHA residents. The patient rate among KCNs community residents shows variation over the years but appear to be consistently similar to the BRHA rates and lower than for all First Nations living on-reserve in Manitoba. Among KCNs residents, the number of patients declined somewhat from 56.5 patients per 1,000 residents in 1984 to 47.9 per 1,000 in 2006.

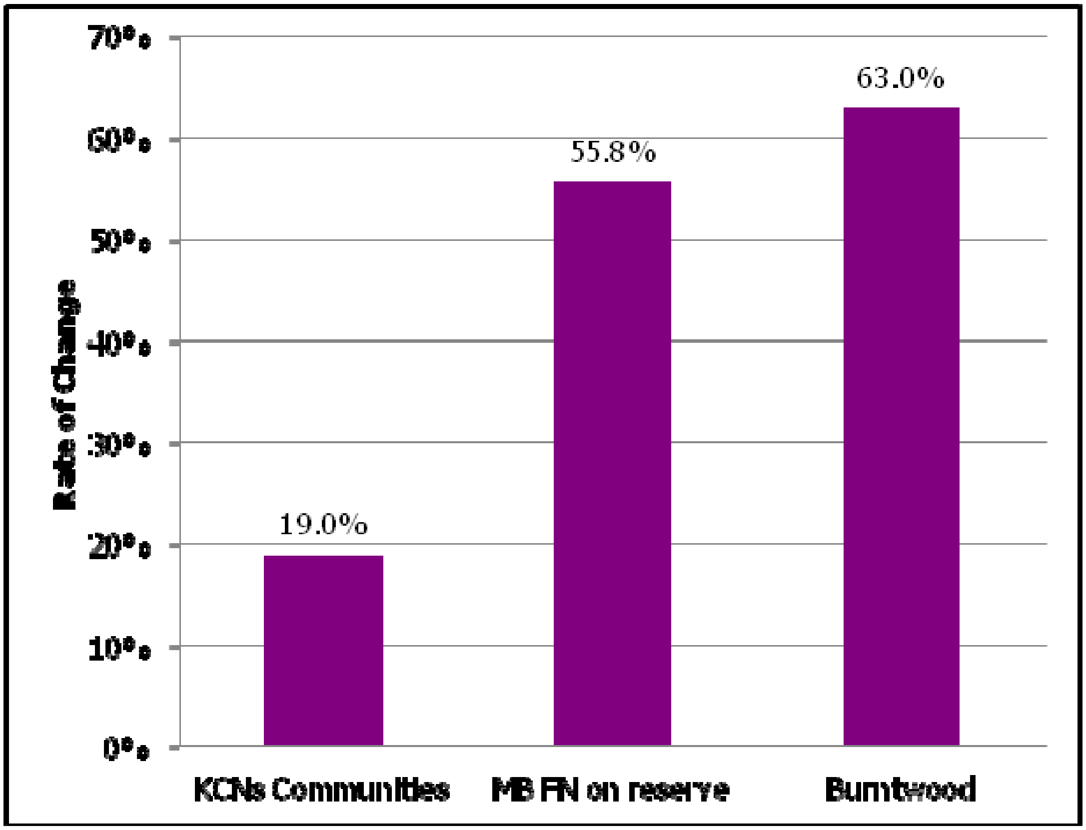


Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-20: Patient Rates for Infections of Skin and Subcutaneous Tissue by Year (1984-2006)

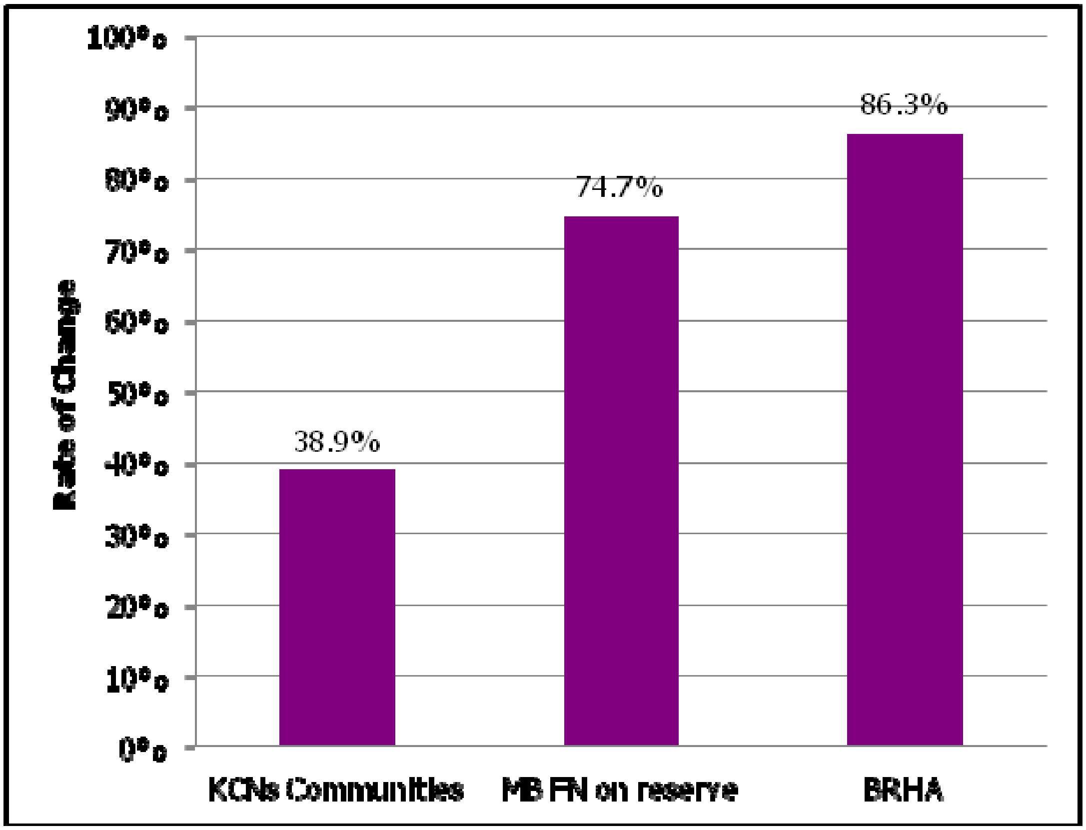
Although rates of patients being treated for skin infections have decreased (due to a larger increase in population compared to number of patients), it is important to note that the actual number of patients treated for skin infections among all KCNs residents increased by 19.0% from 79 patients in 1984 to 94 patients in 2006. This is the lowest rate of change among the comparison areas (see Figure 5-21). In this same time period, the number of physician visits among KCNs residents increased from 113 in 1984 to 157 in 2006, an increase of 38.9% (see Figure 5-22).



Source: Manitoba Health, special data run 2011.
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-21: Percentage Change in Numbers of Patients for Infections of Skin and Subcutaneous Tissue, All Residents (1984-2006)



Source: Manitoba Health, special data run 2011.
Note:
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-22: Percentage Change in Numbers of Physician Visits for Infections of Skin and Subcutaneous Tissue, All Residents (1984-2006)

Between 1984 and 2006, skin infections accounted for 326 or 9.6% of all hospitalizations for the conditions of interest. In this time period, KCNs residents accounted for 6.6% of all BRHA hospitalizations for infections of skin and subcutaneous tissue, which is higher than the 3.8% of the BRHA population they represent.

Within KCNs communities, residents age 50 and older accounted for more than one in three (39.1%) hospitalizations for infections of skin and subcutaneous tissue. Table 5-7 shows the per cent of hospitalizations by age group and gender for all hospitalizations for infections of skin and subcutaneous tissue for KCNs residents.

Table 5-7: Hospitalizations for Infections of Skin by Gender and Age Group, KCNs (1984-2006)

	Female	%	Male	%	Total	%
< 1	5	1.7%	7	2.4%	12	4.1%
1 to 4	8	2.7%	6	2.1%	14	4.8%
5 to 9	13	4.5%	6	2.1%	19	6.5%
10 to 14	5	1.7%	8	2.7%	13	4.5%
15 to 19	7	2.4%	2	0.7%	9	3.1%
20 to 24	5	1.7%	11	3.8%	16	5.5%
25 to 29	7	2.4%	10	3.4%	17	5.8%
30 to 34	9	3.1%	13	4.5%	22	7.5%
35 to 39	11	3.8%	7	2.4%	18	6.2%
40 to 44	5	1.7%	8	2.7%	13	4.5%
45 to 49	6	2.1%	12	4.1%	18	6.2%
50 to 54	11	3.8%	14	4.8%	25	8.6%
55 to 59	6	2.1%	19	6.5%	25	8.6%
60 to 64	5	1.7%	10	3.4%	15	5.1%
65 to 69	4	1.4%	5	1.7%	9	3.1%
70 to 74	16	5.5%	7	2.4%	23	7.9%
75 to 79	14	4.8%	10	3.4%	24	8.2%
80 +	3	1.0%	6	2.1%	9	3.1%

Source: Manitoba Health, special data run 2011.

Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake First Nation and York Factory First Nation.

CAUSES OF DEATH

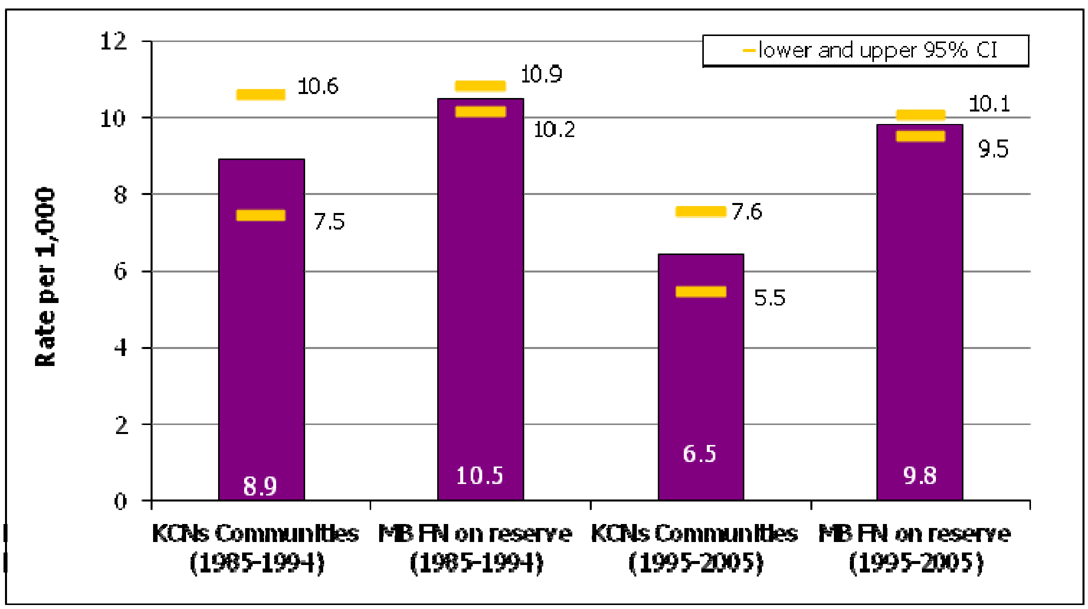
Mortality (death) rates provide information about the overall health of the population, similar to life expectancy. That is, most typically, communities with high mortality rates will also have lower life expectancy. Mortality rates can be a useful indicator to examine changes over time. For example, while life expectancy measures do not change a great deal in the short term, some mortality rates can be drastically reduced in short periods of time. One example is the reduction in SIDS-related (sudden infant death syndrome) deaths that has been observed since the implementation of "Back to Sleep" and other education campaigns. Other examples include suicide or other injury prevention programs that can have an immediate impact on risky behaviours.

Mortality rates that take longer to change include cancer related mortalities as they often occur, at least partially, as a result of risk factors engaged in over a lifetime. For example, lung cancer mortality rates are impacted by smoking behaviours over decades. Therefore, smoking cessation campaigns that occur today will not immediately have an impact on lung cancer mortality rates.

It is important to look at mortality and causes of mortality both in terms of all deaths as well as specifically at deaths that occur at younger ages as these deaths are more likely to be preventable.

According to First Nations Inuit Health, there were a total of 310 deaths from all causes among KCNs community Members in the 26 year period between 1980 and 2005. This means that that there were on average 11.5 deaths per year. Females accounted for 116 (37.4%) of these death while males accounted for 194 (62.6%).

Rates have also been calculated for two 10-year periods to allow for comparison between different communities. Among KCNs community Members, the mortality rate decreased from 8.9 deaths per 1,000 residents between 1985 and 1994 to 6.5 deaths per 1,000 between 1995 and 2005. In the first time period, although the KCNs community rate appears to be lower than the Manitoba First Nations living on-reserve rate of 10.5 deaths per 1,000 residents, the difference between the two groups is not statistically significant (as illustrated by the overlapping confidence intervals). In the second time period (1995-2005), however, the KCNs rate of 6.5 deaths per 1,000 residents is statistically lower than the Manitoba First Nations living on-reserve rate of 9.8 deaths per 1,000 residents (see Figure 5-23). Although the calculated mortality rate among KCNs residents decreased, the true number of deaths increased slightly from 127 between 1985-1994 to 150 between 1995-2005. The mortality rate decreased because the population grew at a higher rate than the number of deaths.

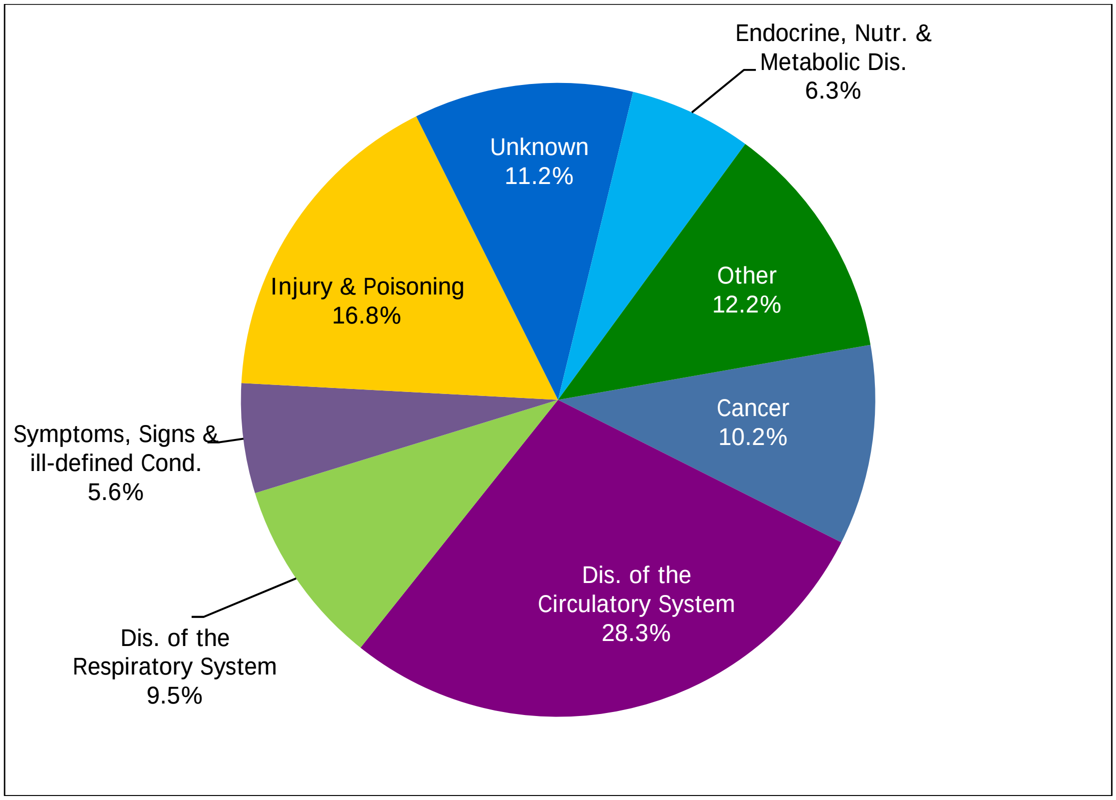


Source: Health Canada, First Nations and Inuit Health and Regions and Programs Branch (In-house data).
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- CI refers to confidence interval. The confidence interval gives the range of rates in which it is likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval (CI).

Figure 5-23: Total Mortality Rate by Area (1985-1994 and 1995-2005)

A review of causes of death among all KCNs community Members showed that diseases of the circulatory system accounted for more than one in four deaths (28.3%) followed by injury and poisoning at 16.8% of all deaths. The third leading cause of death among all KCNs residents was unknown followed by cancer accounting for one in 10 deaths (see Figure 5-24 and Table 5-8), which lists the 12.2% of "other" causes of mortality based on the ICD-10 coding system). Among KCNs males in particular, disease of the circulatory system was a noteworthy cause of death accounting for almost one in every three deaths (32.3%) between 1980 and 2005. This was followed by injury and poisoning at 17.5% (almost one in five deaths) and cancer at 11.1% of all deaths. Among KCNs men, disease of the circulatory system and injuries alone account for over one half of all deaths. However, a positive trend is that the mortality rates for both appear to be decreasing.



Source: Health Canada, First Nations and Inuit Health and Regions and Programs Branch (In-house data).
Notes:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- See Table 5-6 for a listing of the "other" causes of death.

Figure 5-24: Causes of Mortality in Keeyask Cree Nations Communities, All Residents (1980-2005)

Table 5-8: "Other" Causes of Mortality in Keeyask Cree Nations Communities, All Residents (1980-2005)

	Number	%
Diseases of the Digestive System	9	3.0%
Diseases of the Genitourinary System	9	3.0%
Diseases of the Nervous System	8	2.6%
Certain Conditions Originating in Perinatal Period	4	1.3%
Certain Infectious and Parasitic Disease	3	1.0%
Pregnancy, Childbirth and Puerperium	1	0.3%
Congenital malformations, deformations and chromosomal abnormalities	1	0.3%
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	1	0.3%
Mental and Behavioural Disorders	1	0.3%
TOTAL	**37**	

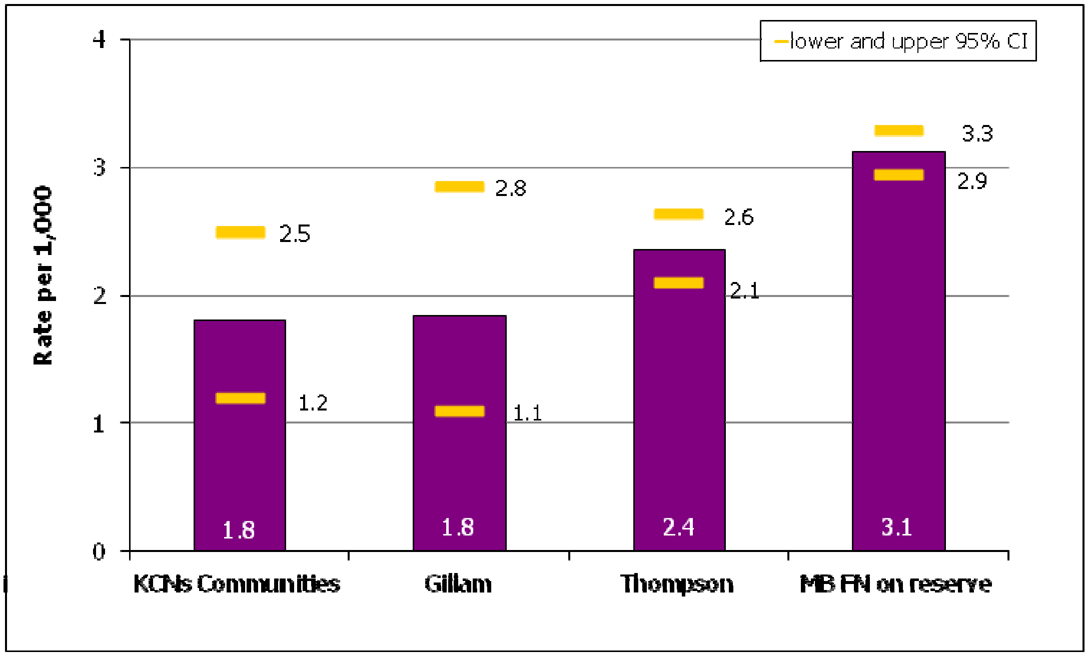
Source: Health Canada, First Nations and Inuit Health and Regions and Programs Branch (In-house data).
Note:

- All causes are ICD-10 classifications. See Appendix 5A for details of each classification.
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

The premature mortality rate (deaths before age 75) has been identified as one of the best single measures of health status and many researchers rely on this indicator above all others to measure the health of the community. Communities with higher premature mortality rates also tend to have higher rates of illnesses, hospital utilization and poorer health overall. Premature deaths data by cause can help to identify how many deaths may have preventable (for example, those due to injuries).

One useful measurement of premature mortality is "Potential Years of Life Lost" (PYLL). PYLL is calculated by subtracting age at death from age 75 (the standard "death age") for each person who died, and then adding all of these differences for a total PYLL. This information is usually grouped by cause of death for comparison with cause-specific death rates. This measure emphasizes causes of death that tend to be more common among younger persons, such as injuries and inherited anomalies.

Figure 5-25 shows the average annual premature mortality rates for KCNs communities and the comparison areas. The premature mortality rate for KCNs was 1.8 deaths per 1,000 residents on average between 1998 and 2006. This rate was statistically similar to both Gillam and Thompson but statistically lower than the rate of 3.1 deaths per 1,000 for all Manitoba First Nations living on-reserve.



Source: Manitoba Health, special data run 2011.

Note:

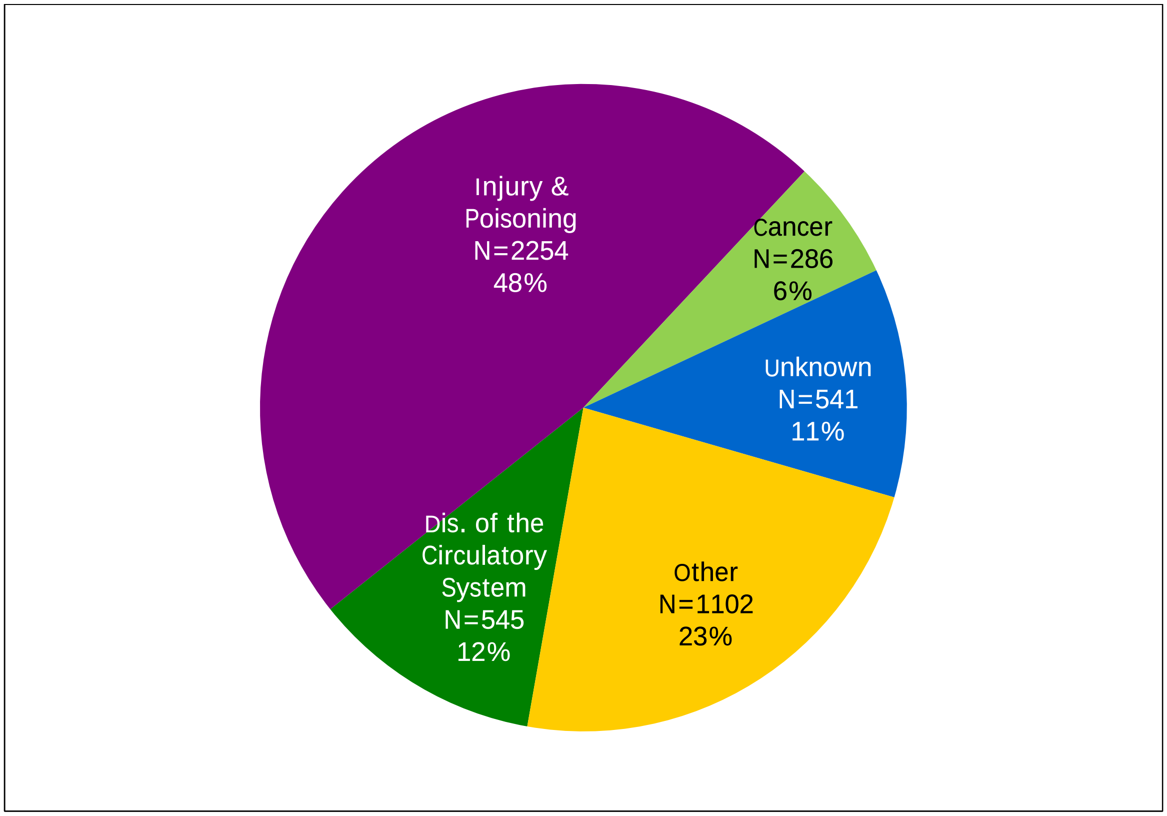
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.
- CI refers to confidence interval. The confidence interval gives the range of rates in which it is likely to be the true value 95% of the time – that is, that we are confident that 95% of the time, the true value or rate would be within the given range of confidence interval (CI).

Figure 5-25: Premature Mortality Rates by Area (1998-2006)

While diseases of the circulatory system were the leading cause of all KCNs resident deaths, when only premature deaths (those that occurred before age 75) were reviewed, there are different trends. Injury and poisoning, which are almost totally preventable, accounted for 2,254 or 48% of all PYLL between 1980 and 2005. Diseases of the circulatory system was second accounting for 12% of PYLL and unknown causes were third accounting for 11% of PYLL. This shows that while diseases of the circulatory system account for the most deaths and are very important, many of these deaths occur at an older age and may not be preventable. Injury deaths however, impact younger residents and are preventable for the most part (see Figure 5-26 and Table 5-9) which lists all causes of death presented in the category of "other" in the pie chart).

Among KCNs females, the leading cause of death was diseases of the circulatory system but the leading cause of PYLL was injury and poisoning accounting for 38.9% (or 731 potential years of life lost) of all PYLL. Unknown deaths were second accounting for 11.9% of PYLL and disease of the nervous system was third at 9.3% (174 PYLL) of PYLL among KCNs females.

Among KCNs males, injury and poisoning is a very important cause of PYLL accounting for more than half (53.4%) of all PYLL among KCNs males (or 1,523 PYLL). The next leading cause of PYLL is diseases of the circulatory system at 14.4% of PYLL followed by unknown causes at 11.2%. While injuries and diseases of the circulatory system combined accounted for almost half of all deaths among KCNs males, they account for almost three quarter of potential years of life lost before age 75.



Source: Health Canada, First Nations and Inuit Health and Regions and Programs Branch (In-house data).
Note:

- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

Figure 5-26: Causes of PYLL in Keeyask Cree Nations Communities, All Residents (1980-2005)

Table 5-9: "Other" Causes of PYLL in Keeyask Cree Nations Communities, All Residents (1980-2005)

	Number	%
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	187	4.0%
Diseases of the Nervous System	179	3.8%
Diseases of the Digestive System	176	3.7%
Diseases of the Respiratory System	129	2.7%
Endocrine, nutritional and metabolic diseases	114	2.4%
Diseases of the Genitourinary System	93	2.0%
Congenital malformations, deformations and chromosomal abnormalities	69	1.5%
Mental and Behavioural Disorders	51	1.1%
Pregnancy, Childbirth and Puerperium	49	1.0%
Certain Infectious and Parasitic Diseases	43	0.9%
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	12	0.3%
TOTAL	**1102**	

Source: Health Canada, First Nations and Inuit Health and Regions and Programs Branch (In-house data).
Note:

- All causes are ICD-10 classifications. See Appendix 5A for details of each classification.
- KCNs communities include Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation and York Factory First Nation.

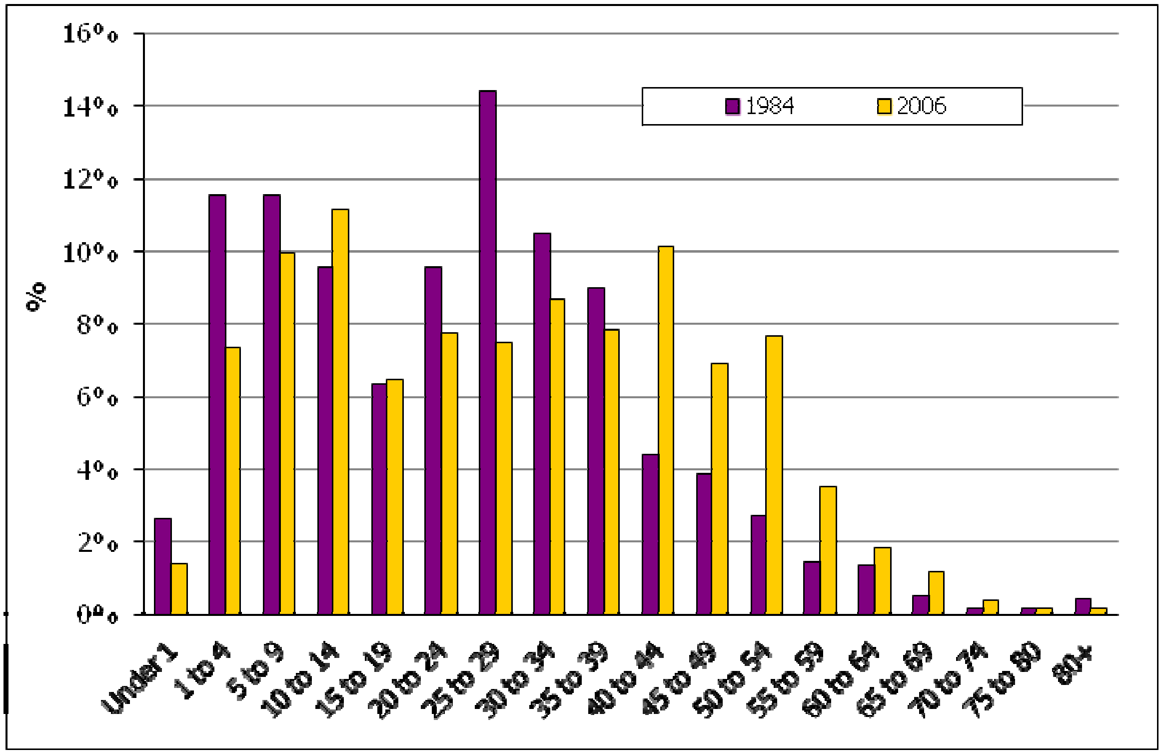
5.3.2.2 Gillam

Gillam is the second largest off-reserve community in the BRHA, and is also home to approximately 500 FLCN Members who can access health services in the community (see Section 4.3.3.1). The following data is inclusive of the FLCN Members residing in Gillam as long as these residents identify to Manitoba Health that Gillam is their mailing address. Because of the way data are collected by Manitoba Health, it is very difficult to separate out FLCN resident data from other Gillam community residents when all have the same postal code.

5.3.2.2.1 Health Characteristics Associated with Population Characteristics

Gillam residents account for fewer than three per cent of the BRHA population. While the population of the region has declined, the extent of decline is greater in Gillam. According to Manitoba Health, the population of Gillam in 1984 was 1,403 and the 2006 population of 1,085 representing a decrease of 22.7% residents.

While the population of Gillam is relatively young compared to the rest of Manitoba, it is the younger age groups (particularly age 20 to 34) where the population has experienced the largest decrease since 1984 (see Figure 5-27). According to Manitoba Health, in 1984, 6.7% of the Gillam population was over the age of 50; this increased to 14.9% by 2006. The change in population distribution will likely impact health and service needs in the community and may result in higher rates of chronic disease and cancer being observed in the community.



Source: Manitoba Health.

Figure 5-27: Gillam Change in Population Structure (1984 and 2006)

Gillam residents most commonly are sent to Thompson or Winnipeg to give birth. Birth and pregnancy rates for Gillam residents have declined over time. The birth rate for Gillam residents in 2006 was 14.7 births per 1,000 residents; this is lower than Manitoba First Nations on-reserve rate of 26.5 but higher than the provincial rate of 12.1 per 1,000. The pregnancy rate for Gillam women age 15-49 was 69.3 per 1,000; this was much lower than Manitoba First Nations rate of 135.1 but higher than the provincial rate of 60.7 in 2006.

Some of the birth and pregnancy outcomes reviewed included low and high birth weight rates, spontaneous abortion and infant mortality. In most cases, Gillam rates were similar to, or lower than, comparison areas. In some cases, such as infant mortality, there were no cases at all among Gillam residents. One area where change was observed was in the rate of spontaneous abortions (also known as miscarriage). The 10-year average annual rate increased from 29.3 to 63.6 per 1,000 residents between 1987-1996 and 1997-2006. This appears to be similar to the Manitoba First Nations (on-reserve) rate of 65.4 per 1,000 residents but higher than the provincial rate of 49.0 per 1,000 between 1997 and 2006.

However, these rates are based on small numbers and the Gillam rate was not statistically different from the other comparison areas.

In 2006 there were two babies born weighing more than 4000 grams (high birth weight) and no low birth weight babies (less than 2500 grams). Because of the small numbers of births and very small numbers of low and high birth weight infants it is difficult to identify clear trends (for example, low birth weights go up and down in extremes).

CARDIOVASCULAR DISEASE

For several chronic conditions, including cardiovascular disease, patient rates and physician visit rates were higher than the comparison areas but hospitalization rates were often lower. This may indicate that with more access to resources by Gillam residents (either within the community or through travel to Thompson or Winnipeg), patients were better able to manage their chronic illnesses at the community level and were less likely to require hospitalization.

In 2006, there were 133 patients accounting for 344 physician visits for cardiovascular disease recorded among Gillam residents. These visits accounted for 26.3 per cent of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, cardiovascular disease accounted for 8,324, or 22.7 per cent of all physician visits. The number of patients treated for cardiovascular disease increased by 35.7% between 1984 and 2006. This indicates that cardiovascular disease is a very important cause of illness as well as driver of medical service use in Gillam communities.

For comparison purposes, rates have also been calculated. The 2006 rate of 113.6 per 1,000 females in 2006 was statistically similar to all other comparison areas. The 2006 patient rate of 131.1 per 1,000 males was statistically similar to all comparison areas with the exception of higher than both BRHA males (98.3 per 1,000) and Manitoba First Nations males living on-reserve (87.5 per 1,000). Overall, the 2006 Gillam patient rate of 122.6 per 1,000 was higher than the BRHA (97.5 per 1,000) and Manitoba First Nations living on-reserve (86.7 per 1,000). The difference in physician visit rates was more striking with Gillam residents having 317.1 visits per 1,000 residents, which is statistically higher than all comparison areas with the exception of Thompson (at 318.3 visits per 1,000 residents). This may indicate a difference in access to services between Gillam residents and other comparison areas (although similar rates of patients are treated at least once, Gillam residents may have more frequent access to treatment) or it may indicate that Gillam residents tend to be more ill and require more care (but hospitalization rates do not appear to support this).

The average annual 10-year hospitalization rates for cardiovascular disease for all Gillam residents increased slightly from 10.2 to 12.9 per 1,000 between 1987-1996 and 1997-2006. This is similar to the BRHA at 13.7 per 1,000 but statistically lower than Manitoba First Nations living on-reserve at 17.3 per 1,000 as well as KCNs community residents (23.1 per 1,000 in 1997-2006). The Gillam hospitalization rate in this time period was only statistically higher than the rate for Thompson residents at 9.0 per 1,000 residents. For community planning purposes it is noted that the total number of cardiovascular disease hospitalizations among Gillam residents also increased very slightly from 146 to 152 between 1987-1996 and 1997-2006.

DIABETES

While treatment and hospitalization rates were consistently lower among Gillam residents compared to the comparison areas, the trend for Gillam appears to be towards an increase in the rate of residents being treated for diabetes.

In 2006, there were 63 patients accounting for 220 physician visits for diabetes recorded among Gillam residents. These visits accounted for 16.8% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, diabetes accounted for 3,897, or 10.6% of all physician visits.

The actual number of unique patients treated for diabetes among all Gillam residents increased by 320% from 15 patients in 1984 to 63 in 2006. This is the lowest rate of change among the comparison areas. The number of physician visits among Gillam residents also increased, from 52 in 1984 to 220 in 2006 and is an increase of 323.1%.

The patient rate among Gillam residents for diabetes increased from 10.7 patients per 1,000 residents in 1984 to 58.0 per 1,000 in 2006. Both Burntwood and Manitoba First Nations living on reserve also show a sharp and steady increase in patient rates over time. The 2006 rate of 58.1 per 1,000 was statistically lower than Manitoba First Nations living on-reserve (89.6 per 1,000) and KCNs community residents (101.4 per 1,000). The Gillam rate was statistically similar to both Thompson (43.4 per 1,000) and Burntwood (63.4 per 1,000).

Among Gillam females, the 10-year hospitalization rate for diabetes decreased from 5.8 to 4.5 per 1,000 between 1987-1996 and 1997-2006. The most recent rate is statistically similar to the BRHA at 3.8 per 1,000 and Manitoba First Nations living on-reserve (6.8 per 1,000) but statistically higher than Thompson (1.8 hospitalizations per 1,000 residents).

Unlike females, among Gillam males, the 10-year hospitalization rate for diabetes increased somewhat from 2.2 to 3.4 per 1,000 between 1987-1996 and 1997-2006. The most recent rate is statistically similar to the BRHA at 3.1 per 1,000 but statistically lower than Manitoba First Nations living on-reserve (6.6 per 1,000) and KCNs community residents (6.7 per 1,000).

While physician visits have increased, overall, the 10-year hospitalization rates for diabetes for Gillam remained the same at 3.9 per 1,000 between 1987-1996 and 1997-2006. The most recent rate is statistically similar to the BRHA at 3.4 per 1,000 and statistically lower than Manitoba First Nations living on-reserve at 6.7 per 1,000.

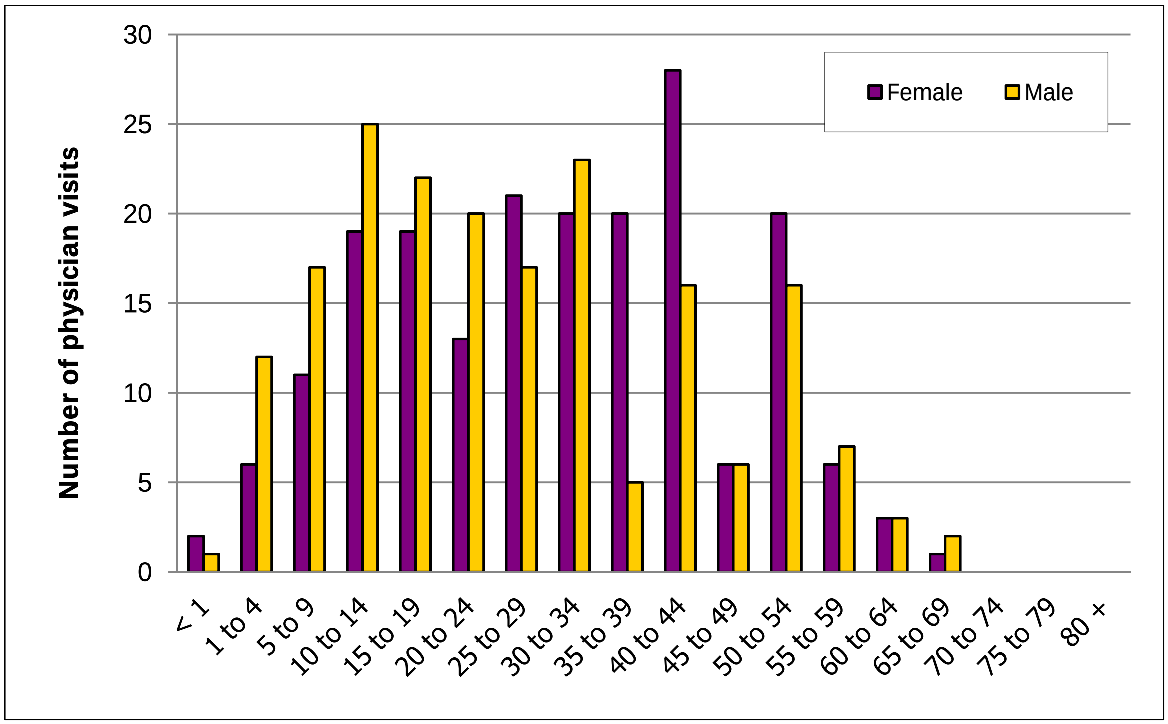
It is important to note that the physician visit data shows that the numbers of people (and resulting need for consulting with a physician) diagnosed with diabetes was increasing, particularly among males. That the hospitalization rate data did not show the same trend may indicate that Gillam residents have had good access to primary health care and physician services to help successfully manage diabetes in the community and avoid health problems that lead to hospitalization.

INJURY

Between 1984 and 2006, injuries accounted for 14,382, or 39.3% of all physician visits. In 2006, there were 218 patients accounting for 387 physician visits for injuries recorded among Gillam residents.

Between 1984 and 2006, Gillam residents accounted for 3.8% of all BRHA physician visits for injuries, which is slightly higher than the 2.9% of the BRHA population that they represent. However, this difference may be more of a result in differences in service provision and submission of data to Manitoba Health (compared to many communities in the region, particularly First Nation communities where services are provided by nurses who do not submit data to Manitoba Health) than an actual difference in rates of physician visits.

In 2006, Gillam residents age 19 and under accounted for about one in three (34.6%) physician visits for injuries. Figure 5-28 shows the number of physician visits by age group and gender for injuries between 1984 and 2006.



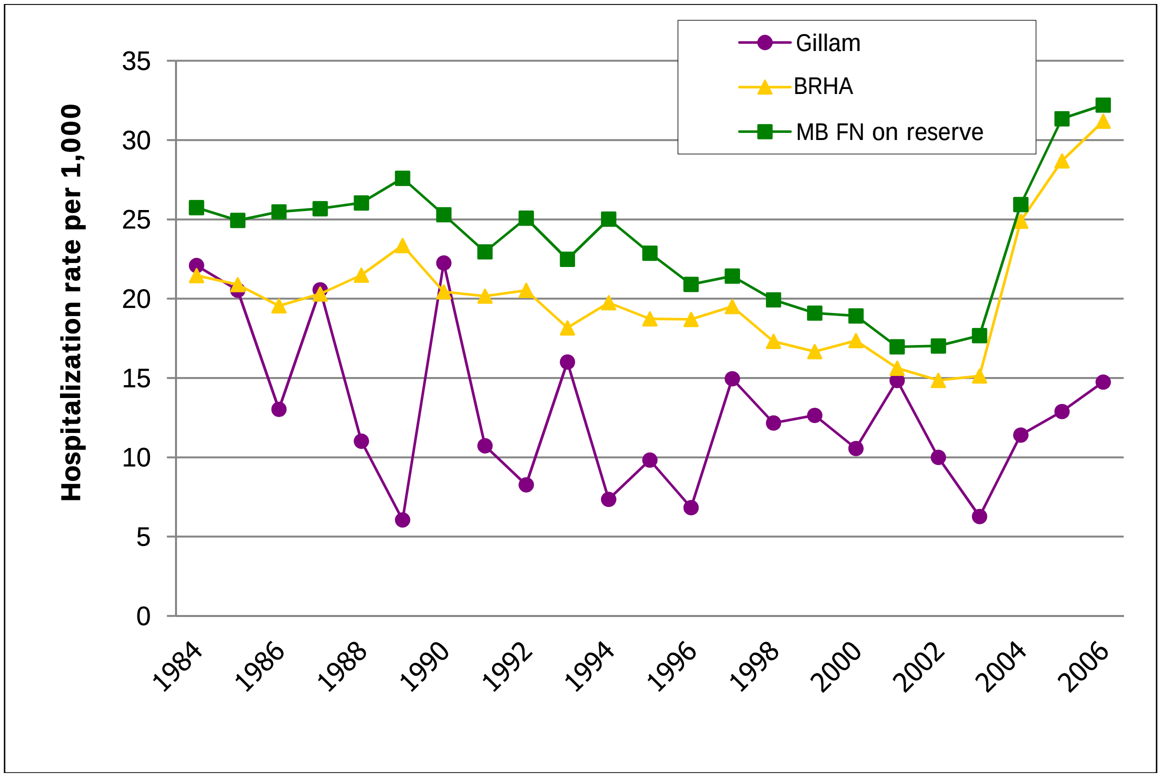
Source: Manitoba Health, special data run 2009.

Figure 5-28: Physician Visits for Injuries by Gender and Age Group, Gillam (2006)

Between 1984 and 2006, Gillam residents accounted for 1.9% of all BRHA hospitalizations for injuries which is lower than the 2.9% of the BRHA population that they represent. As with physician visits, within Gillam, residents age 19 and under accounted for about one third (35.5%) of hospitalizations for injuries.

The patient rate among Gillam residents for injuries decreased from 265.9 patients per 1,000 residents in 1984 to 200.9 per 1,000 in 2006. Manitoba First Nations living on-reserve also showed a slight decrease from 199.2 to 179.1 per 1,000, while the BRHA residents showed a very slight increase from 157.1 to 162.7 per 1,000. However, the Gillam patient rates are typically higher than the comparison areas throughout the time period (but this may be due to better reporting of physician visits).

Figure 5-29 shows a large variation from year to year in injury hospitalization rates among Gillam residents. This variation may be attributed to small population numbers. By comparison, the BRHA and Manitoba First Nations living on-reserve show more clear trends. For community planning, it is noted that the number of actual patients hospitalized for injuries among all Gillam residents decreased by 41.6% from 373 patients in 1984 to 218 in 2006. The number of physician visits for these patients also decreased by 48% from 744 in 1984 to 387 in 2006.



Source: Manitoba Health, special data run 2009.

Figure 5-29: Hospitalization Rates for Injuries by Year, All Residents (1984-2006)

Among females, the 10-year average annual hospitalization rate for injuries remained unchanged at 8.9 per 1,000 between 1987-1996 and 1997-2006. These rates are statistically lower than the most recent rates for the BRHA at 17.5 per 1,000 females and for Manitoba First Nations living on-reserve at 19.6 per 1,000 females. It should be noted that the number of hospitalizations among Gillam females decreased from 61 to 50 between 1987-1996 and 1997-2006 but because the population also decreased during this period, the calculated rates are the same.

A similar trend was evident among Gillam males, with the 10-year average annual hospitalization rates changing very little from 14.5 to 15.0 per 1,000 males between 1987-1996 and 1997-2006. As with females, the most recent rate is statistically lower than the BRHA (22.8 per 1,000 males) and Manitoba First Nations living on-reserve (24.6 per 1,000 males). As with females, please note that the actual number of hospitalizations for Gillam decreased from 108 to 93 between 1987-1996 and 1997-2006.

Because the population decreased more than the cases decreased, the calculated hospitalization rate increased slightly.

MENTAL HEALTH

Mental health is an important area to consider as part of overall health characteristics.

In 2006, there were 101 patients accounting for 209 physician visits for mental health disorders recorded among Gillam residents. These visits accounted for 16.0% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, mental health disorders accounted for 5,469, or 14.9% of all physician visits among Gillam residents.

Between 1997-2006, the calculated 10-year average annual physician visit rate of 220.4 per 1,000 residents for mental health and behavioural disorders was statistically higher than all other comparison areas with the exception of Thompson (at 248.4 per 1,000 residents) (but this difference may be a result of better reporting of data to Manitoba Health by physicians).

The number of physician visits for mental and behavioural disorders among Gillam females stayed very stable, increasing by just 1.9% between 1984 and 2006 (from 54 to 55). The 2006 calculated rate, for community comparison, of 104.2 per 1,000 Gillam females in 2006 is statistically higher than the BRHA at 93.1 per 1,000 and similar to Manitoba First Nations living on-reserve (105.1 per 1,000). The number of physician visits among Gillam males for mental and behavioural disorders increased by 58.6% between 1984 and 2006 (from 29 to 46). The 2006 calculated rate of 82.6 physician visits per 1,000 Gillam males is similar to both the BRHA (82.4 per 1,000) and Manitoba First Nations living on-reserve (78.1 per 1,000).

There were a small number of hospitalizations for mental health and behavioural disorders among Gillam residents. In 2006, there were a total of 12 hospitalizations for mental health disorders recorded among Gillam residents. These visits accounted for 24.5% of all hospitalizations for conditions of interest in 2006. Overall, between 1984 and 2006, mental health disorders accounted for 250 or 17.7% of all hospitalizations for conditions of interest. Overall, Gillam residents accounted for 2.7% of all BRHA hospitalizations for mental and behavioural disorders, which is very similar to 2.9% of the BRHA population that they represent.

Rates have also been calculated for comparison to other areas. Between 1996 and 2007, the 10-year average annual rate of 10.7 hospitalizations per 1,000 Gillam residents was statistically similar to all comparison populations with the exception of Thompson, which was lower at 7.0 per 1,000.

Among Gillam females, hospitalization rates for mental and behavioural disorders have fluctuated over the years but increased from 5.9 hospitalizations per 1,000 in 1984 to 7.6 per 1,000 females in 2006. In 2004, there appeared to be a spike in hospitalization rates for Gillam females (to over 15 per 1,000 females). This may mean that in this year several females were hospitalized or it may indicate that one female was very ill and was hospitalized several times in that year. It is important to note that between 2004/05 and 2006/07 one of the leading reasons for hospitalizations among Gillam females was "behavioural disorders related to alcoholism." This may be related to the spike in hospitalization rates for mental health disorders in 2004.

The fact that physician visit rates are higher in some cases for Gillam community members while hospitalization rates are similar to most comparison areas may indicate that there is better physician visit data being reported for communities such as Thompson and Gillam. It may also mean that there are enough primary health care services in the community to provide support to residents and allow them to be treated at the community level (and avoid hospitalization).

SKIN INFECTION

Hospitalization and physician visit rates among Gillam residents for skin infections appear to be lower than comparison areas, and for the most part, declining.

In 2006, there were 43 patients accounting for 60 physician visits for infections of skin and subcutaneous tissue recorded among Gillam residents. These visits accounted for 4.6% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, these infections accounted for 2,226, or 6.1% of all physician visits.

Physician visits by Gillam residents for infections of skin and subcutaneous tissue accounted for 1.4% of physician visits for all BRHA residents. In comparison to the proportion of the population (2.4%), these visits are proportionally lower than the Gillam population proportion. Between 1984 and 2006 overall, Gillam residents accounted for 3.0% of all BRHA physician visits for infections of skin and subcutaneous tissue, which is very similar to the 2.9% of the BRHA population that they represent in this longer time period.

Among Gillam females, physician visit rates for infections of skin and subcutaneous tissue decreased by 60.5% between 1984 and 2006. The 2006 rate of 28.4 per 1,000 was lower than both the BRHA (51.2 per 1,000) and for Manitoba First Nations living on-reserve (63.3 per 1,000).

Male physician visit rates for infections of skin and subcutaneous tissue for Gillam increased by 33.3% between 1984 and 2006. The 2006 rate of 50.3 per 1,000 in 2006 was similar to the BRHA (54.3 per 1,000) as well as Manitoba First Nations living on-reserve (58.7 per 1,000).

Overall, the total physician visit rates for infections of skin and subcutaneous tissue decreased 27.1% (from 59 visits to 43 visits) between 1984 and 2006. The 2006 rate of 39.6 per 1,000 was statistically lower than both the BRHA (52.8 per 1,000) and Manitoba First Nations living on-reserve (61.0 per 1,000).

The 10-year hospitalization rate for infections of skin and subcutaneous tissue for Gillam residents decreased from 3.8 to 2.3 per 1,000 between 1987-1996 and 1997-2006 (from 54 hospitalizations to 27). This is lower than the BRHA rate at 3.7 per 1,000 and for Manitoba First Nations living on-reserve at 4.6 per 1,000 between 1997-2006. Among females, the 10-year average annual hospitalization rates for infections of skin and subcutaneous tissue decreased from 3.5 to 2.1 per 1,000 between 1987-1996 and 1997-2006; the most recent rate is lower than both the BRHA at 3.3 per 1,000 and for Manitoba First Nations living on-reserve at 4.3 per 1,000 in 1997-2006.

Among males, the 10-year hospitalization rate also declined, from 4.0 to 2.4 per 1,000 between 1987-1996 and 1997-2006. The most recent rate is lower than both the BRHA at 4.0 per 1,000 and Manitoba First Nations living on-reserve at 4.8 per 1,000 in 1997-2006.

MORTALITY

In many northern communities, disease of the circulatory system and injuries are typically among the leading causes of death. Gillam is different in that cancer was the leading cause of death in the community between 1998 and 2006. The second leading cause of death was diseases of the digestive system. A review of premature deaths indicated that injury was the leading cause of potential years of life lost among males but this was only based on two deaths so must be interpreted with caution.

In Gillam, there were 27 deaths among residents between 1998 and 2006 for a total mortality rate of 2.6 deaths per 1,000 residents. This was lower than Manitoba First Nations living on-reserve at 4.1 per 1,000 and Manitoba at 8.5 per 1,000. Females accounted for 10 (37%) of these deaths while males accounted for 17 (63%). This is a very small number of deaths to make inferences about changes over time or differences between areas.

There were seven deaths among Gillam residents due to cancer, leading to a mortality rate of 0.7 per 1,000 between 1998-2006; this is similar to Manitoba First Nations living on-reserve (0.6 per 1,000) but statistically lower than Manitoba at 2.3 deaths per 1,000.

There were three deaths due to diseases of circulatory system accounting for a mortality rate of 0.29 per 1,000, lower than Manitoba First Nations living on-reserve (1.0 per 1,000) and Manitoba (2.9 per 1,000). There were also three deaths due to diseases of the respiratory system accounting for a mortality rate of 0.3 per 1,000; this is similar to Manitoba First Nations living on-reserve (0.2 per 1,000) but lower than Manitoba at 0.7 deaths per 1,000 residents.

Between 1998 and 2006, there were 19 deaths among residents younger than 75 (considered "premature deaths"). The Gillam rate of 1.8 premature deaths per 1,000 residents was statistically lower than the rate among Manitoba First Nations living on-reserve (3.1 premature deaths per 1,000) but is statistically similar to the other comparison areas.

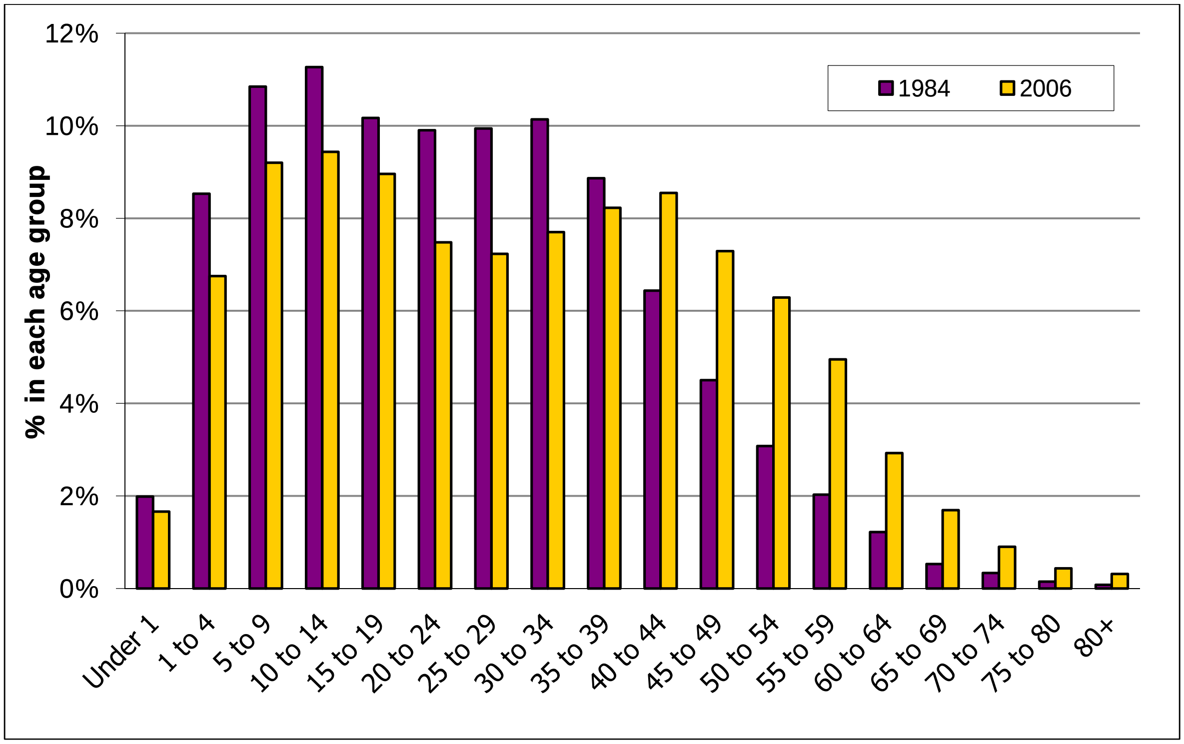
PYLL among Gillam females increased from 46 to 111years between 2000-2003 and 2004-2007. Among Gillam males, PYLL decreased from 133 to 63 years for the same time period. The leading cause of PYLL was cancer for males and diseases of the digestive system for females. The causes of premature mortality in Gillam is based on small numbers but is noteworthy as they are different from other northern communities where the leading cause of PYLL and premature mortality overall is typically injury and poisoning.

5.3.2.3 Thompson

5.3.2.3.1 Health Characteristics Associated with Population Characteristics

Thompson is the largest community in the BRHA and Manitoba Health reports the 2008 population as being 13,931 residents. Given that the population of the BRHA is 46,818, Thompson residents account for just about one third of all residents in the region. Only 3.3% of the Thompson population is over 65 years old. This is very similar to the Manitoba First Nations rate of 3.4% and much lower than the provincial average of 13.8% in 2008.

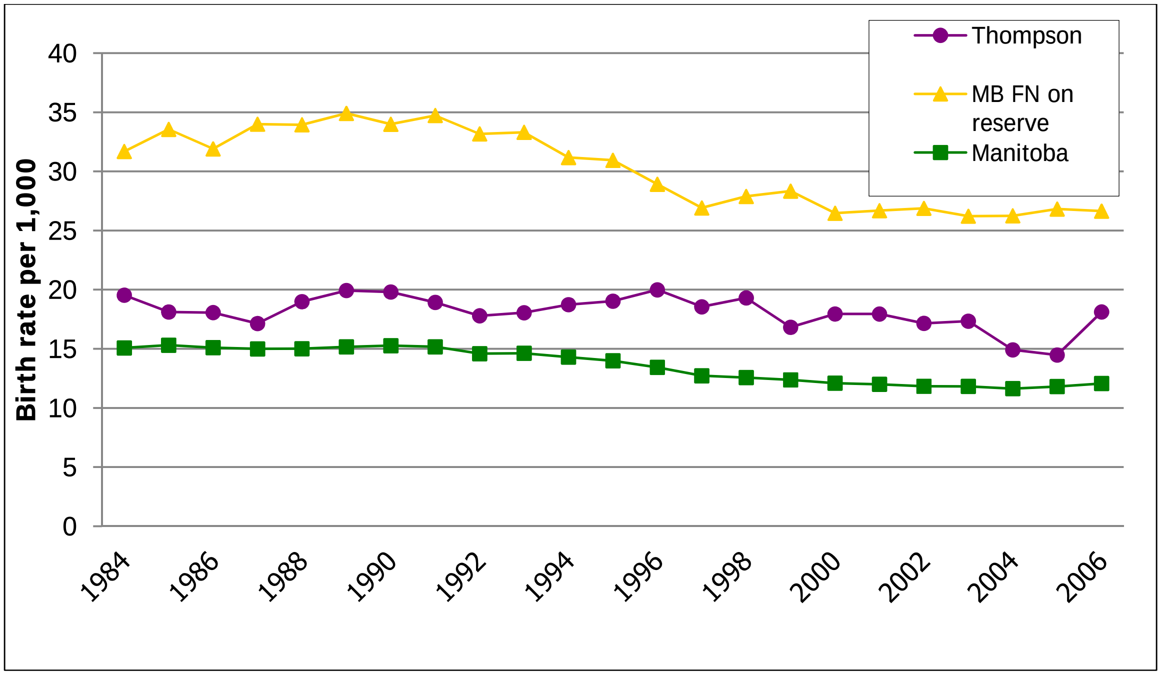
According to Manitoba Health, the population of Thompson in 1984 was 14, 946 and the 2006 population of 14,074 represents a decline of 5.8%. Although the population of Thompson is still relatively young compared to the rest of Manitoba, Figure 5-30 shows that the population has grown in the older age groups, while the younger age groups (particularly age 20 to 34) have experienced the largest decrease since 1984. In 1984, 32.6% of the population was under the age of 15 and 7.4% was over the age of 50. This changed by 2006 to 27% of the population being under age 15 and 17.5% over age 50.



Source: Manitoba Health, special data run, 2009.

Figure 5-30: Thompson Change in Population Structure (1984 and 2006)

The birth rate for Thompson in 2006 was 21.2 births per 1,000 residents; this is statistically lower than the Manitoba First Nations living on-reserve rate of 33.5 but statistically higher than the provincial rate of 14.8 per 1,000 in 2006. As Figure 5-31 shows, the 20-year trend in birth rates for Thompson has been quite stable. The 2006 pregnancy rate for Thompson women age 15-49 was 76.6 per 1,000 females; this is lower than the Manitoba First Nations living on-reserve rate of 135.1 per 1,000 females but higher than the provincial rate of 60.7 per 1,000 in 2006. Like birth rates, the pregnancy rate for Thompson has changed very little between 1984 and 2006.



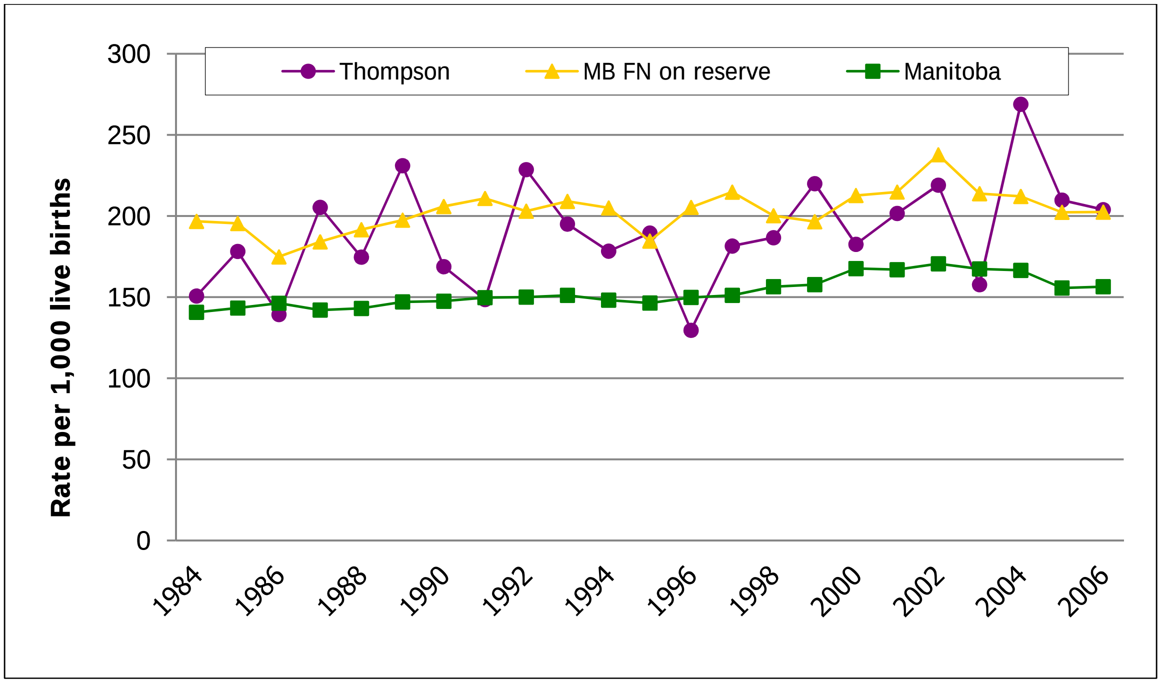
Source: Manitoba Health, special data run 2009.

Figure 5-31: Birth Rates for Thompson, MB First Nations on-Reserve and Manitoba (1984-2006)

In 2006, the rate of low birth weight (less than 2,500 grams) infants in Thompson was 70.6 per 1,000 live births, which is statistically higher than the Manitoba First Nations rate of 59.2 per 1,000 live births and the provincial rate of 56.6 per 1,000 live births. It is important to note that the actual number of low birth weight infants born to residents of Thompson in 2006 was 18 (compared to 74 in Manitoba First Nations communities and 807 in Manitoba overall). This is important, as the small number leads to a large variation in rates from year to year.

The high birth weight rate (greater than 4,000 grams) for Thompson was 203.9 births per 1,000 live births, which is similar to the Manitoba First Nations rate of 202.4 per 1,000 live births but statistically higher than the provincial rate of 156.4 per 1,000 live births. For Thompson, this rate is calculated based on a total of 52 high birth weight infants born in 2006 (accounting for 20% of all births in that year). There appears to be a trend toward an increase in the rate of high birth weight infants in Thompson (see Figure 5-32).

The 10-year average annual rate of reported spontaneous abortions (also known as miscarriage) for Thompson increased from 12.1 to 51.0 per 1,000 reported pregnancies between 1987-1996 and 1997-2006. It is important to note that this increase is based on reported miscarriages and pregnancies. Therefore, it is possible that at least some of the increase in rates for Thompson is due to better reporting of pregnancy and miscarriage. The most recent rate for Thompson is statistically lower than Manitoba First Nations at 65.4 per 1,000 but statistically similar to the provincial rate of 49.0 per 1,000 pregnancies between 1997-2006.



Source: Manitoba Health, special data run 2009.

Figure 5-32: High Birth Weight Rates for Thompson, MB First Nations on-Reserve and Manitoba (1984-2006)

CARDIOVASCULAR DISEASE

For several chronic conditions, including cardiovascular disease, patient rates and physician visit rates were higher than the comparison areas but hospitalizations were much lower. This may indicate that with more resources in a larger community, such as Thompson, patients are better able to manage their chronic illnesses at the community level and are less likely to require hospitalization.

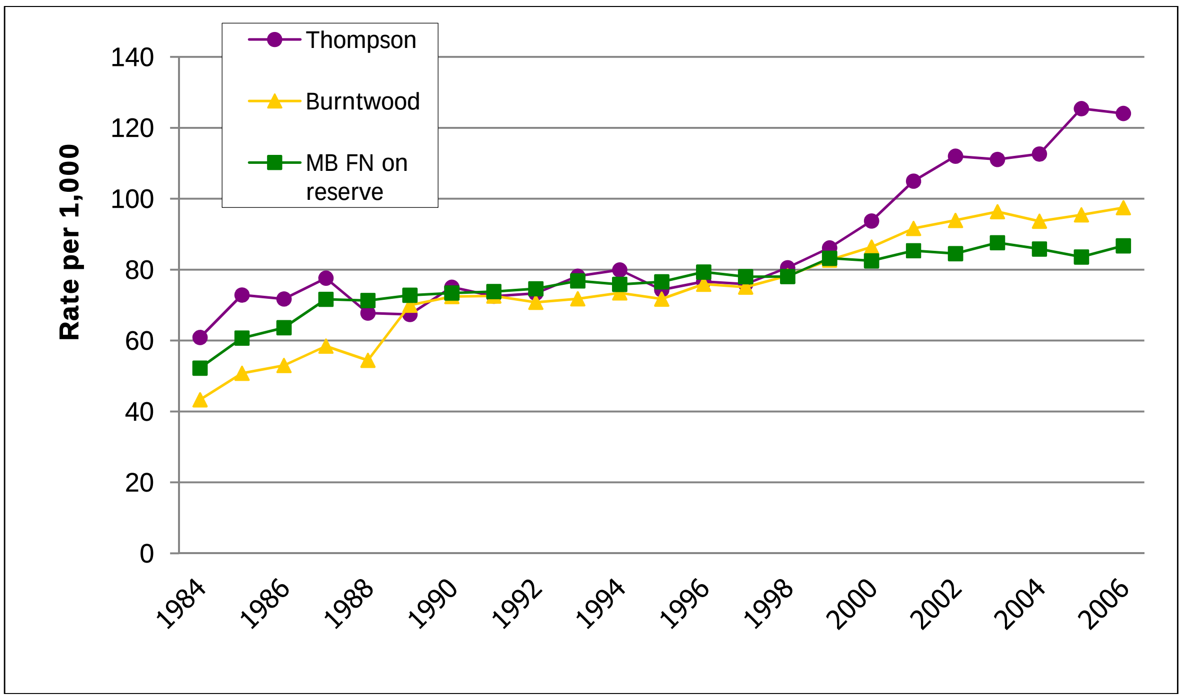
Between 1984 and 2006, cardiovascular disease accounted for 81,990, or 21.5% of all physician visits among Thompson residents. In this time period, Thompson residents accounted for 37.5% of all BRHA physician visits for cardiovascular disease, which is slightly higher than the 33.3% of the BRHA population that the community represented in that time period. This indicates that cardiovascular disease is an important cause of illness as well as a driver of medical service use in Thompson.

Thompson residents age 50 and older accounted for two out of three (66.9%) physician visits for cardiovascular disease, with the highest number of physician visits seen among male residents ages 55 to 59.

The total number of physician visits for cardiovascular disease among Thompson residents increased 57.5% (from 2,844 to 4,480) between 1984 and 2006. While we know the population of Thompson has decreased, it important to note that the number of unique patients that were treated almost doubled from 910 to 1,746 in this time period.

Among Thompson females, the physician visit rate increased by 95.9%. The 2006 physician visit rate of 127.0 visits per 1,000 was statistically higher than both the BRHA (96.6 per 1,000) and Manitoba First Nations living on-reserve (86.0 per 1,000). The male physician visit rate for cardiovascular disease increased 111.7% between 1984 and 2006. The 2006 rate of 121.2 per 1,000 was statistically higher than both the BRHA (98.3 per 1,000) and for Manitoba First Nations living on-reserve (87.5 per 1,000).

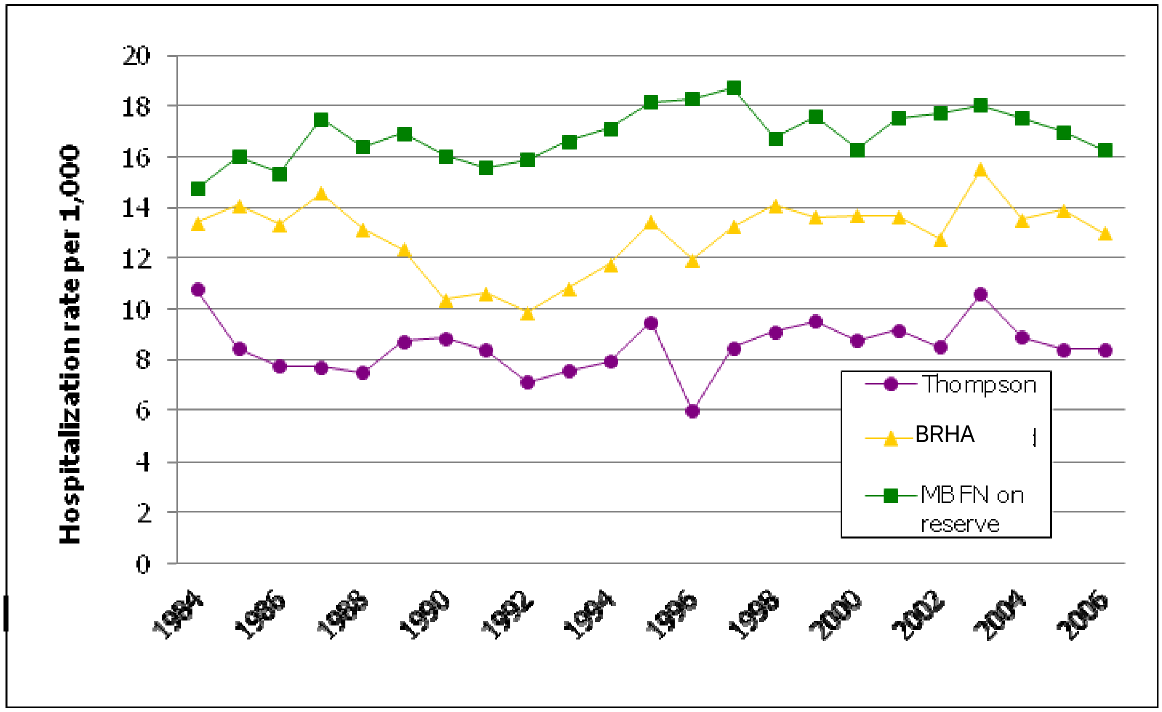
Among Thompson females, the unique patient rate for cardiovascular disease increased from 64.8 patients per 1,000 residents in 1984 to 127.0 patients per 1,000 females in 2006. Thompson males had the highest rate of patients among comparison areas in 1984 and rates steadily increased from 57.3 unique patients per 1,000 in 1984 to 121.2 per 1,000 in 2006. Figure 5-33 shows that as with the rates among the BRHA and Manitoba First Nations living on-reserve, there is a gradual but clear increase over time in patient rates for residents of Thompson. This may be partly due to the increase in the numbers of older residents living in the community.



Source: Manitoba Health, special data run 2009.

Figure 5-33: Patient Rates for Cardiovascular Disease by Year, All Residents (1984-2006)

The 10-year average annual hospitalization rate for cardiovascular disease increased very slightly from 7.9 to 9.0 per 1,000 between 1987-1996 and 1997-2006. The slight rate increase for Thompson represents an increase of actual hospitalizations from 1,228 to 1,280 (a much smaller increase than seen for physician visits). As Figure 5-34 shows, hospitalization rates for Thompson residents are consistently lower than rates for BRHA and Manitoba First Nations living on-reserve. For Thompson females, the 10-year average annual hospitalization rate for cardiovascular disease remained quite stable at 6.5 and 7.1 per 1,000 between 1987-1996 and 1997-2006. This was statistically lower than the BRHA at 12.2 per 1,000 females and for Manitoba First Nations living on-reserve at 16.0 per 1,000 females between 1997-2006. For Thompson males, the 10-year average annual hospitalization rate for cardiovascular disease increased slightly from 9.2 to 10.7 per 1,000 between 1987-1996 and 1997-2006. The Thompson male rate is statistically lower than the BRHA at 15.1 per 1,000 males and Manitoba First Nations living on-reserve at 18.6 per 1,000 in 1997-2006.



Source: Manitoba Health, special data run 2009.

Figure 5-34: Hospitalization Rates for Cardiovascular Disease by Year, All Residents (1984-2006)

DIABETES

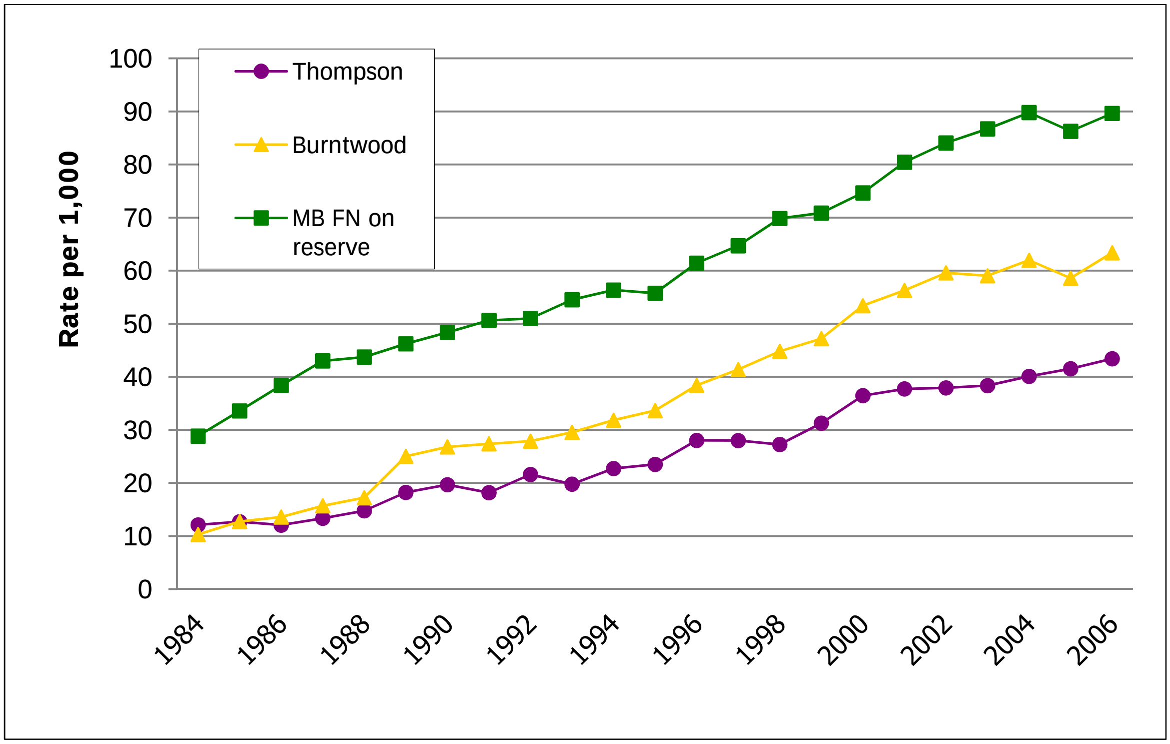
In 2006, there were 611 patients accounting 1,638 physician visits for diabetes recorded among Thompson residents. These visits accounted for 9.8% of all patients seen for conditions of interest in 2006.

Overall, between 1984 and 2006, diabetes accounted for 26,115, or 6.8% of all physician visits.

In this time period, Thompson residents accounted for 23.2% of all BRHA physician visits for diabetes which is lower than the 33.3 per cent of the BRHA population that they represent.

Thompson residents age 50 and older accounted for two thirds (68.2%) of physician visits for diabetes, with the highest number of physician visits seen among female residents ages 60 to 64 followed by males age 55 to 59.

The patient rate among Thompson residents increased from 12.1 patients per 1,000 residents in 1984 to 43.4 per 1,000 in 2006 (see Figure 5-35). Both BRHA and Manitoba First Nations living on-reserve, appear to consistently have higher patient rates than Thompson residents and both also show a steady increase in physician visit rates.



Source: Manitoba Health, special data run 2009.

Figure 5-35: Patient Rates for Diabetes by Year, All Residents (1984-2006)

For community planning purposes, it is noted that the actual number of unique patients treated for diabetes among all Thompson residents increased by 237.6% from 181 patients in 1984 to 611 in 2006. This is the lowest rate of change among the comparison areas. The number of physician visits also increased, but less than the number of individual patients, from 694 in 1984 to 1,638 in 2006 - an increase of 136%.

Among Thompson females, patient rates for diabetes increased from 13.1 patients per 1,000 residents in 1984 to 44.0 patients per 1,000 in 2006 (from 94 to 304 patients). The number of physician visits increased by 161.4% from 329 in 1984 to 860 in 2006.

The number of males treated for diabetes increased even more than females at 252.9% (from 87 to 307). The number of physician visits increased from 365 in 1984 to 778 in 2006 and is an increase of 113.2 per cent.

Between 1997-2006, the 10-year average annual hospitalization rate for diabetes among Thompson residents remained very stable at about 1.9 per 1,000 residents. This was statistically lower than both the BRHA (3.4 per 1,000) and Manitoba First Nations (6.7 per 1,000). It is noted that the actual number of diabetes hospitalizations among Thompson residents decreased from 299 to 266 between 1987-1996 and 1997-2006 but the rate did not change due to the decrease in population.

Among Thompson females, the 10-year hospitalization rate for diabetes decreased from 2.4 to 1.8 per 1,000 between 1987-1996 and 1997-2006. This is statistically lower than the BRHA at 3.8 per 1,000 as well as Manitoba First Nations living on-reserve at 6.8 per 1,000 in 1997-2006. Among Thompson men, the 10-year hospitalization rate for diabetes increased slightly from 1.4 to 1.9 per 1,000 between 1987-1996 and 1997-2006. However, these remains statistically lower than both the BRHA at 3.1 per 1,000 and Manitoba First Nations at 6.6 per 1,000 in 1997-2006.

It is important to note that the physician visit data show very clearly that the numbers of people (and resulting need for consulting with a physician) diagnosed with diabetes is increasing steadily. That the hospitalization data does not show the same trend may indicate that Thompson residents have better access to primary health care and physician services to help them successfully manage their diabetes in the community and avoid health problems that would lead to hospitalizations.

INJURY

In 2006, there were 2,642 patients accounting for 4,693 physician visits for injuries recorded among Thompson residents. These visits accounted for 28.2% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, injuries accounted for 144,704, or 37.9% of all physician visits.

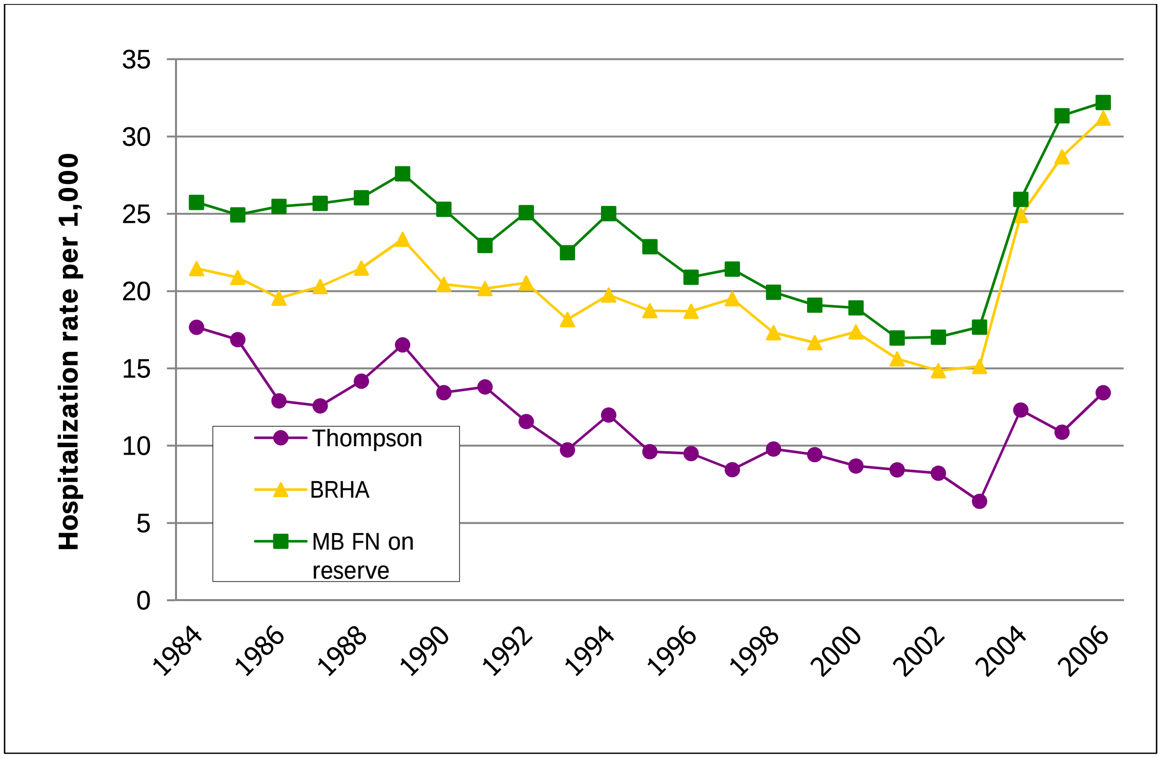
Between 1984 and 2006 overall, Thompson residents accounted for 38.5% of all BHRA physician visits for injuries, which is higher than the 33.3% of the BRHA population that they represent.

Between 1984 and 2006, injuries accounted for 144,704, or 37.9% of all physician visits. In the same time period, Thompson residents accounted for 38.5% of all the BRHA physician visits for injuries, which is higher than the 33.3% of the BRHA population that they represent.

Thompson residents age 19 and under accounted for 34.8% of physician visits for injuries, with the highest number of physician visits seen among male residents ages 15 to 19 and 30 to 34.

Between 1984 and 2006, injuries accounted for 4,002 or 36.6% of all hospitalizations for conditions of interest. In this same time period, Thompson residents accounted for 19.2% of all the BRHA hospitalizations for injuries, which is lower than the 33.3% of the BRHA population that they represent. Within Thompson, residents age 19 and younger accounted for 34.1% of injury hospitalizations.

Figure 5-36 illustrates the calculated hospitalization rates by year between 1984 and 2006 to allow for comparison between Thompson, Manitoba First Nations living on-reserve and BRHA residents. Each of these populations show minor variation from year to year with a trend toward declining rates until 2004 where rates increased again.



Source: Manitoba Health, special data run 2008.

Figure 5-36: Hospitalization Rates for Injuries by Year, All Residents (1984-2006)

Among Thompson females, the 10-year average annual hospitalization rate for injuries decreased slightly from 8.9 to 7.7 per 1,000 between 1987-1996 and 1997-2006. This is statistically lower than BRHA females at 17.5 per 1,000 and Manitoba First Nations females living on-reserve at 19.6 per 1,000 in 1997-2006. The Thompson male 10-year average annual hospitalization rate for injuries also decreased from 15.5 to 11.4 per 1,000 between 1987-1996 and 1997-2006. Similar to rates among females, the most recent rates are statistically lower than BRHA males at 22.8 per 1,000 as well as Manitoba First Nations males living on-reserve at 24.6 per 1,000 males between 1997-2006.

Among Thompson residents, the total 10-year average annual hospitalization rate for injuries decreased from 12.3 to 9.6 per 1,000 between 1987-1996 and 1997-2006 (a decrease from 1,911 to 1,371 hospitalizations).

MENTAL HEALTH

Mental health is another important characteristic of overall health. Rates of patients and treatment with a physician are typically higher than comparison areas and continue to increase over time. While hospitalizations are typically lower than the comparison areas (again likely pointing to increased ability to manage the condition at the community level), these rates are increasing.

In 2006, there were 1,612 patients accounting for 3,737 physician visits for mental health and behavioural disorders recorded among Thompson residents. These visits accounted for 22.4% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, mental health disorders accounted for 87,626, or 22.9% of all physician visits among Thompson residents.

Between 1984 and 2006 overall, Thompson residents accounted for 47.4% of all BRHA physician visits for mental health and behavioural disorders, which is higher than the 33.3% of the BRHA population that they represent.

Within Thompson, residents age 50 and older accounted for 17% of physician visits for mental and behavioural disorders, with the highest number of physician visits seen among female residents ages 30 to 39.

The patient rate among Thompson residents for mental health and behavioural disorders appears to be consistently higher than the comparison areas and increased from 109.2 patients per 1,000 residents in 1984 to 114.5 per 1,000 in 2006. Both Burntwood and Manitoba First Nations living on reserve show a more pronounced and steady increase in patient rates.

The actual number of patients treated for mental health and behavioural disorders among all Thompson residents decreased by 1.2% 1,632 patients in 1984 to 1,612 in 2006; however, the rate increased slightly due to the decrease in population, which is used to calculate rates. The rate of change in numbers of patients is lower than for Burntwood and Manitoba First Nations living on-reserve. Among Thompson residents, the number of physician visits decreased from 3,755 in 1984 to 3,737 in 2006 and is proportionally a small decrease at 0.5%.

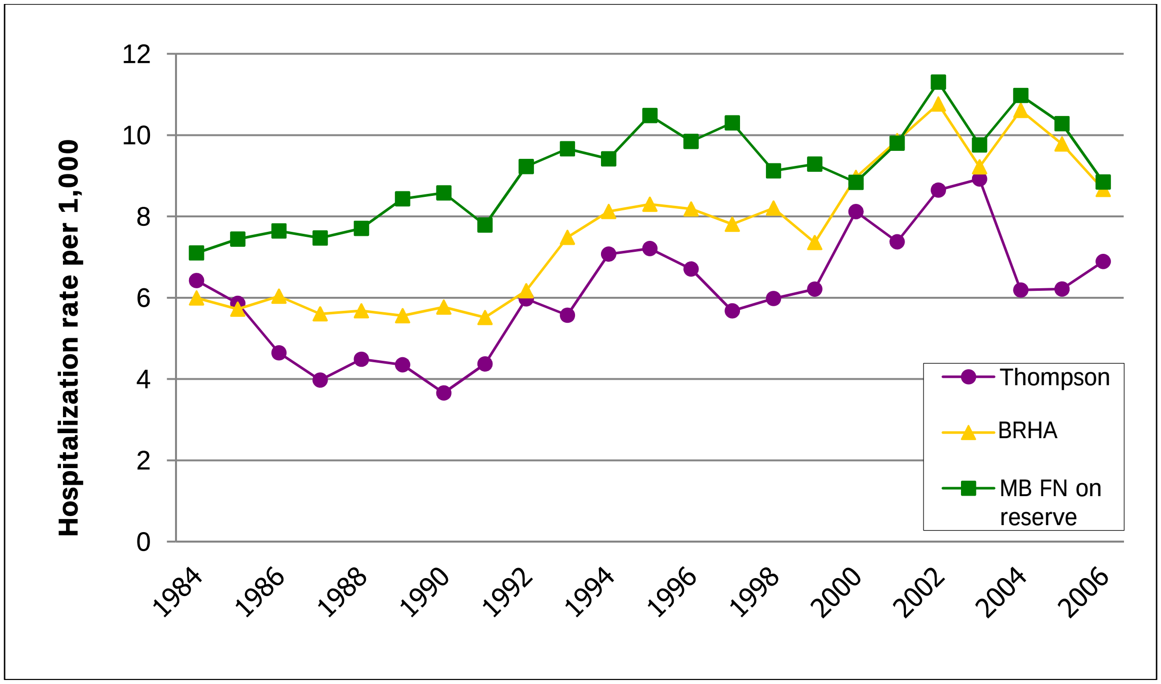
Among Thompson females, the patient rate for mental health disorders appears to have decreased slightly over time (from 131.7 patients per 1,000 residents in 1984 to 122.8 patients per 1,000 in 2006). However, rates are consistently quite a bit higher than the comparison areas.

The actual number of patients among Thompson females decreased by 10.1% between 1984 and 2006 from 943 patients in 1984 to 848 patients in 2006. The number of physician visits decreased by 13.3% from 2,238 in 1984 to 1,940 in 2006. The number of Thompson male patients increased by 10.9% between 1984 and 2006 (from 689 patients to 764 patients). The number of physician visits increased by 18.5% from 1,517 in 1984 to 1,797 in 2006.

The female physician visit rate among Thompson residents for mental and behavioural disorders decreased by 6.8% (from 943 to 848 physician visits) between 1984 and 2006 to 122.8 visits per 1,000 in 2006. However, this rate remains statistically higher than BRHA females (93.1 per 1,000) and Manitoba First Nations females living on-reserve (105.1 per 1,000). The opposite trend is seen for males where male physician visit rates for mental and behavioural disorders increased by 20.5% between 1984 and 2006 to a rate of 106.6 visits per 1,000. This rate is higher than for BRHA males (82.4 per 1,000) and for Manitoba First Nations living on-reserve (78.1 per 1,000 males). Overall, the total physician visit rate for mental and behavioural disorders increased by 4.9% between 1984 and 2006 to 114.5 per 1,000 in 2006. This rate is higher than the BRHA at 87.7 per 1,000 residents as well as for Manitoba First Nations living on-reserve at 91.3 per 1,000 residents.

Between 1984 and 2006, mental health disorders accounted for 2,082 or 19.0% of all hospitalizations for conditions of interest. Thompson residents accounted for 26.5% of all BRHA hospitalizations for mental and behavioural disorders, which is lower than the 33.3% of the BRHA population that they represent.

The hospitalization rate for mental and behavioural disorders increased very slightly from 6.4 hospitalizations per 1,000 in 1984 to 6.9 per 1,000 in 2006 (see Figure 5-37). Both BRHA and Manitoba First Nations living on-reserve also show relatively stable trends in hospitalization rates with slight increases for BRHA residents (from 6.0 per 1,000 in 1984 to 8.7 per 1,000 in 2006) and for all Manitoba First Nations living on-reserve (from 7.1 per 1,000 to 8.8 per 1,000).



Source: Manitoba Health, special data run 2009.

Figure 5-37: Hospitalization Rates for Mental and Behavioural Disorders by Year, All Residents (1984-2006)

The 10-year average annual rate of 7.0 hospitalizations per 1,000 Thompson residents was statistically lower than all comparison populations. As noted in the physician visit data, treatment prevalence rates were much higher than the comparison areas in the same time period. This suggests that Thompson community residents have more support at the community level through access to physicians, and likely other support services, to manage mental health conditions in out-patient settings and are less likely to become ill enough to require hospitalization.

SKIN INFECTION

In 2006, there were 719 patients accounting for 1,209 physician visits for infections of skin and subcutaneous tissue recorded among Thompson residents. These visits accounted for 7.3% of all physician visits for conditions of interest in 2006. Overall, between 1984 and 2006, these infections accounted for 24,091, or 6.3% of all physician visits.

Between 1984 and 2006 overall, Thompson residents accounted for 32.3% of all BRHA physician visits for infections of skin and subcutaneous tissue, which is very similar to the 33.3% of the BRHA population that they represent.

Among Thompson residents, the total number of physician visits for infections of skin and subcutaneous tissue increased by 9.6% from 656 to 719 between 1984 and 2006. The calculated 10-year average annual physician visit rate for Thompson residents between 1997 and 2006 was 70.9 visits per 1,000 residents. This rate was statistically lower than both the BRHA (76.7 visits per 1,000) and Manitoba First Nations living on-reserve (106.3 visits per 1,000), but higher than Gillam (62.9 visits per 1,000) as well as the combined KCNs rate.

Overall, the 10-year hospitalization rates for infections of skin and subcutaneous tissue for Thompson remained relatively stable, changing from 2.1 to 1.9 per 1,000 between 1987-1996 and 1997-2006 (from 329 to 267 hospitalizations). The most recent 10-year average annual hospitalization rate of 1.9 per 1,000 for Thompson residents was statistically lower than for all comparison areas with the exception of Gillam.

MORTALITY

According to Manitoba Health, there were a total of 362 deaths among Thompson community residents in the nine year period between 1998 and 2006 for a total mortality rate of 2.8 deaths per 1,000 residents. This is statistically lower than both Manitoba First Nations (4.1 per 100,000) and Manitoba (8.5 per 100,000). Females accounted for 134 (37%) of these deaths while males accounted for 228 (63%).

Similar to Gillam and unlike many northern communities, cancer was the leading cause of death accounting for almost one in three deaths (30%) between 1998 and 2006. This was followed by diseases of the circulatory system, which accounted for 23% of deaths and injury at 16% of deaths. Overall, cancer and diseases of the circulatory system account for just over one half of deaths among Thompson residents.

Within Thompson, nine per cent of deaths among females and seven per cent among males occurred before the age of twenty. The leading causes of death for both young males and females were injury and poisoning.

According to Manitoba Health, there were 362 deaths among Thompson community residents in the nine year period between 1998 and 2006. This means that that there were on average 40 deaths per year. Females accounted for 134 (37%) of these death while males accounted for 228 (63%).

Among Thompson residents, the total mortality rate was 2.8 deaths per 1,000 residents between 1998-2006. The 95% confidence intervals, ranging from 2.6 to 3.1 deaths per 1,000 for Thompson residents, illustrates that the rate in Thompson is statistically lower than Manitoba First Nation on-reserve (4.1 deaths per 1,000 residents) and Manitoba overall (8.5 deaths per 1,000 residents).

The average annual mortality rate due to **Neoplasm** (cancer) in Thompson was 0.8 deaths per 1,000 residents between 1998 and 2006. This is statistically higher than the Manitoba First Nations rate of 0.6 deaths per 1,000 but statistically lower than Manitoba overall at 2.3 deaths per 1,000.

The average annual mortality rate due to diseases of the circulatory system for Thompson residents was 0.7 deaths per 1,000 residents between 1998-2006. This is statistically lower than Manitoba First Nations at 1.0 deaths per 1,000 and Manitoba overall at 2.9 death per 1,000 residents.

The average annual mortality rates due to **endocrine and metabolic disorders** (including diabetes) among Thompson residents was 0.1 deaths per 1,000 residents between 1998 and 2006. This is statistically lower than both Manitoba First Nations and Manitoba overall, both of which had rates of 0.34 deaths per 1,000.

External causes (injury) accounted for 57 deaths among Thompson residents between 1998 and 2006 for a calculated rate of 0.4 deaths per 1,000 residents. The Thompson rate is statistically higher than Manitoba First Nations living on-reserve (0.2 deaths per 1,000) and Manitoba overall (0.1 deaths per 1,000).PYLL among Thompson females decreased from 1,270 to 1,120 between 2000-2003 and 2004 2007. Among Thompson males, PYLL increased from 1,695 to 2,664 between 2000-2003 and 2004-2007. The leading cause of potential years of life lost was injury and poisoning for both males and females. However, rates among males were much higher than females in the most recent time period. Cancer was the second leading cause of potential years of life lost for both males and females in Thompson.

5.3.3 Mercury and Human Health

This section provides an overview of mercury and why there is a concern regarding mercury and the Project. A brief historical account of past monitoring activities in the Local Study Area is provided to set context for current on-going concerns by the KCNs regarding mercury in traditional country foods. This is followed by a description of the process whereby Manitoba Hydro and the KCNs looked at the issue of mercury and human health through a Technical Working Group and the preparation of a Human Health Risk Assessment (HHRA). The section ends with information on mercury in traditional foods today, focusing on the importance of eating healthy country foods for both health and cultural reasons.

Mercury is a common and naturally occurring metal found in the environment across Canada. It occurs naturally in the soil; in the Local Study Area, it is found around Gull and Stephens Lake and in the fish found in these lakes and other lakes in the region, including lakes off-system (see AE SV). Mercury exists in several forms in the environment. Only one form, called **methylmercury**, can **bioaccumulate** (build up and become more concentrated at higher levels in the food chain), which is demonstrated to have consequences on human health. For the purposes of this report, the term mercury is used to mean methylmercury.

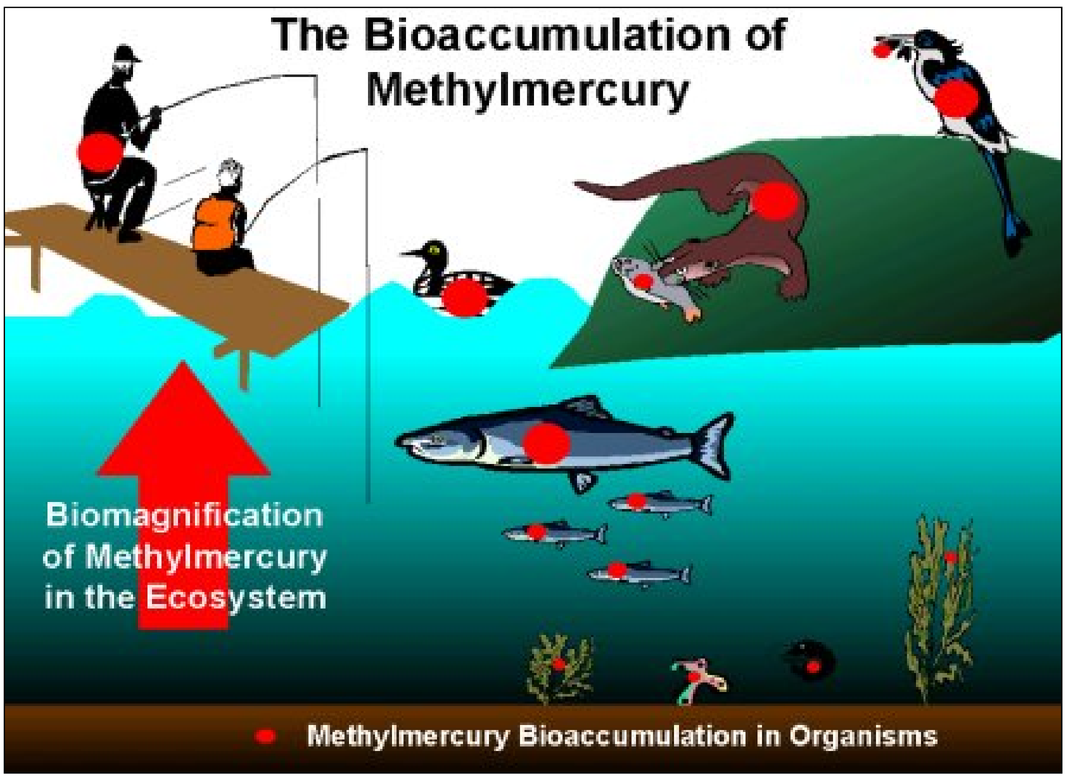
Although mercury occurs naturally in the environment, human activities may result in increased concentrations in the environment, potentially leading to increased exposure for people. Human activities that contribute to increased sources of mercury exposure include:

- Releases of mercury into the air from combustion processes such as coal-fired power generation, metal mining, metal smelting operations and waste incineration;
- Disposal of products that contain mercury (*e.g.*, fluorescent lights, batteries, thermostats, barometers, switches and relays) into landfill sites and subsequent leaching into the environment; and

- Flooding of soils for new hydroelectric reservoirs (this can result in mercury from flooded soils releasing methylmercury into the aquatic food chain).

The vast majority of exposure to people is in the form of mercury through the consumption of fish. Fish with the highest mercury levels tend to be the large and long-lived predatory fish; however, most exposed fish contain some level of mercury. Various lakes across Canada and lakes in the Local Study Area have fish with naturally high levels of mercury and it is not an issue that is restricted to hydro reservoirs. Fish from the freshwater environment that often contain elevated levels of mercury include lake trout, burbot, jackfish (northern pike) and pickerel (walleye)[1], depending on the localized environment (see AE SV). Several other marine fish also are known to have elevated mercury levels; the most commonly eaten of these marine fish are fresh and frozen tuna or canned albacore tuna.

Mercury accumulates mainly in the muscles of fish, though it is also present in other organs. At each higher level in the food chain, the concentration of mercury in the animals increases. This process is called bioaccumulation (see Figure 5-38).



Source: Environment Canada. 2004.
Note:
- The size of the red dots indicates the mercury concentration of the different organisms and people.

Figure 5-38: The Bioaccumulation of Mercury

[1] For the purposes of this SE SV, the term jackfish will be used in lieu of northern pike, and pickerel in lieu of walleye as both jackfish and pickerel are terms commonly used by the people in the Local Study Area.

The effects of mercury on human health depend on the form of mercury, the length of time a person is exposed as well as the level of exposure. If the exposure is of a higher level for a long time, all forms of mercury could cause health effects to the nervous system. In the context of the Project and relevance to the Local Study Area, mercury and its effect on human health is the main concern with respect to hydroelectric reservoir development.

At very high concentrations, health effects primarily associated with mercury have included damage to the brain (*e.g.*, motor skills, irritability, shyness, tremors, changes in vision/hearing, memory problems, and decreased IQ). Mercury in most foods, consumer products, and the natural environment are not at concentrations large enough to cause the health effects listed above (see Appendix 5B). With regard to the Local Study Area, given the cultural importance of eating country foods and their substantial contribution to a healthy diet (particularly in remote communities), it is important to describe the current situation with regard to mercury in the local area, as well as a discussion of safe consumption guidelines.

Acceptable levels of exposure to mercury have been developed by government agencies in Canada and elsewhere to protect public health. Health Canada, the World Health Organization, the US Environmental Protection Agency (EPA) and others have provided guidance on dose rates that protect the health of the public. Because mercury is found throughout the global environment, health agencies around the world have dedicated considerable effort in determining mercury exposure rates considered to be acceptable. This process has prompted health agencies such as Health Canada to recommend that people be made aware of the benefits and risks of mercury exposure to arrive at their own decisions regarding fish consumption (Health Canada 2007).

Guidelines[1] for mercury are based on studies that looked for the lowest concentrations of mercury, which produce any effect in people, and are then further reduced by a safety factor. The guidelines are based on an average weekly amount of fish eaten by a person of a certain weight. Generally speaking, young children and pregnant women (or women of child-bearing age) are of primary concern to health agencies with respect to mercury exposure; however, persons of any age may experience health effects if the exposure is great enough. Because of this, there can be different recommendations for minimizing exposure depending upon which group of the population a person may fall into. For example, many health agencies recommend that pregnant or breastfeeding women and young children restrict their eating of certain types of fish that may contain high concentrations of mercury. However, most health agencies also agree that eating fish is an important part of the diet and these agencies stress that eating fish represents a healthy part of the diet for pregnant and breastfeeding women (as well as for young children). Specific guidelines for Mercury in Fish in Manitoba are developed by Manitoba Water Stewardship (2007)[2].

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[1] Guidelines work under the general assumption that eating fish several times during a week is the same as one large meal of fish.

[2] The department of Manitoba Water Stewardship has recently changed to Manitoba Conservation and Water Stewardship.

5.3.3.1 Mercury in Northern Manitoba in the Past

The effects of past hydroelectric projects prompted concerns about elevated mercury levels in fish, including the effect of mercury on human health. In 1986, the Department of the Environment (DOE) and the Department of Fisheries and Oceans (DFO) began a joint five-year program of environmental research and monitoring in northern Manitoba, called the Federal Ecological Monitoring Program (FEMP)[1]. One of the research programs focused on mercury. FEMP was undertaken in relation to the environmental effects of Manitoba Hydro projects including Lake Winnipeg Regulation, Churchill River Diversion and the hydroelectric projects along the Nelson River.

The 1992 FEMP Final Report reported on mercury testing done by Health Canada between 1976 and 1990 as part of a national program to test people in First Nation communities. The communities at Split Lake and York Landing (*Kawechiwasik)* were included in the testing (along with other Northern Flood Agreement communities at Nelson House, South Indian Lake, Norway House and Cross Lake) and summary data were presented in the FEMP report. Health Canada continued to test First Nation communities until 1999. After that, testing was done at the request of the community.

In general, the Health Canada results reported in FEMP showed that:

- The majority of the mercury values found in samples in all communities from the late 1980s were in the normal range of 0 - 0.019 ppm[2] in blood; concentrations of 0.020 - 0.1 ppm and greater than 0.1 ppm are considered by health authorities to put a person "at increasing risk" and "at risk", respectively (ranges as defined by Health Canada).
- For women of child-bearing age:
  - All women of Split Lake and York Landing (*Kawechiwasik)* had normal mercury values; and
  - Some women in South Indian Lake and Nelson House had values in the 0.020 to 0.080 ppm range.

Results from the community of Split Lake showed that 15% of community Members were tested in 1989/90 (or 192 people). Of those tested, 98% had mercury values in the normal range of 0 - 0.019 ppm; the rest were in the 0.020 – 0.1 ppm range.

Results from the community of York Landing (*Kawechiwasik)* showed that 33% of the population were tested in 1989/90 (or 102 people). Of those tested, 98% had values in the normal range and 2% in the 0.020 – 0.1 ppm range. In both Split Lake and York Landing (*Kawechiwasik*), no women of child-bearing age or children between 1 and 12 years of age had values outside the normal range (*e.g.*, greater than 0.019 ppm).

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[1] The program was a result of Claim 18 in 1981, under the Northern Flood Agreement (NFA), which alleged that Canada, Manitoba and Manitoba Hydro had not met a responsibility of the NFA "to implement a long-term coordinated ecological monitoring and research program that would allow evaluation of impacts on the communities" that signed the NFA and belonged to the Northern Flood Committee.

[2] ppm means parts per million.

Health Canada data showed the highest levels of mercury in people living at South Indian Lake and Nelson House. People living at Split Lake and York Landing (*Kawechiwasik)* showed lower values as compared to South Indian Lake and Nelson House. The lowest mercury levels were found in residents of Norway House and Cross Lake. The Final Report noted that the Health Canada data had several limitations that made it difficult to look for trends in the data[1].

Other mercury testing that has been done was at the request of Nisichawayasihk Cree Nation and was reported on in the Wuskwatim Environmental Impact Statement. Two sample groups (a random group and a volunteer group) from Nelson House and South Indian Lake were tested in 2000 – 2001, which provided a brief snapshot of mercury levels in those who were tested. No one tested in the "at risk" range from either community:

- Random group: 97-98% tested in the normal range; and 2-3 per cent in the "increasing risk" range; and
- Volunteer group: 91-96% tested in the normal range; and 4-9 per cent in the "increasing risk" range.

5.3.3.2 Keeyask Cree Nations

Based on their experiences with previous hydroelectric development and through the FEMP, the issue of mercury and human health became a primary concern for the KCNs in relation to the Project. As such, a Mercury and Human Health Technical Working Group (hereafter the Technical Working Group, or TWG) was established by the Keeyask EIS Coordinators, which included representatives from each of the KCNs communities, the Environmental Assessment Study Team and Manitoba Hydro. The EIS Coordinators agreed that it was essential that invitations be extended to each of the four KCNs communities. The TWG similarly was composed of KCNs Members and representatives of Manitoba Hydro and the Environmental Assessment Study Team. An independent specialist, Dr. Laurie Chan (at the time associated with the University of Northern BC; now with the University of Ottawa), was hired to provide guidance to the Technical Working Group as well as to undertake a peer review of the human health risk assessment; and an independent toxicologist, Mr. Ross Wilson of Vancouver, BC was hired to do the human health risk assessment. The TWG occasionally included the participation of the Medical Health Officer of the Burntwood Regional Health Authority.

Informed by the first workshop in June 2007, three purposes of the TWG were identified by participants:

- To answer the KCNs communities' and Manitoba Hydro's questions about mercury and human health today;
- To answer the KCNs communities' and Manitoba Hydro's questions about future mercury effects on human health if the Project is developed and ways to reduce those effects; and
- To develop ways to effectively communicate with communities about what has been learned.

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[1] Limitations included the large unevenness in the number of community members tested each year; the fact that the data did not allow one to follow an individual person from year to year in the published records; and that reporting was done on an annual basis, which does not allow finding any seasonal patterns or trends.

The TWG met 14 times between June 2007 and June 15, 2011 for workshops to address the purposes noted above (see Appendix 5B for a complete list of meeting dates). Over the course of 2007-2011, TWG members reviewed and provided feedback on presentations, technical reports, summary reports and a variety of products that were being developed for communication to community members (most notably the KCNs communities). Throughout the process, feedback from TWG members regarding the content, style and method of communication guided the development of communication products. This included advice with regard to language on placemats, posters, presentations and other communication tools, types and size of fish to include in the risk assessment, as well as the most effective community communication methods (such as videos, pictures of people holding different size fish for scale and cardboard cut outs of fish) (see Section 5.3.3.5 for further details on the communication strategy and products).

One of the purposes of the TWG was to provide the KCNs communities with information about mercury in people today – before the Project may change the environment. Mercury builds up in the tissue and organs of fish (especially predatory fish such as jackfish and pickerel), aquatic mammals and birds, all of which are traditional food sources of the KCNs. People are at the top of this food chain therefore mercury levels in fish, aquatic mammals and birds can build up in people eating these animals. Through the TWG, the KCNs communities asked questions about the levels of mercury that could cause health effects, the kinds of health effects that are caused by mercury and the levels of mercury that have been found in people in the KCNs communities. Past and current research demonstrates that exposure to elevated levels of mercury for an extended period of time may cause health effects to the nervous system, (*e.g.,* motor skills, irritability, tremors, changes in vision/hearing, memory loss, decrease IQ). Generally, young children and women of child bearing age are of primary concern with respect to mercury exposure, although persons of any age or gender may experience health effects if the exposure if great enough (Wilson 2012; Mergler *et al* 2007).

The TWG provided the opportunity for the KCNs to voice their questions and concerns as they related to mercury. The types of queries raised throughout discussions included the following (see Appendix 5B for the full list of questions and answers):

- What the mercury guidelines suggest about safe levels of fish to eat in the Keeyask area and in proximity to KCN communities today (*e.g.*, Stephens Lake, Gull Lake, Split Lake, and Clark Lake);
- The effects, signs and symptoms of high levels of mercury on people;
- Whether mercury stays in the body forever;
- The treatment for mercury poisoning;
- The effect of mercury on mental health;
- The effect of eating a large amount of fish at once (*e.g.*, eating a lot of fish when out on the land) compared to smaller amounts over time (such as over one week);
- Whether communities should be concerned about the amount of fish being eaten by young people and children when out on the land;

- The safety of swimming in water that has mercury;
- Whether mercury will be released after the water is chlorinated through the water treatment process;
- The commercial limits for mercury in fish (are they the same as health guidelines?); and
- The plan if fish in a lake are found to have levels of mercury that are too high for eating.

Although the list of community concerns in relation to mercury were valid, an important message for the TWG was to emphasize that eating of traditional foods such as fish needs to be balanced with the knowledge of mercury levels in different food sources. Country foods including fish are very important to a person's diet and contribute to overall health. Due to perceived risk/fears and lack of information from trusted sources, many KCNs Members indicated that they had either stopped, or decreased, the level of eating fish and other traditional foods. Because fish in the right quantity are very healthy components to a diet, it was important to address the community concerns and encourage community Members to eat appropriate amounts and types of fish. To this end, a communication strategy was identified as a very important component of the TWG's work together. Details of this strategy are presented in Section 5.3.3.5.

As a result of these concerns, and in an effort to ensure that risks (and benefits) associated with eating a diet rich in traditional foods was understood, the TWG selected Ross Wilson (Wilson Scientific) a toxicologist expert in the field of mercury, to complete a human health risk assessment (HHRA). The purpose of the HHRA was to address current and potential increased mercury concentrations in the environment that may result if the proposed Project is approved. The HHRA Technical Report is provided in Appendix 5C. As noted earlier, Dr. Laurie Chan, a mercury and human health specialist was selected by the TWG to provide independent advice to the TWG, including conducting a peer review of the HHRA Technical Report and communication products developed for use in the communities.

At the TWG workshop in October 2007, Ross Wilson explained the purpose of the HHRA and the steps he would take in preparing the risk assessment – these included:

- The HHRA would aim to provide an accurate assessment of current consumption, and future impact of mercury. The assessment would identify if certain country foods need to be avoided, and which country foods are safe to eat and in which amounts. This information could be presented to the communities to help inform individuals how to make safe choices within the understanding that the benefits of eating these country foods are substantial in contributing to overall health.
- The approach would be consistent with that used by the World Health Organization and Health Canada, which is based on the concept to minimize exposure to toxic chemicals (in this case mercury), and to note that there will be levels where it is safe to eat certain country foods.

The TWG participated in the "Problem Formulation" to identify the people of concern and the exposure pathways of concern related to mercury. Through discussion, the following was identified:

- People of concern were identified as all ages that can be exposed. In terms of the risk assessment calculations, three groups were included: adults (men and women past child-bearing age), toddlers up to 4 yrs. of age and women of child-bearing age; and

- Exposure pathways are primarily country foods.

Once the people of concern (by cohort group), exposure pathways and chemical were identified, the human health risk assessment was prepared (see Appendix 5C for details).

The specific questions that the HHRA addressed were:

1. Is it safe to eat fish under present conditions?
2. If the proposed Project is approved, what are the risks to persons consuming fish, aquatic fur-bearing animals and ducks?

The HHRA also considered the domestic uses of the land by the various First Nation groups. In addition, the most recent scientific evidence on health effects from mercury was reviewed and considered in the risk assessment. The HHRA also produced guidelines for the consumption of select traditional foods for the existing environment (see Section 5.3.3) in addition to projections for the post-Project environment (see Section 5.4.2).

As input to the HHRA, the TWG members were asked to assist with providing information about the types of country foods used by people in the communities in the area (Gull Lake, Stephens Lake and Split Lake). They were asked which country foods were eaten, how often, and in which season(s). The TWG identified country foods in the main food groups of fish (whitefish, jackfish, pickerel and sturgeon), wild game (beaver, muskrat, moose and snowshoe hare), and waterfowl (ducks). The TWG also identified that community members had concerns about Gull eggs and wild plants (northern tea, blueberries and Seneca root); however, there are no estimates of mercury concentrations in these foods so the risk assessment did not include these foods. The TWG members were also concerned about drinking surface water from Gull or Stephens Lake and swimming in these waters, and whether there was an exposure pathway to mercury through these sources. As such, ingestion of surface water and skin contact with surface water in Gull and Stephens lakes was included in the HHRA (Wilson Scientific 2012).

Realistic estimates of country foods eaten were required and the KCNs community Members assisted in providing this information as well as ensuring that all major food groups of country food were represented. The KCNs community Members were also asked to advise if anything was missed.

Risks were estimated as Hazard Quotient values and used the following formula:

$$\text{Hazard Quotient} = \frac{\text{Estimated Exposure } (\mu\text{g/kg body weight/day})}{\text{Tolerable Daily Intake } (\mu\text{g/kg body weight/day})}$$

With respect to Health Canada guidance for foods, a Hazard Quotient value of 1 is typically considered to be the maximum acceptable exposure that will not be associated with unacceptable risks; therefore this value was used as the acceptable risk for mercury.

In addition to estimation of risks as Hazard Quotients, the Recommended Maximum Weekly Intakes (RMWIs) for the various country foods were estimated in the HHRA. The RMWI represents the amount of food that if consumed on a weekly basis would result in an exposure that is equal to the Tolerable Daily Intake (and thus result in a Hazard Quotient value equal to 1) (Wilson Scientific 2012).

MERCURY CONCENTRATIONS AND TRADITIONAL FOODS TODAY

Current levels of mercury in the traditional foods identified as central to the HHRA were obtained and are presented below. This information was used to calculate risk and make recommendations about consumption of each type of food. Surface water was also examined and is presented in this section.

Table 5-10 provides a summary of the mercury concentrations in fish muscle tissue that were used in the HHRA and referred to as "present concentrations". These concentrations were estimated by the aquatic study team and can be found in the AE SV. Note that present mercury concentrations in lake sturgeon are based on only 13 fish from one location (Gull Lake).

Table 5-10: Total Mercury in the Muscle Tissue of Length Standardized* Fish from Gull and Stephens Lakes: Present Concentrations (2001-2006 for Gull Lake, 2001-2005 for Stephens Lake)

Species	Mercury Concentration (ppm; wet weight)*	
	Gull Lake	Stephens Lake
Lake whitefish	0.07	0.09
Jackfish	0.22	0.26
Pickerel	0.23	0.29
Lake sturgeon	0.20	No measurements currently available

Source: concentrations provided by the aquatic study team and summarized in Wilson Scientific 2012.
Note:
* Standard lengths: lake whitefish 350 mm; jackfish 550 mm; pickerel 400 mm, lake sturgeon 1,300 mm. Individual mercury concentrations will be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.

Table 5-11 provides a summary of the mercury concentrations in muscle tissue of wild game that were used in the HHRA for present concentrations. Mercury in wild game was estimated as total mercury concentrations (*e.g.*, present in both inorganic and methylmercury forms). These concentrations were estimated by the terrestrial study team and can be found in the Terrestrial Environment (TE) SV.

Table 5-11: Total Mercury in the Muscle Tissue of Wild Game Collected from the Project Area: Present Concentrations

Species	Mean Mercury (ppm; wet weight)	Range of Concentration (ppm; wet weight)
Beaver	0.01	<0.01 – 0.05
Muskrat	0.02	<0.01 – 0.06
Moose	0.07*	<0.01–0.17
Snowshoe Hare	0.05*	<0.01–0.12

Source: concentrations provided by the terrestrial study team and summarized in Wilson Scientific 2012.
Note:
* Mercury concentrations in moose and snowshoe hare was only a literature estimate and may have greater uncertainty than other species for which measured values were obtained from the study area.

As described in the HHRA Report (see Appendix 5C), the terrestrial study team estimated that concentrations of mercury in ducks would be similar to or less than concentrations measured in local whitefish; therefore mean mercury concentrations for ducks in Gull Lake are estimated as ≤0.07 ppm and ≤0.09 ppm in Stephens Lake. All mercury in ducks was assumed to exist as methylmercury and mirrored lake whitefish concentrations. No information was available on mercury concentrations in gull eggs, therefore an assessment on gull eggs was not possible (Wilson 2012).

The KCNs communities also identified the key plant species of blueberries, Northern or Labrador tea and Seneca root; however, there was no information available on present concentrations in these plants. In order to establish some baseline information, a volunteer plant collection protocol was developed in 2011 for the KCNs community Members to collect samples of these plants and provide them to an independent lab for testing. At the time of submission, no plant samples had been provided and tested.

Mean total mercury concentrations in surface water measured in Gull and Stephens lakes were less than the analytical method detection limit[1] of 0.05 μg/L (see AE SV). The maximum measured total mercury concentration for the entire Study Area (Split Lake to the Nelson River estuary) was 0.32 μg/L measured in August 2003. Mercury has been detected across the Study Area and at three sites has occasionally exceeded the Manitoba Water Quality Standards, Objectives, and Guidelines for freshwater aquatic life of 0.1 μg/L. However, all samples were within the Manitoba drinking water guideline of 1 μg/L.

Table 5-12 presents the assumed consumption rates of the country foods examined in the HHRA. These rates of consumption were used at the request of the KCNs communities as provided at the Country Foods Workshop in October 2009. The HHRA considered these values in order to ensure a conservative assessment and address all concerns of the KCNs communities.

[1] The lowest level of detection according to the analytical method used for the Keeyask Project.

It was also recognized that certain fish are only consumed at certain times of the year (*e.g.*, sturgeon are only consumed in the spring and the fall). This less than continuous exposure is not considered in the HHRA because the key concern is developmental toxicity. Developmental toxicants sometimes only require a couple of weeks of exposure to bring on adverse effects and the fact that a pregnant woman only consumed a certain country food for a few weeks during pregnancy would not necessarily be a mitigating factor that would diminish the potential developmental toxicity.

Due to developmental toxicity risks, groups at increased risk (*e.g.*, women of child-bearing age and young children) need to be more cautious and selective in the types and amount of country foods eaten. Overall however, it is important to maintain eating safe country foods (including fish) as a key contributor to a healthy diet.

Table 5-12: Assumed Consumption Rates of Various Country Foods Consumed by First Nation Communities

Food Type	Serving Size for Young Child	Serving Size for Adult	Frequency of Consumption
Fish			
Whitefish	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Jackfish	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Pickerel	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Sturgeon	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Wild Game			
Beaver	57 g (or 2 ounces)	200 g (or 7 ounces)	Three times per week
Muskrat	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week
Moose	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Five times per week
Snowshoe hare	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week
Waterfowl			
Duck	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week

Source: Wilson Scientific 2012.

Based on the measured current mercury concentrations in lake whitefish, jackfish, and pickerel in Gull and Stephens lakes and lake sturgeon in Gull Lake, and the respective serving sizes and eating rates, a range of risks were calculated for the groups evaluated (*e.g.*, young children up to 4 yrs. of age, women of child-bearing age and adult males/women beyond child-bearing age).

The greatest risks were estimated from eating jackfish and pickerel (due to their higher tissue mercury concentrations relative to other fish species) from either Gull or Stephens lakes. These two predatory fish species have mean mercury concentrations that are in the range (greater than 0.2 ppm but less than 0.5 ppm) where various health agencies have recommended that young children and women of child-bearing age may want to restrict eating these types of fish to a meal or so per week (Wilson Scientific 2012).

The concentrations of mercury in lake whitefish were below the concentrations where restrictions may apply to young children and women of child-bearing age; lake sturgeon in Gull Lake were equal to the arithmetic mean concentrations of 0.2 ppm. Wilson Scientific is not aware of any international health agencies that would take issue with persons consuming fish with mercury concentrations less than 0.2 ppm. Importantly, both lake whitefish and sturgeon fish are excellent sources of nutrition.

In order to minimize risks (due to bioaccumulation of mercury), smaller, younger or non-predatory fish should be selected over larger, predatory fish. Other ways to reduce the risk would be to eat smaller serving sizes or eat the fish less frequently.

Table 5-13 provides fish consumption recommendations using the serving sizes provided by the KCNs. These recommendations are for present day conditions and are based on actual size distributions that currently exist.

In the case of lake sturgeon (for which only data for 13 fish from Gull Lake was available and for which the length-mercury concentration relationship was not significant), it is recommended that sturgeon of less than 48 inches (or 1,200 mm) can be eaten on an unrestricted basis (*e.g.*, these fish would have mercury tissue concentrations of 0.2 ppm or less).

Table 5-13: Eating Recommendations Based on Fish Size Class: Current Conditions (based on Mean Mercury Concentrations)

Receptor Group of Concern	Lake Whitefish			Jackfish (Northern Pike)			Pickerel (Walleye)		
	<300 mm	300-450 mm	>450 mm	<400 mm	400-800 mm	>800 mm	<400 mm	400-550 mm	>550 mm
Gull Lake									
Women of childbearing age and toddlers	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 serving per week	Avoid eating	Unrestricted eating	Avoid eating	Avoid eating
Women past child-bearing age; adult men	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 serving per week	Avoid eating	Unrestricted eating	Eat up to 1 serving per week	Avoid eating
Stephens Lake									
Women of childbearing age and toddlers	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Avoid eating	Avoid eating	Unrestricted eating	Avoid eating	Avoid eating
Women past child-bearing age; adult men	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 serving per week	Avoid eating	Unrestricted eating	Eat up to 1 serving per week	Avoid eating

Source: Wilson Scientific 2012.

Notes:

- Based on serving sizes of 14 ounces (400 grams) per serving for men and women and 3.5 ounces (100 grams) per serving for toddlers.
- A Hazard Quotient value of one was assumed to be acceptable; however, all fish less than 0.2 ppm were classified as low and no eating restrictions were recommended.

Risks from eating wild game (beaver, muskrat, moose and snowshoe hare) were estimated for the current conditions. The serving size and how often wild game is eaten were based on information provided by the KCNs and are considered to represent upper bound exposures.

Based on the predicted current total mercury concentrations in beaver, muskrat, moose and snowshoe hare, respective serving sizes and how often these foods are eaten, no unacceptable risks were calculated for the groups evaluated (*e.g.*, toddler, women of child-bearing age or adult males/women beyond child-bearing age). People can continue to eat these foods at the amounts and frequencies that they are accustomed to under current conditions (Wilson Scientific 2012).

There is some uncertainty in regard to the moose and snowshoe hare concentrations of mercury and it is recommended that monitoring of these species be completed to confirm that the assumed mercury concentrations were reasonable. In addition, a 2010 and 2011 volunteer sample protocol was established with the KCNs whereby samples from harvested moose and caribou could be sent to an independent lab for mercury concentration analysis to provide further baseline conditions. Some moose and caribou samples have been collected (no snowshoe hare samples); however, the sample size was very small.

Risks from eating ducks were estimated for the current conditions. The serving size and how often waterfowl are eaten were based on information provided by the KCNs. Based on the predicted current mercury concentrations in ducks from Gull Lake and Stephens Lake (expected to mirror those of lake whitefish concentrations) and the respective serving sizes and how often waterfowl are eaten, no unacceptable risks were calculated for the groups evaluated (*e.g.*, toddler, women of child-bearing age or adult males/women beyond child-bearing age)[1]. Geese are expected to have lower concentrations than ducks; therefore, no unacceptable risks are predicted for consuming geese (Wilson Scientific 2012). There is some uncertainty regarding duck concentrations and monitoring of these species has been recommended to ascertain if the assumed mercury concentrations remain reasonable (see TE SV).

No risk estimates were available for gull eggs as no estimate of the mercury concentration of these eggs was available.

No risk estimates were available for northern tea, blueberries or Seneca root as no estimate of the mercury concentration of these wild plants was available. To provide an estimate of risks, monitoring of wild plants would be necessary. As noted previously, in 2011 a plant sampling protocol was developed to enable the volunteer collection of plant samples of these species for independent mercury testing under current conditions. No samples have been provided as yet.

For the purposes of the risk assessment only, it was assumed that KCNs communities would drink surface water as a drinking water source. In addition, it was assumed that the KCNs communities would use the water for bathing/swimming. Mercury was assumed to be present in surface water at a concentration equal to the analytical method detection limit of 0.05 μg/L. This concentration is considerably lower than the Canadian Drinking Water Guideline of 1 μg/L for total mercury.

[1] Mercury present in duck is assumed to be methylmercury rather than total mercury.

The result of the risk estimates found that contact with or drinking surface water does not pose unacceptable health risks under the current conditions (in relation to mercury).

The risk assessment also considered potential risks to people who may be exposed to mercury from various elements of the environment (*e.g.*, people who drink the water and eat the identified country foods or people who may eat moose, fish and duck all in one week).

In the case of adding mercury-related risks from surface water exposures to eating country foods, the combination of these activities does not change the conclusions or recommendations presented above or in the HHRA. This is because the Hazard Quotients for contact with surface water are so low that when the Hazard Quotients are added to together, the value essentially remains unchanged.

In the case of interactive effects from eating multiple foods, there are too many possible combinations to fully evaluate all possible interactions that may occur. However, it is clear that eating fish is the main contributor in terms of health risk. Despite a number of combinations where the exposure may exceed the Tolerable Daily Intake, the recommendations for eating country foods are sufficient as noted in the HHRA. Because the most risk comes from eating large predatory fish (jackfish and pickerel) and long-lived fish (lake sturgeon), the recommendations indicated in the HHRA should be followed in order to reduce the risk of additive exposure from eating other foods that may contain mercury (Wilson Scientific 2012).

5.3.3.3 Gillam

Residents of Gillam could be exposed to fish primarily from Stephens Lake, both through personal and or sport fishing and through restaurant and store-bought pickerel supplied by the only special-licence holder who sells his catch locally. It is assumed that serving sizes and frequency of meals would be less than those estimated for the KCNs; however, to be cautious, the same recommendations used for the KCNs would be applicable to residents of Gillam concerning domestic consumption of fish from Stephens Lake. Sport fishers should refer to the Manitoba Water Stewardship Guidelines for Mercury in Fish in Manitoba (Manitoba Water Stewardship 2007).

5.3.3.4 Thompson

Residents of Thompson could be exposed to fish from Gull and Stephens lakes through personal and or sport fishing; however, Thompson residents are not likely to be consuming fish from these areas to the same degree as residents of Gillam or the KCNs. Thompson residents should follow the Manitoba Water Stewardship Guidelines for Mercury in Fish in Manitoba (Manitoba Water Stewardship 2007).

5.3.3.5 Communication Strategy and Products

COMMUNICATION STRATEGY

As noted in Section 5.3.3.2 above, the Mercury and Human Health TWG developed a communication strategy to communicate the results of the technical analysis about mercury and human health to communities in the vicinity of the Project. The key elements of the strategy include:

- **Balanced Message:** The message should balance risks and benefits of country food use. The message should encourage country food use, within consumption guidelines based on the technical human health risk analysis. The messages should be set within the overall context of healthy nutrition and the role that country food plays in a healthy diet.
- **Two Phases of Communication:** Phase 1 would focus on the existing environment – consumption guidelines based on mercury levels today. Phase 2 would focus on the environment after impoundment. Just prior to impoundment, communication products would introduce the upcoming changes in mercury levels that will come within 3-5 years after impoundment of the reservoir. Consumption guidelines will be provided through the Project's Monitoring Advisory Committee based on estimates and updated with monitoring results (see Sections 5.4.1.3 and 5.4.2.3 for further detail on effects of the Project on mercury and consumption guidelines).
- **Target Groups:** Communities who may use and or help inform the public in the area in the vicinity of the Project:
  - TCN, WLFN, FLCN and YFFN (Chiefs and Councils, health care providers and Members);
  - Gillam (Mayor and Council, health care providers and general public);
  - Health care agencies (provincial and federal); and
  - Other resource users (*e.g.*, sport fishers) who make use of the area.

COMMUNICATION PRODUCTS

In order to assist communities and individuals in achieving the right balance – *e.g.*, continuing to eat country food safely while being knowledgeable of the risk – the Mercury and Human Health TWG is preparing a series of communication products for use in the communities in the vicinity of the Project. The products are to be sent to provincial and federal health agencies in addition to each of the KCNs communities and Gillam. The communication products include mercury placemats, a poster, maps, a mercury yardstick, a PowerPoint presentation for health care providers and a video-enhanced PowerPoint for in-community use.

The communication strategy and associated products are intended to inform and educate KCNs communities and residents of Gillam about the health benefits and risk re: mercury associated with eating country foods. Currently, as noted in the preceding sections, there is some level of mercury in existing country food, most notably pickerel and jackfish that requires young children and women of child-bearing age to be more selective in the type and amount of fish they consume. Overall, eating country foods safely is an important part of a healthy diet; community residents are encouraged to follow the consumption recommendations that afford substantive health benefits from eating country food

5.3.4 Public Safety and Worker Interaction

Public safety refers to the overall prevention and protection of people from issues that affect their personal and collective safety and security (*e.g.*, acts/activities that may cause harm) (Public Safety Canada 2009). "Security is a fundamental component of well-being that involves safety and protection from harm. It also involves individual and community perceptions of safety, which can be just as important to well-being as the experience of threats or harm" (Human Resources and Skills Development Canada n.d.). In the context of the Project, effects related to public safety would mainly be attributable to an influx of workers into nearby communities and spending of new income associated with Project employment. Public safety as a VEC does not include safety concerns related to the actual construction or operation of the Project, which Manitoba Hydro is required to address under regular workplace safety standards.

This section addresses the following topics:

- A review of the public safety concerns experienced with past hydroelectric projects in the Local Study Area, including worker interaction and alcohol related issues;
- An overview of available crime and public safety statistics; and
- A description of the public safety enforcement infrastructure and programs available in each community as well as issues, concerns and gaps identified during key person interviews.

5.3.4.1 Public Safety Issues from Past Hydroelectric Projects

The KCNs have witnessed the development of multiple hydroelectric projects on the Nelson River system (see Section 2.2.1.4). This has resulted in a variety of experiences with a non-local workforce, some positive and some negative; although the latter are more likely to be identified in relation to the Project. These past experiences have resulted in fears associated with negative interaction with non-local workers at the construction camp (*e.g.*, racism), negative interaction with non-local workers who go into Thompson or Gillam during their "off" time, and finally the potential for non-local workers to visit the KCNs' home communities and the potential for disruptive behaviour to ensue. While concerns about effects on public safety related to an influx of non-local workers are most frequently raised by and cause anxiety for FLCN, similar concerns have also been identified by the other KCNs based on experiences with past major construction projects in the Local Study Area. For example, TCN has raised similar concerns about worker interaction in their community of Split Lake based on past experience of their Members (CNP, *pers. comm.* 2012).

The Town of Gillam's history in particular includes periods of large influxes of transient construction workers primarily associated with hydroelectric development. During these periods, Gillam was known to become a rowdier community, with higher rates of alcohol-related incidents (Gillam KPI Program 2009-2010). During the construction of Limestone a separate RCMP detachment was created in the temporary community of Sundance to deal with the influx of non-local construction workers to the area, and with potential worker interaction issues with the local community (FLCN 2009a Draft).

Because of their location in and in-proximity to Gillam, FLCN has a long history of interaction with hydro development construction workers, beginning with the development of the Kettle Generating Station in the 1950s. When Manitoba Hydro began construction of the Kettle Generating station in 1966 the population of Gillam was approximately 350 people. By 1969, there were approximately 1,800 people living in Gillam, and an additional 1,500 living at the construction camp. (Manitoba Department of Industry and Commerce 1969, 1978). FLCN describes this transition in saying "within months, the demographic of Gillam changed from being predominately Cree families to predominately non-Aboriginal men" (FLCN 2009a Draft). One Member of the community described this in saying, "Before Hydro came we always thought we were one people. After Hydro there was a lot of friction and discrimination" (FLCN 1997).

Alcohol often fuelled the negative experiences that FLCN Members remember. One description of the bar at the Kettle construction camp stated "the male-only bar quickly became the centre for many workers, and drinking became one of the most popular leisure activities in the camps" (FLCN 2009a Draft). "The quiet town (FLCN) once knew was transformed almost overnight into a place where street parties, brawls and violence were commonplace" (FLCN 2009a Draft). One Elder described this in the Fox Lake History saying, "I can't say how many thousands of men there were – but there were a lot of men and all the women around here were ours. Ours, unfortunately" (FLCN 2009a Draft).

In recent years the Members of FLCN have spoken candidly of their past experiences with hydroelectric development. There are numerous stories associated with rampant alcohol use in combination with the influx of non-local male construction workers. The FLCN History describes the results of the "party" atmosphere that existed with past projects including stories of fights, assaults, sexual assaults, pregnancy, and a hit-and-run incident involving drunk driving that resulted in the death of a community Member (FLCN 2009a Draft). Among the issues identified by the community were harassment, racist comments, enticement to alcohol and drug use, sale of drugs, physical abuse, violence, infidelity, pregnancy, and paternal abandonment (FLCN KPI Program 2009-2011). FLCN has reported that interaction incidents during past hydroelectric projects have left psychological and emotional scars with their victims that have lasted for many years and in some cases a lifetime. The consequences of these incidents, such as depressive-like behaviour, have not only affected the victims of these incidents, but also their families and friends.

The use of alcohol was not limited to the construction crews who arrived in the area to work on projects. Alcohol also became readily available to the Members of FLCN, in particular those who found employment on the project. The Fox Lake History provides numerous accounts of Members finding employment on projects and spending their earnings on alcohol; however, the history also notes that alcohol abuse could be attributed to a range of factors including coping with residential school experiences as well as coping with the changes to the social environment in Gillam.

5.3.4.2 Public Safety Indicators in the Local Study Area

Two of the key public safety indicators related to community well-being are rates of property crimes and rates of violent crimes (Human Resources and Skills Development Canada2012). As of 2010, the overall "volume and severity of crime reported by police declined or remained stable across most of the country" (Brennan and Dauvergne 2011). That being said, Manitoba continues to report the highest violent Crime Severity Index[1] of all the provinces, despite an 8% decrease between 2009 and 2010. In addition to this, the police-reported Crime Severity Index ranked Thompson as the second highest value for centres with more than 10,000 people in the country (Brennan and Dauvergne 2011). Most of the crimes reported to police (79% nationally in 2010) are non-violent[2] in nature (Brennan and Dauvergne 2011). "Although property crime does not involve violence or direct confrontation, it can still undermine the confidence and sense of personal safety of those who have been victimized" (Human Resources and Skills Development Canada2012).

Policing statistics were gathered from the RCMP detachments in Thompson and Gillam, in addition to a policing report specific to the City of Thompson (prepared by the RCMP) for the five year period between 2005 and 2009. The data were aggregated based on each community's RCMP detachment and size, so as to ensure the confidentiality of the smaller communities. As such, the data is presented for the City of Thompson, Split Lake (TCN) and York Landing (*Kawechiwasik)* (YFFN) combined, and Gillam, Fox Lake (Bird) and Ilford (WLFN) combined. These statistics are provided in Appendix 5E.

Despite the high Crime Severity Index ranking provided to the City of Thompson (Brennan and Dauvergne 2011), overall policing statistics for the City of Thompson indicate a decreasing trend in infractions over the period between 2005 and 2009 (Thompson Municipal Policing Reports 2005-2009). This includes a decrease in the overall number of assaults, number of breaking and entering (both business and residential), total theft (over and under $5,000), total fraud, total drug offences, and "other criminal code" offences. The exceptions to this trend include motor vehicle theft and criminal code traffic offences, which have both risen over the same five year period. Similarly provincial statute infractions, under the *Intoxicated Persons Detention Act* have increased since 2005 (Thompson Municipal Policing Reports 2005-2009). The Thompson RCMP detachment indicated that a considerable amount of time is spent dealing with intoxicated persons, who represent a very small proportion of the overall population (Thompson KPI Program 2008-2009).

In Split Lake and York Landing (*Kawechiwasik)* crime rates have fluctuated somewhat over the five year period between 2005 and 2009, although in many cases are limited to one or two infractions per year. For assaults, infractions were at a low of 49 in 2005 and a high of 94 in 2006, although from 2007 to 2009 the number of assaults only varied by one incident per year, with an average of 82. Theft over $5000 is a rare occurrence (only 1 incident in the five year period), with theft under $5000 only on occasion (between

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[1] The Crime Severity Index (CSI) is based upon the volume of crime in addition to the seriousness of crime. In the calculation of the CSI, each offence is weighted based upon the average sentence handed down by criminal courts.

[2] Non-violent crimes include both property crimes and other non-violent criminal code offences. (Brennan and Dauvergne 2011).

zero and eight times per year). Motor vehicle thefts averaged around seven per year, and varied from a low of three incidents in 2007 and a high of 10 incidents in 2006. "Other criminal offences" accounted for the majority of remaining infractions.

The data provided for the Gillam RCMP detachment (including Ilford [WLFN] and Fox Lake [Bird]) was aggregated differently than the Thompson RCMP detachment data, and as such presents the results on slightly different indicators. For example, instead of presenting information on total assaults, all "crimes vs. person" were combined. In the five-year period examined, the overall volume of crimes vs. persons ranged between a high of 82 in 2006 to a low of 42 in 2009. Crimes vs. property have fluctuated over the five year period, with a high of 108 offences (2006), a low of 49 (2005) and an average of approximately 69 offences per year. A large majority of crimes vs. property are a result of mischief (Gillam KPI program 2009-2010). Thefts under $5,000 at an average of 12 incidents over each of the years considered are more common than thefts over $5,000 where the average was three incidents per year, with a high of seven (2009) and low of zero (2005) in the years considered. "Other criminal code" accounted for the majority of remaining infractions. Drug related offences have generally decreased over the five year period, although remain limited to a few infractions each year. Traffic code offences (including both infractions to the criminal code and to provincial statutes) fluctuated over the five year period. Infractions under the *Intoxicated Persons Detention Act* and other liquor related offences were reported under provincial statute infractions, and the Gillam RCMP detachment indicated that a considerable amount of time is spent dealing with a small number of intoxicated persons (Gillam KPI Program 2008-2009).

5.3.4.3 Keeyask Cree Nations

PUBLIC SAFETY SUPPORT AND PROGRAMS

This section provides a discussion of the existing public safety support and programs for the KCNs communities in the Local Study Area. This section includes a discussion of issues, concerns and gaps identified during key-person interviews as well as future plans for public safety programs and infrastructure.

Section 4.3.3 details the policing available in each of the Local Study Area communities. There are two main entities responsible for policing: the RCMP and Band constables hired by each of the KCNs. Band constables are hired directly by each First Nation under a program through Aboriginal Affairs and Northern Development Canada (AANDC) to provide basic policing services on-reserve. There are two RCMP detachments with headquarters in Gillam and Thompson, while the Band constables work on their respective reserves. Band constables work in cooperation with the RCMP detachments as necessary.

5.3.4.3.1 Cree Nation Partners

TATASKWEYAK CREE NATION

The RCMP detachment in Thompson serves the community of Split Lake, in addition to two full-time special constables who are responsible for taking emergency calls and dispatching assistance as required. In addition, the community has two full-time Band constables that have not received training through AANDC; and 7-10 part-time untrained constables who fulfill a security role in the community. The Band constables/peacekeepers respond to most incidents, which most often relate to domestic disturbances and vandalism (CNP 2010c). The Band constables work closely with the RCMP detachment but the community is not involved in any of the crime prevention, restorative or alternative justice programs that the RCMP offer in other communities (CNP 2010c).The RCMP is called upon largely in relation to assaults (domestic, sexual, aggravated and weapons related) (CNP 2010c, CNP *pers. comm.* 2011).

The TCN Ooskahtisuk Club Project was recently approved for multi-year funding by Public Safety Canada. Designed to reduce substance abuse and anti-social behaviour among children/youth, the program is likely to benefit over 60 children and their families. The goals of the project are:

- “Reducing crime rates among youth;
- Enhancing safety in the Community;
- Improving educational outcomes for youth;
- Increasing high school graduation rates; and
- Encouraging greater success in pursuing upcoming employment opportunities” (CNP 2010c).

TCN Members have expressed the following public safety concerns in their community:

- “Increased vandalism and youth crime;
- Increased incidences of physical violence;
- Drug and alcohol abuse; and
- Self-injurious behaviour” (CNP 2010c).

The community has identified some deficits in terms of the public safety services available over the past five years. Some Members have expressed a desire to see more direct RCMP involvement in the community, while others have noted an increase in Band-hired security positions in recent years to deal with issues like vandalism and youth crime (CNP 2010f; CNP *pers. comm.* 2011).

WAR LAKE FIRST NATION

The Gillam detachment of the RCMP is responsible for policing in Ilford and WLFN. In addition, the Band employs one Band constable in the community. The Band constable will call upon the RCMP for assistance with issues such as domestic violence (CNP *pers. comm.* 2011), although the response time can be slow, usually taking a minimum of two hours from the time a call is placed (CNP 2010f). Use of alcohol on this dry reserve was cited as the most common public safety issue. The Band has applied for funding for a second constable (CNP *pers. comm.* 2011).

WLFN does not have any of the RCMP crime prevention programs available elsewhere in the Local Study Area, although the RCMP has assisted with community recreation initiatives in the past. There is a safe house available to women who experience domestic violence (CNP 2010f).

5.3.4.3.2 Fox Lake Cree Nation

The FLCN Band constable is responsible for policing the reserve in Bird. The Band constable works with the RCMP in Gillam and both parties indicate they have a good working relationship (Gillam KPI Program 2009-2010; FLCN KPI Program 2009-2011). Typically, the types and numbers of incidents in Bird do not require assistance from the RCMP, and consist of things such as traffic offenses, the occasional breaking and entering into homes/businesses, and illegal drugs and alcohol being brought onto the reserve (Bird is a dry reserve) (FLCN KPI Program 2009-2011).

During key-person interviews, FLCN Members generally stated that both Fox Lake and Gillam are safe communities in which to live, due in part to the small size of the community. However, FLCN Members also noted some public safety related concerns:

- The use of alcohol and drugs on-reserve;
- Community Member use of alcohol while in Gillam where alcohol is more readily available;
- A lack of opportunities for youth (*e.g.*, recreation) who are at times prone to mischief;
- The lack of a female Band constable to address issues related to female Members of FLCN; and
- A certain level of mistrust with the current RCMP due to a range of factors including their historical relationship, and regular turnover of the local RCMP complement.

5.3.4.3.3 York Factory First Nation

The Thompson RCMP detachment is responsible for policing the community of YFFN at York Landing (*Kawechiwasik)*. In addition, the Band hires six Band constables for policing in the community who call upon the RCMP as necessary. Conducting patrols, dealing with family violence, search and rescue, and conducting searches for alcohol (York Landing (*Kawechiwasik)* is a dry reserve) are among the list of items Band constables encounter and handle regularly. For more grave incidents such as assault, sexual assault, or weapons-related incidents, the Band constables have two holding cells for imprisoning suspects until the RCMP can arrive from Thompson. It should be noted that it typically takes at least one day before the RCMP can arrive due to the remote location of the community and the lack of all-weather road access (YFFN KPI Program 2009-2010).

Many YFFN Members interviewed feel that York Landing (*Kawechiwasik)* is a very safe community in which to live, due in part to the small size of the community and the extended family relationships that link people together. One of the challenges with the small size of the community is that Band constables are not necessarily recognized as law enforcement officers. As such, the Band constables sometimes call upon Chief and Council for support in enforcing the laws (YFFN KPI Program 2009-2010).

YFFN Members have voiced the following public safety concerns:

- Increasing alcohol-related injuries;
- Changes in the local environment (*e.g.*, high water levels and flooding) that make resource use activities and going out on the land more precarious; and

- Lack of resources/funding to support youth programming, which results in youth being prone to mischief and at times exhibiting violent behaviour (YFFN KPI Program 2009-2010).

5.3.4.4 Gillam

PUBLIC SAFETY SUPPORT AND PROGRAMS

The Gillam detachment of the RCMP is responsible for policing the communities of Gillam, FLCN (in Bird), Ilford and WLFN. The detachment has six constables and one sergeant (with one of the constables being a supplement or temporary employee, providing additional support during periods of turnover).

Key person interviews generally indicated that Gillam is a safe community to live in, due in part to the small population that resides there. Several people suggested the fact that "everyone knows everyone" makes it quite easy to keep track of what is going on, where people are, and what people are doing (in particular children and youth). Most of the interviewees felt that compared to other towns and urban centers, Gillam is a safe place (Gillam KPI Program 2009-2010). The Gillam RCMP confirmed that the detachment is a safe place to live, with the highest number of complaints received associated with alcohol-related incidents limited to a small number of residents in the community. The Gillam RCMP are involved in several public safety programs in Gillam and in Fox Lake including:

- Crime Prevention
  - KARE – Kids Are the Responsibility of Everyone;
  - DARE – Drug Abuse Resistance Education; and
  - School Liaison – An RCMP officer is attached to each of the schools in the detachment.
- Restorative and Alternative Justice
  - Restorative Justice – Detachment members participate in forums related to minor offences to identify alternative solutions. This includes coordination with the Native Alcohol and Drug Abuse Program for FLCN; and
  - Community and Youth Corrections – involves a probation officer who travels on a monthly basis from Thompson. Information on various clients is shared and participants are kept up to date on activities/progress (Gillam KPI Program 2009-2010).

With the designation of Kettle Crescent as reserve land, there is potential that the Band constable program may extend its reach into Gillam, however no official plans have been confirmed to date.

5.3.4.5 Thompson

PUBLIC SAFETY SUPPORT AND PROGRAMS

The RCMP is responsible for policing in the City of Thompson. In addition, the City of Thompson has engaged Prairie By law Enforcement (PBE), a private company to assist in enforcing Thompson's behavioural bylaws such as public drunkenness, fighting, urinating or other unwanted public behaviours (Thompson KPI Program 2008-2009).

The community benefits directly and indirectly from strategic partnerships that the RCMP forms with other law enforcement and governmental agencies and other community groups. Several unique associations have been formed between the RCMP and various organizations and agencies in the community including the City of Thompson, School District of Mystery Lake, the Addictions Foundation of Manitoba Advisory Board, among others (RCMP 2009). In October of 2009 the Thompson RCMP, the Ma Mow We Tak Friendship Centre, the University of Manitoba's School of Social Work, the Mystery Lake School District and the Thompson Community Foundation launched a new program called Safeguarding Aboriginal Youth Spirits. The Safeguarding Aboriginal Youth Spirits program is a community based mobilization project that looks to assist in the development of a toolkit for gang awareness, prevention and alternatives for Aboriginal youth in Northern Manitoba who are deemed to be at risk for gang involvement.

Thompson is one of nine communities in Canada participating in the "Municipal Drug Strategy." The Thompson RCMP had 3,400 incidents related to the *Intoxicated Persons Detention Act*. These statistics have been increasing each year. The Alcoholism Foundation of Manitoba (AFM) has seen a significant increase in their case loads related to drugs and alcohol abuse in the north. Staff at the YWCA see a direct correlation between the increase in addictions and the increase in money in the community (Thompson KPI program 2008-2009).

A major concern noted by the RCMP in Thompson is the recruitment of young people into gangs. Thompson is working to address this issue by investing in recreation opportunities for youth such as the skate park, the arena upgrade and sport camps in order to provide alternatives for youth during leisure time (Thompson KPI program 2008-2009).

5.3.5 Travel, Access and Safety

As a socio-economic VEC travel, access and safety considers water/ice-based transportation (and the land-based trails used to access traditional and resource use areas that are accessed from the rivers and lakes) and road travel in relation to traffic volumes, access and safety. Existing travel, access and safety conditions in the Local Study Area were determined using a variety of sources including the socio-economic KPI programs, the KCNs' Environmental Evaluation Reports as well as traffic volume and collision data from Manitoba Infrastructure and Transportation (MIT) and the RCMP. Section 5.3.5.1 describes the characteristics of water and ice-based travel on the Nelson River system and includes information on the KCNs' use of the areas in close proximity to the Project. Section 5.3.5.2 describes existing travel, access and safety conditions on roadways in the Local Study Area, including travel on ice roads.

5.3.5.1 Existing Water/Ice-based Travel Conditions

Over many generations, rivers and lakes have served as a travel conduit, a means of communication, and as a valuable dietary resource for First Nations people. According to FLCN, the rivers and lakes provide people with the ability to travel from place to place, which in turn allows them to reaffirm social, economic and diplomatic ties between one another (FLCN 2010 Draft). Although the Nelson River was known for its swift and fierce rapids before the river was developed as part of Manitoba Hydro's generating system, KCNs Members used the Nelson River like a highway, traveling between communities, resource harvesting areas and the coast for purposes such as hunting, fishing, trapping, gathering and visiting friends and families (CNP Keeyask Environmental Evaluation Report; YFFN Evaluation Report (*Kipekiskwaywinan*); FLCN 2010 Draft). Over the course of time, certain land-based trails and paths used to access traditional resources on foot and by dog sled have evolved and are now used as travel corridors for snowmobiles and all-terrain vehicles. Some of these paths are still used today to access traplines and resource harvesting areas (CNP 2010b).

Rivers, lakes and land-based trails that intersect the waterways in the Split Lake Resource Management Area (SLRMA) are used by KCNs resource harvesters and other residents in the Local Study Area. Of the 83 traplines in the Resource Use Regional Study Area for example, 21 have road access (either all-weather or winter roads) however 62 have no road access (SE SV, Resource Use Section 1.4.3). Waterways and land-based trails are used to gain access to many areas for resource gathering activities including hunting, fishing and trapping.

There are areas throughout the SLRMA that support the Cree's existence and way of life. Many areas are used for traditional practices such as hunting, trapping and fishing, or for recreational activities such as swimming, canoeing and camping. Since the SLRMA is large, the community subdivides it into 12 smaller base camp areas defined by a base camp serving access trails in a particular area. For example, the Split Lake base camp is closest to the Split Lake community (CNP 2010b). In the area around the Project site, TCN have identified 86 km of portages facilitating canoe routes, including Stephens Lake (CNP 2010b). The portages vary in quality with approximately 51 km being overgrown and in need of clearing, 15 km being burned over and in need of re-cutting, and 20 km being deemed acceptable. About 5 km of portages characterized as overgrown extend around the north side of Gull Rapids, with another 15 km proceeding north and east of Gull Rapids to Stephens Lake, intersecting the planned route of the north access road to the Project (CNP 2010b).

There are 208 km of identified and frequently used snowmobile trails in the Split Lake base camp area. A major snowmobile trail between Split and Stephens lakes begins at Split Lake and proceeds 51 km along the north side of the Nelson River to Gull Lake, where it then veers north and east to Stephens Lake, intersecting the planned north access road to the Project. As with the portages, the snowmobile routes in the Split Lake area are in varying conditions with approximately 103 km in acceptable condition (including all of the trail from the community of Split Lake to Gull Lake), 75 km of which is overgrown and in need of clearing, and 30 km that is burned and in need of re-cutting (CNP 2010b).

The Nelson River from Split Lake downstream through Gull Rapids and into Stephens Lake is used by many KCNs Members and Project-induced changes to the water regime in these waterways could affect their travel, access and safety. The following provides a summary of the physical characteristics of the open water and ice conditions between Split and Stephens lakes to provide context for existing travel, access and safety in this area.

OPEN WATER

Split Lake is a widening of the channel on the Nelson River system, which creates a lake-like environment. As shown in Map 1-1 (Communities in the Socio-Economic Local Study Area), the communities of TCN (at Split Lake) and YFFN (at York Landing (*Kawechiwasik*)) are located on the north and south shores of the lake respectively. As described in the Physical Environment supporting volume (PE SV), the present water level on Split Lake is affected by the LWR and CRD projects; and immediately downstream of Split Lake, the river narrows and flows into Clark Lake. Birthday Rapids is approximately 10 km downstream of Clark Lake. The 10 km reach between Clark Lake and Birthday Rapids is approximately 600 m wide and characterized by a turbulent continuous series of rapids and a 4 m drop in water levels. A 2 m drop through the length of Birthday Rapids results in water velocities greater than 1.5 m/s. Two Goose and Portage creeks both discharge into the Nelson River between Birthday Rapids and Gull Lake. Gull Lake is a wide channel in the Nelson River leading up to Gull Rapids. Several small creeks including Broken Boat and Box Bay enter the river in this stretch. Upstream from Gull Rapids, numerous rock outcrops create multiple channels of flow and at Gull Rapids a change in topography creates a drop of approximately 11 m across its length (PE SV). Almost immediately downstream of the rapids is the inlet to Stephens Lake, which acts as the reservoir for the Kettle Generating Station located at the downstream end of the lake. A short distance downstream of the Kettle Generating Station is the town of Gillam.

WINTER ICE

Over the course of the winter a number of different processes lead to the creation of a thermal ice cover in the reach of the Nelson River between Split Lake and Gull Rapids. The specific nature of the ice cover is a function of many variables and can change from year to year depending on water flow, meteorological conditions and effects from past projects. Prior to the LWR and CRD, the timing of ice cover formation and the characteristics of ice on many rivers, lakes and streams was fairly consistent from year to year; although the rise and fall of water levels caused by natural ice formation processes could make the ice cover unpredictable along some parts of the Nelson River including Split Lake (PE SV).

Beginning sometime between mid-October and mid-November an ice cover forms on Split Lake under existing conditions. This cover thickens throughout the winter but is affected by air temperature and the depth of snow cover on the ice. The thickness of ice on the lake can range from 0.8 m to 1.2 m depending on the meteorological conditions. If the snow cover becomes too deep, the weight of the snow can cause the ice cover to sink below the water surface. This can cause cracks to form in the ice and allow water to flood over the ice surface creating "slush" on the lake (PE SV).

In the upstream portion of Gull Lake, the ice cover typically grows to between 5 m and 8 m thick. Downstream from the Project site, low flow velocities in the reach between the foot of Gull Rapids and the inlet to Stephens Lake allows much of the reach to freeze in early fall as lake ice. Depending on air temperatures, a thermal cover of lake ice typically begins to form on Stephens Lake in the early fall (PE SV).

5.3.5.1.1 Keeyask Cree Nations

HISTORIC AND CURRENT TRAVEL AND ACCESS

The existing open water and ice conditions along the Burntwood-Nelson watershed have been altered over the past several decades by hydroelectric developments in particular CRD, LWR and the Kettle Generating Station (see Section 2.2.2). Changes brought about by these activities continue to affect the waterways and shorelines, modifying them from their natural state and affecting the pursuits, activities and lifestyles of residents in the Local Study Area. These developments have reduced the ability of people to travel safely due to water level fluctuations, the reversal of seasonal flows, increased amounts of debris in the water such as peat and deadheads (submerged trees) and shoreline instability and erosion (FLCN 2009a Draft; FLCN 2010 Draft; CNP 2010b; YFFN Evaluation Report (*Kipekiskwaywinan*)).

Within the Local Study Area, parts of the Nelson River immediately upstream from the Project site (upstream from Gull Rapids) are rarely traveled by boat in the summer time. Open water travel from the west downstream to the Project site is known to occur but is impeded by Birthday Rapids, which requires a boat operator that is knowledgeable of local navigation hazards. The waters between Birthday and Gull rapids are navigable According to key person interviews the water through the rapids is fast and dangerous and difficult to traverse in a boat. There were portages on both the north and south sides of the river, however with infrequent use these portages have become overgrown and are not currently in use. Some respondents suggested that those familiar with the rapids might be able to successfully navigate them in a motor boat (FLCN KPI Program 2009-2011). There are three cabins located on the north side of the Nelson River between Birthday and Gull Rapids, two of which are located on the same site (RU Section).

Historically, people traveled by dog team to access both resource use areas and communities prior to the construction of all-weather roads; however, today people travel by snowmobile in order to get out to their trap lines, go ice fishing or to access their cabins (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a; FLCN KPI Program 2009-2011). FLCN Members have indicated there are inherent dangers associated with going out on the ice in winter since water fluctuations and thin ice in some areas can cause unsafe conditions. (FLCN KPI Program 2009-2011).

Large ice pans and sheets that jam or form hanging ice on portions of the river between Birthday and Gull rapids limit ice-based travel in winter, although these ice conditions do not form every year. Additionally, a lack of safe and smooth shore ice between Birthday and Gull rapids reduces or prevents snowmobile travel in winter along some portions of the Nelson River. Under certain weather and ice conditions, the upper portion of the reach between the outlet of Clark Lake and Birthday Rapids forms border ice, which is smooth enough to navigate with a snowmobile. This type of condition is not available every year due to ice front progression that often progresses through Birthday Rapids (Manitoba Hydro. *pers comm.* 2011).

Cree Nation Partners: Tataskweyak Cree Nation and War Lake First Nation

Prior to the construction of roadways and hydroelectric projects in the Local Study Area, CNP Members traveled by boat in summer and dog-team in the winter on established routes over the open or frozen water. These routes acted as the principal transportation corridors within the Local Study Area and provided linkages to the outside world and places such as Ilford and Gillam. The waterways have been described by Elders as the "lifeblood of their existence" and they were travelled in safety and with confidence.

> They could land anywhere along the banks of the lakes and rivers; the shorelines had not yet been destroyed and desecrated. They could navigate the lakes and rivers in safety and know what to expect. In the winter time they would know where to travel, where the ice was safe (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Gull Rapids has been an important part of the culture and heritage of TCN. Large social gatherings would occur at the rapids during sturgeon spawning season (CNP Keeyask Environmental Evaluation Report).

The benefits of traditional trapping, hunting and fishing activities are inherently connected to CNP's cultural relationship to the land and waterways of the SLRMA. The social importance of traditional activity is linked to the preservation of the connection between CNP Members and the land, as well as the economic benefits enjoyed from these activities (CNP 2010b). Previously, Members of TCN have said there have been extensive adverse effects from past hydroelectric projects and that, developments of the 1970s reduced access and made it more costly and less safe for people to access their traditional territory. The CRD, LWR and construction of the Kettle Generating Station caused much terrestrial and shoreline habitat to be destroyed by flooding or rendered inhospitable for wildlife and human use by water level and flow changes. The projects flooded shorelines, introduced mud, silt, vegetation and wood debris into the waterways and made the water dirtier (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a, 1996b).

CNP has noted that hydroelectric developments in the 1970s altered the ice regime causing ice to form later in the year and to break-up earlier. In addition, higher winter water flows caused thin ice and slush ice, which resulted in perilous travel conditions (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a, 1996b). The seasonal reversal of water levels on Split Lake from LWR affected ice formation on Split Lake, leaving thin spots requiring travelers to be cautious. There are reports of some community Members going through unstable ice with their snowmobiles.

Today, CNP Members generally access trapline areas and fishing locations using all terrain vehicles (ATVs), snowmobiles, planes, boats and canoes. Members of CNP carry out activities in all seasons that often require the use of waterways including berry picking, hunting, trapping and fishing (CNP 2010b; CNP 2010e).

Based on available information, there is no evidence that TCN navigates through Gull Rapids in the open water season or in winter. Ann 11 m drop across its length, very high water velocities, and numerous rock outcrops prevent safe open-water boat travel across Gull Rapids.

Fox Lake Cree Nation

FLCN Members have permanently resided in the Gillam and Bird area since the construction of the Hudson Bay Railway, although their use of their traditional area has persisted over centuries. In the past, prior to hydro development on the Nelson River, people would travel back and forth between Gillam and Split Lake as well as downstream toward Hudson Bay. According to Members of FLCN, the original, unaltered Nelson River was known to be powerful, and parts of the river were regarded as fast and dangerous. Areas with a lot of rapids were not usable for travel although people were able to predict river dynamics and practiced strict river safety. Among other things, the water gave people the freedom to move seasonally (FLCN 2010 Draft).

Prior to the impoundment of the reservoir for the Kettle Generating Station, FLCN Members made extensive use of a number of rivers in the Local Study Area including the Nelson, the Kettle, the Butnau and the Moosokot rivers. Both the Butnau and Moosokot confluences were important way-stations for FLCN Members and these areas have been identified as locations for campsites, fishing, hunting, and burial locations (FLCN 2010 Draft). Large rapids including Gull Rapids and Kettle Rapids have been identified as important fishing areas and the rapids between Gull Rapids and the Kettle Generating Station (an area that is now flooded) were highly regarded as sturgeon fishing areas (FLCN 2010 Draft).

Since hydroelectric development began, the waterways have not been the same and this has altered people's use of the area. The creation of Stephens Lake flooded most of the former watershed of the Moosokot River; however, the upper reaches of this river still exist, and draw fishers from FLCN. Stephens Lake continues to be used by a number of FLCN Members for recreational hunting, fishing and berry picking along the shoreline. The western and northern portions of Stephens Lake, continue to be an important resource area for FLCN Members. FLCN reports that fishing is practiced all around Stephens Lake, with considerable activity focused on the Keeyask Rapids area (FLCN 2010 Draft).

Members of FLCN note that when traveling on Stephens Lake by boat, they need to keep an eye out for "floaters[1]" and submerged trees that can damage boats and motors. In addition, debris along the shoreline is noted to be an impediment to landing and accessing the shoreline (FLCN KPI Program 2009-2011).

In the winter, parts of Stephens Lake do not freeze solid and FLCN Members note that this is a safety hazard for snowmobile travel since some people have had their snowmobiles go through the ice (FLCN KPI Program 2009-2011).

Under open water and winter ice conditions most FLCN Members do not travel upstream of Gull Rapids. The reasons given for this include the difficulties associated with navigating the rushing waters of the rapids and difficult ice conditions; and the fact that the area is seen as Split Lake territory (FLCN KPI Program 2009-2011).

FLCN has identified fishing in and around Gull Rapids in the post-Kettle period. A portage route on the north side may have been passable in the past; however, the portage around the north side of the Keeyask rapids is reported to be in an "overgrown" condition, which suggests that travel may be difficult (CNP 2010b).

[1] Floaters are masses of tree and peat that form floating islands and may sometimes have logs in them.

York Factory First Nation

"All of the major waterways in northern Manitoba that flow into the Hudson Bay served as highways for the York Factory Cree and their ancestors" (YFFN 2010). The means of travel between Split Lake and the coast for YFFN Members have included boat, dog team, rail, and a combination thereof. The community's traditional land use and occupation has strong ties to the post at York Factory. The relocation of YFFN to York Landing in 1957 changed the community's physical and cultural landscape. The relocation, combined with Manitoba Hydro developments on the Nelson River system, have "interfered with people's abilities to adapt to the changing physical environment" (YFFN 2010). As the YFFN Evaluation Report *Kipekiskwaywinan* notes, "We no sooner were re-settled on the Aiken River at Split Lake when the first Hydro dam at Kelsey was built. Our new homelands and waters were changed, before we had barely begun to understand and learn about them" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

The CRD and LWR changed water levels on Split Lake, flooding the Aiken River, eroding shorelines, and causing considerable changes in the area. According to YFFN Elders, further subtle changes followed the development of the Kettle Generating Station. According to YFFN Members "increasingly unsafe travel conditions not only make it harder to engage in traditional harvesting activities, but make many of us nervous to travel outside of the community" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

The relocation to York Landing also resulted in travel and access challenges associated with modern means of travel. Access to the community is a key concern for YFFN Members. York Landing is isolated for up to 12 weeks each year as freeze-up and break-up on Split Lake make the lake impassable. This condition is exacerbated by restrictions to air travel, such as extended periods where fog prevents aircraft from landing or taking off. Travel out of the community for meetings, medical appointments, grocery trips, and family visits are equally expensive and this creates an on-going sense of social and psychological confinement in the community (YFFN Evaluation Report (*Kipekiskwaywinan*)).

In the summer, York Landing is accessible by air, by personal watercraft and via ferry service operated by Manitoba Infrastructure and Transportation. Ferry operations, which have been operating for 30 years, begin in the spring when the ice on Split Lake breaks up; and the service typically continues until the end of October. During the spring thaw, debris and floating logs in the lake sometimes cause navigation problems for the ferry, and Members of YFFN have noted that in the summer water erodes the shorelines, pulling away dead trees which pose a threat to boat and ferry navigation on Split Lake (YFFN KPI Program 2009-2010). As quoted in the YFFN Evaluation Report (*Kipekiskwaywinan*), a YFFN Member states : "There's debris along the shoreline and it's hard to land a boat. You have to get out and haul logs away before you can get to shore…sometimes you can't even land your boat. They talk about shoreline clean up; it doesn't even work. It doesn't matter how many trees you clean up." YFFN also note that "Boat drivers now have to learn how to navigate boulders, currents and other new hazards under ever changing water conditions" (YFFN Evaluation Report (*Kipekiskwaywinan*)). Although many Members of YFFN use the ferry service to access their community, this form of travel can be delayed when debris such as floating trees have to be pried out from beneath the ferry or when fog is too thick to navigate safely (YFFN KPI Program 2009-2010).

Travel, access and safety are an important concern for YFFN when undertaking traditional resource use activities – activities that are considered socially and culturally important to YFFN. Some engage in resource use along the Mistuska River and in areas north of Stephens Lake (YFFN Evaluation Report (*Kipekiskwaywinan*)). The Aiken River south to the rail crossing, Split Lake to the mouth of the Burntwood River and the Lower Nelson River are used for open water travel by boat. Winter travel to access traplines is done along transmission line corridors as well as trails and frozen waterbodies.

Further to this, use of the winter road system to access York Landing requires considerable safety precautions as adverse weather conditions and wave action on ice crossings can seriously affect the road. One KPI respondent noted that water fluctuations close to the community throughout the winter can cause "slush ice" to form at certain points along the winter road. At present, water levels on Split Lake reportedly fluctuate up to 0.6 m in the winter and cause the ice to be unsafe and intermittently cause access problems at the ice road to the land road transition leading into the community (YFFN 2010). This can have a serious effect on the communities that rely on the winter road for shipments of supplies. Drivers of large vehicles have reportedly found it difficult to negotiate the steep topography at certain locations, and occasionally heavy equipment is required for assistance (YFFN KPI Program 2009-2010).

EXISTING AGREEMENTS BETWEEN KCNS AND MANITOBA HYDRO

Since the 1960s the LWR and CRD projects have changed the water regime of the Nelson River, resulting in adverse effects on travel, access and safety.

In order to address the adverse effects of LWR, CRD and associated hydroelectric projects, the 1977 Northern Flood Agreement (NFA) and several subsequent implementation agreements with individual First Nation communities were negotiated. TCN and YFFN were signatories to the original NFA along with Cross Lake First Nation (now called Pimicikamak Cree Nelson), Nelson House First Nation (now called Nisichawayasihk Cree Nation) and Norway House Cree Nation. The NFA and subsequent Comprehensive Implementation Agreements are described in the SE SV Section 2: Historical Context.

The NFA contains provisions regarding navigation, including activities that Manitoba Hydro must undertake to ensure the safety of affected waterways. The NFA states that Manitoba Hydro will ensure that debris resulting from their operations including construction, flooding of land or diversion of waters, do not become a hazard to navigation. The NFA has several components to ensure safe passage for those using affected waterways including:

- Boat patrols;
- Debris clearing measures;
- Shoreline stabilization; and
- A safe ice trails program.

The measures noted above are implemented through the Waterways Management Program (WMP), the express purpose of which is to improve safety on waterways affected by Manitoba Hydro's operations. As part of their WMP, Manitoba Hydro now assumes a role in performing cleanup and removal of deadheads in waterways affected by the LWR and CRD and performs extensive cleanup along the shorelines to prevent more debris from entering the waterways (Manitoba Hydro 2010d; Niezen 2003). In addition, boat patrols map and record daily routes, mark deadheads and reefs, identify debris work areas, place hazard markers identifying safe travel routes for resource users, gather floating debris, deadheads, old nets, *etc.* The debris is gathered on the shoreline and burned over the winter. The boat patrol workers are seasonal Manitoba Hydro employees, hired from the surrounding northern Aboriginal communities (Manitoba Hydro 2010d).

Cree Nation Partners: Tataskweyak Cree Nation and War Lake First Nation

Following the 1977 NFA, TCN entered into the Northern Flood Implementation Agreement in 1992 with Manitoba Hydro, the Province and Canada. The 1992 Agreement established ongoing mechanisms among the parties to implement NFA obligations and defined land and resource management, and environmental monitoring processes within the Resource Management Area. The 1992 Agreement also contained provisions and processes to determine compensation for adverse effects related to "Future Development" and led to the Agreement in Principle (AIP) (2000), which sets out principles and understandings relating to the potential development of the Keeyask Project including Project planning, design, construction and operation.

TCN and War Lake signed a Memorandum of Cooperation and Understanding (2001) setting out the basis upon which they, as the Cree Nation Partners (CNP), would continue to work together to negotiate all matters related to the Keeyask Project. At the time that the NFA was signed, WLFN had not yet been formed as a First Nation separate from TCN and was therefore not a signatory to the 1977 NFA. In 2005, WLFN entered into an agreement with Manitoba Hydro, which outlines methods to offset adverse effects stemming from development in the Churchill, Nelson, Rat and Burntwood River systems as well as the LWR (WLFN *et al.* 2005). This Agreement calls for Manitoba Hydro to provide maps showing potential sites for future hydroelectric development; as well as descriptions of the intended development including the anticipated extent of inundation and an outline of anticipated effects on water levels and rates of change in water levels in the SLRMA.

Fox Lake Cree Nation

Fox Lake Cree Nation has been affected by operations of Manitoba Hydro including the LWR and CRD projects. Although they were not signatories to the original NFA, in 2004 the Fox Lake Impact Settlement Agreement was reached providing the FLCN with compensation. In addition to the financial contributions, the FLCN Agreement also provided for a Resource Management Area within FLCNs traditional territory. Although the risks associated with the use of the Nelson River are fewer downstream of the Conawapa Rapids, in an effort to further reduce the risks associated with the use of the river between the rapids and Hudson Bay, Manitoba Hydro agreed to construct three cabins and install a portable boat landing ramp in the vicinity of each of Monkey Island, Jackfish Island, Weir River, Angling River and Roblin River/Deer Island. In addition, Manitoba Hydro is responsible for the installation, removal and replacement of the boat landing ramps on a seasonal basis. As a further safety measure, Manitoba Hydro also provides FLCN with three satellite phones for the use of FLCN Members who use the Nelson River downstream of Conawapa Rapids (FLCN *et al.* 2004).

York Factory First Nation

York Factory First Nation was a signatory of the 1977 NFA and in 1995 entered into a Comprehensive Implementation Agreement (CIA) that addressed many of the effects of northern hydroelectric development. The YFFN CIA established transportation programs associated with the water flow levels and volumes along waterways affected by Manitoba Hydro's operations. The responsibilities of Manitoba Hydro as outlined in the CIA include:

- Annually supply, install and maintain reef markers as aids to navigation and implement boat patrols.
- Remove debris at shoreline locations where winter ice trails intersect the shoreline and a hazard to access exists.
- Annually prepare, mark, monitor and maintain ice crossings and main trails on the ice for use by snowmobiles and pedestrians (this includes ice trails on Split Lake (near York Landing) and up the Aiken River.
- Post notices on changing ice conditions and load limits and conduct annual public meetings to provide information to YFFN Members on safe use of ice crossings.

5.3.5.1.2 Gillam

EXISTING WATER / ICE TRAVEL

The town of Gillam is located north of the 56th parallel on the south shore of Stephens Lake. Many Gillam residents, including FLCN Members use Stephens Lake recreationally. A number of residents of Gillam have cabins on Stephens Lake. These residents have noted that water fluctuations on the lake are a safety concern for boaters in the summer and snowmobilers in the winter. Water level fluctuations can vary by as much as six feet in one week and can cause dangerous ice conditions. The water fluctuations occur as a result of the Kettle Generating Station, which uses Stephens Lake as a reservoir for its operations (PE SV).

Residents with cottages use snowmobiles in the winter to access their cabins. Information gathered through key person interviews indicates that it is sometimes difficult to get out to cabins in the spring due to fluctuations in water levels that can cause the ice to be slushy; or can create a ditch of water between lake ice and the islands where some residents have their cabins (Gillam KPI Program 2009-2010).

There are snowmobile trails around the town that are groomed about once a week or every two weeks depending on the snow conditions. There are no major snowmobile trails (or network of trails) in the vicinity of Gull Rapids (Gillam KPI Program 2009-2010).

5.3.5.2 Existing Road Conditions and Traffic

5.3.5.2.1 Local Study Area

PROVINCIAL ROADWAYS

The Local Study Area encompasses a large geographic area, is sparsely populated and the distances between communities are quite large as shown in Map 4-1 (Travel Distances in the Local Study Area). Some communities are connected to southern parts of the province by a network of provincially maintained year-round roads. All-weather roads that are open and maintained year-round provide access to the communities of Thompson, Split Lake, Fox Lake (Bird) and Gillam. The roadways relevant to the Project in the Local Study Area include PR 391 and PR 280. These roads, in addition to the ice roads used to access the KCNs communities, are shown in Map 4-1. PR 391 runs north from the city of Thompson. PR 280 runs from the junction of PR 391 northeast to the Keeyask north access road and onward to the town of Gillam. PR 280 is used to access the communities of Split Lake, the ferry landing or ice road to York Landing, Fox Lake (Bird) and Gillam.

The following section describes the present condition of roadways and ice roads including their physical attributes, traffic volume and collision statistics for PR 391 and PR 280 within the Local Study Area. In Manitoba, highways under the control of the Minister of Infrastructure and Transportation (MIT) are classified as either Research Transportation Association of Canada (RTAC) routes, Class "A1" or Class" B1" highways[1]. Each class of highway has its own specific axle loading and gross vehicle weight limits. Both highways are designated as Secondary Arterial[2] by MIT, which means that they are designed to carry up to 6,000 vehicles per day depending on their geometric features (Dillon Consulting 2003; ND Lea Engineers and Planners Inc. 2002).

The Government of Manitoba through MIT has been making improvements to PR 391 and PR 280 for a number of years. In 2002 for example, the Minister of Transportation and Government Services announced that $700,000 would be invested to add additional gravel on various locations of PR 280 between PR 391 and PR 290 including gravel stabilization on 261 km of road (Government of Manitoba 2002; Keeyask Hydropower Limited Partnership 2009). Since then, the roads in the Local Study Area have undergone regular maintenance and improvements, including road upgrades, signage and pull-offs, which should improve travel on PR 280.

In the 2009 Manitoba Budget Address, the Minister of Finance announced that upgrades would be made to PR 280 between Thompson and Gillam as part of the 2009/2010 Highway Infrastructure Projects. MIT requested that Manitoba Hydro manage upgrades to the roads prior to future hydro development such as the Keeyask Project. The project costs are being shared on a 50/50 basis between Manitoba

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[1]Class A1 highways are any Provincial Trunk Highway numbered from 1 to 110 while Class B1 highways have number designations higher than 110 (Government of Manitoba 2010d).

[2]Primary Arterials provide intra/inter-provincial and international connections and direct service to the most important and larger population centres. Secondary Arterials connect other important population centres (Government of Manitoba 1997).

Hydro and MIT. The detailed design, contract negotiations, and contract management during construction are managed by Manitoba Hydro while MIT is responsible for environmental licensing, land acquisition, and review and approval of designs. MIT continues to own and maintain the roadway as their asset (Government of Manitoba 2009b). The upgrades to PR 280 are being undertaken by Amisk Construction (a joint venture between TCN and Sigfusson Northern). Tasks associated with the upgrades include widening, smoothing and grading (see Section 4.3.5 for additional information).

PR 391

PR 391 is a two-lane undivided gravel roadway with a posted speed limit of 90 kph (ND Lea Engineers and Planners Inc2002). From the city of Thompson to the Thompson Airport access road, PR 391 is classified as a RTAC Class A1 highway. However, commencing December 1st in any year to the last day of February in the ensuing year, the road is approved as a Seasonal RTAC Route from the city of Thompson and gross vehicle weights (GVW) of 62.5 tonnes are allowed. From March 1 to November 30, the weight limit is reduced to approximately 55 tonnes (Government of Manitoba 2010f.).

PR 391 Traffic Volume

Table 5-14 describes PR 391 traffic volume data collected by MIT for the years 2003, 2005, 2007, 2008 and 2009 as a count for the Average Annual Daily Traffic (AADT[1]) and Average Summer Daily Traffic (ASDT[2]). The counts, shown in Table 5-14, represent one-way traffic at Traffic Monitoring Station 2151. The AADT on PR 391 for the years 2003, 2005, 2007 range between 760 and 830 vehicles. The ASDT for the same period is between 897 and 1004 vehicles. There is a noticeable increase in the AADT from 2008 to 2009, which may be a result of traffic associated with projects occurring in the area.

PR 391 Collision Statistics

The collision data presented in Table 5-15 below represents the total collisions that occurred on two control sections of PR 391 (control section 05391010 and control section 05391015), which are between Thompson and PR 280, over the period from 1996 to 2004. In total, 178 collisions were reported along sections of the highway that would be used during construction of the Project, which works out to an average of approximately 20 collisions per year. Of these, 137 resulted in property damage, 40 resulted in injuries and one collision resulted in a fatality.

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[1]AADT represents the number of vehicles passing a particular point on the roadway on an average day of the year (Manitoba Infrastructure and Transportation 2009).

[2] The average summer daily traffic is the number of vehicles passing a point on an average day during the period May 1 through September 30. The ASDT % is typically expressed as a percentage of the AADT but in the tables here is presented as a whole number representing the estimated number of vehicles.

Table 5-14: PR 391 Traffic Volume Summary

Year	Average Annual Daily Traffic (AADT)	Average Summer Daily Traffic (ASDT)
2003	800	968
2005	760	897
2007	830	1004
2008	830	*
2009	1230	*
2010	*	*

Source: (MIT and University of Manitoba 2010).
Notes:
Traffic volume for PR 391 is observed at Traffic Monitoring Station 2151 (West of Thompson Airport Access and East of PR 280 junction).
* Data not available from MIT.

Table 5-15: PR 391 Collision History (combined) for Highway Control Sections 05391010 and 05391015 (1996-2004)

Year	Number of Collisions
1996	28
1997	25
1998	23
1999	27
2000	20
2001	14
2002	12
2003	5
2004	24
Total	178

Source: MIT 2007. Tallied by InterGroup Consultants.
Note:
- Includes RCMP-reported collisions only.

PR 280

PR 280 is a two-lane undivided roadway constructed with a mix of gravel and asphalt (Dillon Consulting 2003). From its junction with PR 391 to the Town of Gillam, PR 280 is classified as a RTAC Class A1 highway (Government of Manitoba 2010d).

PR 280 Traffic Volume

Table 5-16 describes the PR 280 traffic volume data collected by MIT for several years from 2003 through 2010. The traffic counting stations used in this report are known as coverage count stations and are short-term traffic count stations that are surveyed on a two-year cycle. On the selected cycle year, coverage count stations are typically surveyed 2 times a year for 48 hours each time. The traffic counting stations were correlated to the appropriate highway section as described in the Methodology Section 5.2. The traffic along each highway section varies. Table 5-16 presents traffic volumes as an average for the portion of the road from the PR 391 junction with PR 280 to the junction with the Keeyask north access road. Average annual daily traffic volumes on PR 280 as shown in Table 5-17 range between 130 and 186 vehicles depending upon the year. The average summer daily traffic ranged between 190 and 244 vehicles. The data show a 16 vehicle decrease in AADT between 2003 and 2010.

Table 5-16: PR 280 Traffic Volume Summary

Year	Average Annual Daily Traffic (AADT)	Average Summer Daily Traffic (ASDT)
2003	186	244
2005	161	190
2007	167	202
2008	130	*
2009	170	*
2010	170	*

Source: MIT and University of Manitoba (2010). Tallied by InterGroup Consultants.
Notes:
- Data for the Average AADT and Average ASDT comes from MIT counting stations 2293, 2376, 2377, 2437, 2438, 2441, 2442 between the PR 391 junction and the Keeyask north access road junction. AADT values for 2008, 2009, 2010 were derived by calculating the sum of the first five traffic stations beginning with those nearest to the PR391/PR280 junction.

* Data not available from MIT.

PR 280 Collision Statistics

To assist in identifying safety issues, the latest available collision data was obtained for PR 280 along the roadway control sections identified in Table 5-17. The collision data covered the period of time from 1996 to 2004. In total, 139 collisions were reported along sections of the highway in the Local Study Area. Of these, 90 collisions resulted in property damage and 49 resulted in injuries. None of the collisions involved fatalities.

Table 5-17: PR 280 Collision History by Highway Control Section (1996-2004)

Highway Control Section	Total Collisions
05280010	23
05280020	16
05280030	27
05280040	11
05280050	23
05280060	9
05280070	11
05280080	19
Total	**139**

Source: (Larsen, *pers. comm.* 2009).
Note:
- Data not provided for control section 05280090 as there were no reported collisions.

PR 391 and PR 280 Estimated Background Traffic Volumes (2012-2020)

Table 5-18 presents the projected peak background traffic for the summer season and Table 5-19 presents the projected peak background traffic for the winter season along four highway sections of PR 391 and PR 280 for the years 2014 to 2021. The traffic counts presented in the table are round trip estimates of the vehicles that would be using the roads assuming no future Keeyask Project.

Highway Section 1 in Table 5-18 and Table 5-19 represents the stretch of PR 391 between Thompson and PR 280. This highway section has the greatest volume of background traffic of all of the highway sections in the Local Study Area. For the summer months, the background traffic is estimated to range between 518.9 and 580.7 vehicles. For the winter months, the background traffic for this section of PR 391 is estimated to be between 432.4 and 473.3 vehicles.

Highway Section 2 represents the stretch of PR 280 between PR 391 and the Split Lake Junction and the summer traffic for this highway section is estimated to range between 108.6 and 118.8 vehicles; and in winter the traffic is estimated to range between 88.3 and 96.6 vehicles.

Highway Section 3 represents the stretch of road between the Split Lake junction and the Keeyask junction (where the Keeyask north access road meets PR 280). The summer traffic for this highway section is estimated to range between 96.9 and 106.0 vehicles and in winter the traffic is estimated to range between 80.7 and 88.4 vehicles.

Highway Section 4 represents the stretch of road between the Keeyask junction and PR 290 (north of Gillam). The summer traffic for this highway section is estimated to range between 39.2 and 42.9 vehicles and in winter the traffic is estimated to range between 31.5 and 34.4 vehicles.

Table 5-18: Estimated Background Traffic (Summer: Round Trips) in the Local Study Area (2014-2021)

	2014	2015	2016	2017	2018	2019	2020	2021
Highway Section 1: PR 391-Thompson to PR 280	518.9	525.6	532.4	539.4	546.4	553.5	580.7	568.0
Highway Section 2: PR280-PR 391 to Split Lake Junction	108.6	110.0	111.4	112.8	114.3	115.8	117.3	118.8
Highway Section 3: PR 280-Split Lake Junction to Keeyask Junction	96.9	98.1	99.4	100.7	102.0	103.3	104.7	106.0
Highway Section 4: PR 280-Keeyask Junction to PR 290	39.2	39.7	40.3	40.8	41.3	41.9	42.4	42.9

Source: KGS-Acres 2010.

Table 5-19: Estimated Background Traffic (Winter: Round Trips) in the Local Study Area (2014-2021)

	2014	2015	2016	2017	2018	2019	2020	2021
Highway Section 1: PR 391-Thompson to PR 280	432.4	438.0	443.7	449.5	455.3	461.2	467.2	473.3
Highway Section 2: PR 280-PR 391 to Split Lake Junction	88.3	89.4	90.6	91.7	92.9	94.1	95.4	96.6
Highway Section 3: PR 280-Split Lake Junction to Keeyask Junction	80.7	81.8	82.8	83.9	85.0	86.1	87.2	88.4
Highway Section 4: PR 280-Keeyask Junction to PR 290	31.5	31.9	32.3	32.7	33.1	33.6	34.0	34.4

Source: KGS-Acres 2010.

NORTH ACCESS ROAD

The north access road, which is being constructed as part of the Keeyask Infrastructure Project, will be the primary route used for transporting materials, equipment and workers between PR 280 and the Project site. The north access road will intersect with PR 280, 174 km northeast of the PR 391/PR 280 junction and extend approximately 25 km east to the Project site on the north shore of the Nelson River at Gull Rapids. The north access road has been designed to meet or exceed MIT standards and a fully-developed by-pass intersection was built at the intersection of PR 280 to provide safety for local road users. Additional facilities associated with the access road include a security gatehouse, communication tower, clear-span bridge and signage (Keeyask Hydropower Limited Partnership 2009).

The north access road will be operated as a private road during construction of the Keeyask Project, with use restricted to the following:

- Persons associated with the Project;
- KCNs officials, Members, and persons operating under the direction of the KCNs and authorized by the Project Manager or as otherwise agreed to by the Partnership;
- Manitoba Hydro, its agents and contractors; and
- Emergency use by the RCMP, or for forest fire suppression by Manitoba Conservation (Keeyask Hydropower Limited Partnership 2011).

If for some reason, the Project does not proceed, the north access road will be decommissioned.

Provisions are in place to restrict construction workers from bringing, using or storing snowmobiles, all terrain vehicles (ATVs) and boats at the Project site (including the access road). KCNs resource harvesters and Members may travel on surrounding Crown land by snowmobile or ATV (as use of Crown land is not restricted) for the purposes of carrying out commercial and or domestic harvesting, and for spiritual/ceremonial activities; however, use of the access road for travel by snowmobile or ATV is not permitted for safety reasons. According to the KIP Access Management Plan, snowmobile crossings have been developed at intersections of selected established snowmobile trails to facilitate the safe crossing of the road by local resource users. Such crossings can also be used by ATVs for safe crossing (Keeyask Hydropower Limited Partnership 2011).

WINTER ROADS

In the Local Study Area, the communities of War Lake (at Ilford) and York Landing are isolated by a lack of all-weather roads. Ilford can be accessed year-round by rail line. York Landing is accessible by ferry during the open water season, and by a 32 km winter road typically between mid-January to mid-March depending on weather conditions. It is not until the rivers, lakes, creeks and muskeg have frozen to a safe thickness that the construction of temporary winter roads allows cars and trucks access to these communities.

Temporary winter roads allow a greater amount of freedom of travel for people in the north and also allow for more cost-effective delivery of construction materials, fuel and other supplies to remote communities. The direct access provided by winter roads is more convenient and affordable for residents than other modes of transportation such as air and rail. According to the Government of Manitoba, "approximately 2,500 shipments are transported each year by commercial trucks from the south to the north on the winter road system including essential items such as fuel, groceries as well as construction materials and general freight" (Government of Manitoba 2008).

The timing of the onset of ice cover and the conditions under which it forms and eventually breaks up in the spring are important considerations in the construction of the winter road system. The thickness of the ice as well as the date of freeze up, rate of ice growth, and the quality of the ice cover depends on a number of factors, including weather conditions and the size and depth of the water body, which affects the length of time the roads are able to stay open. Winter roads are typically open for a brief period of about eight weeks from mid-January to mid-March, although the prevailing weather conditions can shorten or extend this period by as much as two weeks (MIT n.d.). In years with less than ideal meteorological conditions, the winter roads may operate for a shorter period of time.

Within the Local Study Area, the winter road system is constructed across a portion of Split Lake and along the Aiken River. YFFN Members have noted that winter conditions are dangerous due to the seasonal reversal of water levels on Split Lake that arise from hydroelectric developments (YFFN 2004a; YFFN Evaluation Report (*Kipekiskwaywinan*)).

The impacts of climate change are already being witnessed in Manitoba and climate models predict that in the future, Manitoba will experience springs that are earlier and wetter, summers that are warmer and drier and winters that are shorter and milder. For Aboriginal and northern communities, climate change has implications for traditional ways of life and culture. "One of the most significant negative impacts of climate change on transportation infrastructure in Manitoba is the safety, sustainability and seasonal duration of winter roads" (Government of Manitoba 2008b).

During the 2008-2009 winter road season, Manitoba's winter road system did not officially open until February 2, 2009 and closed at the end of March after about seven weeks of operation (Government of Manitoba 2009d). The 2009-2010 winter road season was even shorter than the previous year, with the full system officially opening on February 12, 2010 and closing on March 15, 2010 after a quick thaw (Government of Manitoba 2010b). The 2011-2012 winter road season opened on February 17, 2012 and closed during the week of March 13th, comparable to the 2010 winter road season.

5.3.5.2.2 Regional Study Area

Traffic approaching the city of Thompson from the south must do so using Provincial Trunk Highway (PTH) 6. PTH 6 is a primary arterial designed to carry up to 6,000 vehicles per day on a two lane cross-section. Traffic counts on PTH 6 are measured at multiple locations; however for the purposes of the assessment, consideration was given to measurement locations in proximity to major intersections (*e.g.*, where traffic volumes were likely to change due to the location of other roads and or communities). These sections include the following:

- Section 1: PR 236 to PTH 68 (118 km);
- Section 2: PTH 68 to PTH 60 (258 km);

- Section 3: PTH 60 to PTH 39 (210 km); and
- Section 4: PTH 39 to Thompson (153 km).

The most recent traffic counts provided by MIT for 2009 and 2010 show the volume on Section 1 at 3,890 vehicles[1]; on Section 2 at 1,930 vehicles[2]; on Section 3 at 550 vehicles[3]; and on Section 4 at as 1,440 vehicles[4] (MIT and University of Manitoba 2009, 2010). Generally, traffic volumes decrease as one travels north, until after the junction of PTH 39, where traffic counts increase towards Thompson. Overall, these volumes are higher than those experienced within the Local Study Area and considerably lower than their design criteria of 6,000 vehicles per day.

5.3.6 Culture and Spirituality

Culture and spirituality are especially relevant since they represent a composite of values, beliefs, perceptions, principles, traditions and world views and religion that are based on individual and collective history, experience and interpretation. These cognitive values act as a cohesive force to direct the flow of cultural change. Culture and spirituality is an all-encompassing term that underscores the integral relationship of all things that maintain a way of life. Culture in this discussion can be referred to as socially conditioned assemblages of activities and thoughts that are associated with particular social groups or populations (Harris 1994). Spirituality is descriptive of peoples' relationships with their ecosystems and the awareness that goes beyond the immediate sensible world from which knowledge, ability, or medicine is derived. Spirituality also includes the Creator (see Ch. 2 of the Response to EIS Guidelines). Culture and spirituality is a dynamic and interactive process that is commonly celebrated through the oral tradition as traditional knowledge and is constantly evolving through experience, information, knowledge and wisdom.

Each First Nation is a discrete socio-political unit that draws from the traditions and knowledge of community Elders. However, the historical roots point to a common ancestry and cultural core that is strengthened by the many kinship relationships that exist across the communities. The methods used by the four KCNs communities to gather and analyze information were a reflection of each community's unique and distinct historic experiences. For the purpose of the assessment culture and spirituality considers an area spatially much broader than the Local Study Area, so as to include ancestral and traditional lands of TCN, WLFN, FLCN and YFFN. Data sources were derived from the analysis of the nine cultural indicators which formed the core of analysis which are defined in Section 5.2.6. Knowledge that was shared with the research team formed the foundation of analysis along with the Environmental Evaluation Reports of each of the KCNs.

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[1] Count at the provincial traffic counting station #522.

[2] Count at the provincial traffic counting station #725.

[3] Count at the provincial traffic counting station #1891.

[4] Count at the provincial traffic counting station #1885.

5.3.6.1 Keeyask Cree Nations

Each First Nation conducted emic[1] studies that focussed on community perspectives and understandings of the land and cultural resources. While all four communities trace their ancestral roots to the York Factory region, each First Nation's historic experience has been unique. This is reflected in the methods used and products created as a result of the process. A summary of the data sources used to understand culture and spirituality of each of the KCNs is provided in Appendix 5D.

Each of the KCNs has had a unique set of historical experiences that has shaped their individual communities; however, while each community's identity and experience is unique, there are common threads that exist collectively. For example, the KCNs are Cree, they self-identify as Cree, speak the Cree language and all acknowledge their roots to York Factory coastal Cree. The KCNs also share an intimate and interconnected relationship of the people to *Askiy* that is strong and unconditional.

Although the KCNs are four distinct groups, they came together to be partners in the Project. As partners, it was important that their collective Cree worldview guide the Project. In order to reach a collective Cree worldview, KCNs Elders and community Members gathered together on four separate occasions to discuss, share stories and thoughts and arrive at a consensus statement on their core beliefs and Cree worldview. This is described in Chapter 2 of the EIS and highlights are provided below, prior to focusing on each of the KCNs communities.

The Cree are *Ininewak*, placed on earth or *Askiy* by the Creator/*Manitou* (also *Munito* and Great Spirit see Chapter 2). As a people, they are a part of *Askiy*. *Askiy* means the whole of the land, water, animals, plants, people and all other living and non-living things, including the interconnection between them *(i.e.*, all things are related). *Ininewak* culture and spirituality are part of *Askiy*. The *Ininewak* are meant to care for *Askiy* and are sustained by *Askiy*.

Ininewak follow important teachings on how to conduct themselves while living; these include, but are not limited to, the following:

- *Mino-pimatisiwin* means living a good and honourable life (*e.g.,* being a good person, respecting *Askiy*, following our values);
- *Ochinewin* – what comes around goes around (*e.g.,* if a person harms or abuses anything that is part of *Askiy*, there will be consequences for this behaviour) (see Chapter 2 of the EIS); and
- Harmony and balance – if we are harmful or disrespectful, we must acknowledge that harm and make a sincere attempt to put things right, to strive for harmony and balance (see Chapter 2 for a more detailed description).

As described in Section 5.2, nine indicators were used to facilitate the description and analysis of change of culture and spirituality in relation to the KCNs. The indicators highlight the relationships of people to

[1] Emic is a term that refers to the understanding of culture and experience from the viewpoint of the participant, not the observer , whereas Etic refers generally to the understanding of culture based on observed and scientific recordings of a particular cultural group as analyzed and interpreted from the observer's perspective (Harris 1987).

their environmental setting and contribute to assessing cultural values and potential Project effects. Figure 5-1 was developed as an adaptation from Whiting and Whiting's 1975 cultural system model (Petch, 1999), illustrates all of the components that have been considered in the development of these nine cultural indicators.

The following sections use the nine indicators as applied to each of the KCNs communities.

5.3.6.1.1 Cree Nation Partners

TATASKWEYAK CREE NATION

This section reviews the nine cultural indicators defined in Section 5.2.6 in relation to TCN.

Worldview

Worldview as an indicator for TCN sheds light on the importance of articulating and communicating perspectives to help others understand their holistic Cree worldview:

> As a people, we are inseparable from our relationships with Mother Earth – relationships that have developed over thousands of years. This is the foundation of our worldview and is integral to our survival. Our relationships with Mother Earth are the basis of our language, history and spirituality – cumulatively, our culture (CNP Keeyask Environmental Evaluation Report).

The effects of development to the waterways and lands on which the Split Lake Cree had always relied, produced changes reflected by the indicator worldview. The extensive impacts of development affected every facet of the First Nation's use of its traditional lands and waters. Spirituality was at the root of changes felt by the community:

> Many young people, steered towards educational endeavours, were less capable of carrying on traditional activities and began to hold animals in less esteem than had their Elders. The centre of traditional pursuits had always been the shorelines, but shoreline activity decreased because of the adverse effects of hydroelectric development. People lost faith in the altered waterways and in the natural environment that had always sustained them. In short, the sudden environmental degradation in the traditional territories resulted in a traumatic break in the pattern of evolution and sometimes difficult adaptation that had characterized earlier eras (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

In addition, according to CNPs own Keeyask environmental evaluation:

> The Cree worldview identifies us, as a group and individually, as Members of the natural world. Through our beliefs, values, practices and traditions, we have established relationships and obligations with all other parts of the natural world as an integral part of that world. The foundation of the Cree relationship is spiritual. We believe that all parts of nature, animate and inanimate, have a spirit or a soul and are worthy of respect. Thus, when one part of nature is impacted all the other parts are also impacted, which creates an imbalance that must be remedied0 (CNP Keeyask Environmental Evaluation Report).

Language

Language as an indicator for TCN is considered an integral tool for the transmission of traditional knowledge and life skills; and is important to maintain Cree culture through language. Community research indicates that two main factors have influenced changes to Cree language use within the community: residential schools and technology (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

The precise impact of the residential schools of this era, as the population of children attending residential school increased in the 1960s, is beyond the scope of this study. The effect however, directly impacted the use of Cree language in the teaching of traditional knowledge and skills to young people. This created a generational gap and a chasm between Elders and youth which normally would have provided the foundation for the instructional use of language inherent in the Cree culture (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

The other main factor, technology, became more influential after the residential school system had been halted. As modern technological advances were made for personal entertainment the gap between generations was maintained as youth began to replace traditional activities utilized for transmission of language with distractions offered by the introduction of television and video games (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a). Technology and its effects are discussed further under the indicator measure kinship.

Traditional Knowledge

For TCN, traditional knowledge as an indicator of change is closely linked to language and cultural practices. Youth that were displaced from the community during the residential school era returned and took on leadership roles; many had been affected by loss of their first language (Cree) as previously discussed. The community history represented in Analysis of Change (Split Lake Cree – Manitoba Hydro Joint Study Group) notes, that:

> While the younger generation took more of a leadership role in terms of political responsibilities, the Elders continued to take responsibility for ensuring respect for the moral and customary practices of the community (Split Lake Cree – Manitoba Hydro Joint Study Group).

The CNP discuss traditional knowledge as:

> Knowledge that reflects our experience, understanding, wisdom, values, beliefs, norms and priorities governing our relationships with Mother Earth and all her beings, derived and developed through living in our homeland ecosystem since time immemorial. ATK is inextricably linked to our culture and our worldview (CNP Keeyask Environmental Evaluation Report).

This specialized knowledge for cultural survival persisted despite all the disturbances to the Cree cultural identity and remained strong because of an ongoing relationship with the land:

> …our people made great efforts to adapt to ensure traditional learning continued. Learning of traditional knowledge still took place during this period; our young people were stil taught the customs, practices and traditions integral to our cultural identity; everyone still spoke our Cree language; and our worldview was still rooted in our relationships with the land that itself was unchanged by the education system imposed by the Indian Act (CNP Keeyask Environmental Evaluation Report).

Cultural practices were also affected by hydroelectric development as they relate to traditional knowledge as an indicator:

> From a Tataskweyak Cree Nation community perspective, hydroelectric development was by far the most profound agent of change, causing both major physical impacts on the lands and waters, as well as the resulting undermining of the essence of Aboriginal practices and customs (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Cultural Practices

Considering the stresses placed on traditional knowledge as a mechanism of cultural transmission, cultural practices as an indicator reveals considerable changes to the community with measurable origins beginning in the 1950s.

Rapid changes to the physical environment also played a role in cultural practices:

> Commercial and domestic harvesting activities were seriously affected. Fur bearers and waterfowl were destroyed, or driven from their ruined habitats. Moose, deer, and lynx were forced upland as the shorelands could no longer support them. Fish habitat was changed by the increased turbidity, and the relative abundance of various species changed. Mercury contamination of fish, particularly in Stephens Lake, became a problem, and Split Lake Cree were advised not to eat certain species. There was a local perception that the fur and fish that were caught were of inferior quality (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

The community response to increased environmental issues was one of adaptation of their spiritual values and continued attachment to the lands and waters. As traditional pursuits continued to be adversely affected along 'on-system' waterways, hunters, fishermen and trappers had to go further afield in order to harvest game and fish, incurring additional expenses.

With regard to cultural practices it was also noted that major forces of change that affected the community through the 1960s and 1970s are still being felt today within the community:

> Traditional religious beliefs were practiced only by the Elders, who were also the First Nation member's most frequently attending church services. Although there was a reported decline in active church attendance, the Anglican Church and its practices and moral code remained a predominant influence on everyday life (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Health and Wellness

Health and wellness as an indicator brings to light the physical and emotional effects that have changed dietary processes in TCN. Reliance on store-bought food has continued to grow and replace many of the former traditionally harvested foods. This change in dietary habits and shift to more sedentary lifestyle has changed the health of residents with increased incidence of modern illnesses, particularly diabetes. Changes to water flows due to LWR and CRD, especially in winter where thin ice and slush ice result in dangerous travel conditions has increased the risks of travelling on the lakes and rivers. This has meant that fewer people are venturing out to acquire traditional foods:

> Fluctuating water levels in winter resulted in very dangerous ice conditions, for example on Stephens Lake, where water levels varied by as much as six feet in one week. The seasonal

> reversal of water flows, combined with debris, limited shoreline access and water-based transportation (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Kinship

Kinship as an indicator of change for TCN was closely linked to technology and cultural practices. With regards to technology, community research noted below suggests that television played a role in influencing changes to kinship patterns in the community:

> Television was also introduced into many community homes and its impact cannot be underestimated. It created expectations, some false. It exposed young people to the outside world, on the one hand introducing previously unknown cultural influences, but at the same time bringing readier access to information about the struggles of other Indian peoples, in far off parts of the country, to assert their rights. The greater difficulty and less satisfying nature of traditional, outdoor activities tended to make television a substitute, thus isolating the youth even more from the experience of the Elders and the traditional values of the Split Lake Cree (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Kinship is also affected by changing cultural practices, also reflected in TCN research:

> Parents placed increasing emphasis on formal education as a means of understanding and dealing with the changes being experienced, as well as of obtaining future employment. This, combined with continued residential school attendance, left many of the youth unfamiliar with the traditional ways of living off the land. Increased access to Thompson with its 'city ways' was another destabilizing factor. By the early 1970s there was scheduled air service between Split Lake and Thompson. Taxi service from the Odei River, near Orr Creek, began in the mid-1970s. The completion in 1979 of a year-round road, Provincial Road 280, between Thompson and Split Lake consolidated the link. As a result of all of these factors, the social fabric in Split Lake began to erode and young people, alienated from the old ways, increasingly questioned the wisdom of traditional life and values. Church attendance began to drop. The curfew disappeared. Alcohol and drug use increased, although still mainly off reserve (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Leisure

As noted in the discussion of cultural indicators in section 5.2.6.1, Leisure is described as the recreation provided by the cessation of work or dutiful activities and is usually associated with enjoyment or pleasure. Leisure activities are relevant within all KCNs communities because recreation is utilized as a time to share stories of past, present, and future during shared activities. Leisure as an indicator for TCN links the cultural uses of lands and waterways to recreational uses, which act as venues for the transmission of traditional knowledge and spiritual connections to the community.

Historic changes to the cultural landscape has altered and limited recreational activities:

> Dirty water made swimming less attractive and debris inhibited boating. Children got sores from swimming in the lake. Winter recreation was adversely affected as ice conditions made many activities more dangerous. Summer activities had to be curtailed because camping and picnicking sites had either been flooded or left high and dry. Boating was dangerous below the Kettle dam because of severe water level fluctuations. The Churchill River was completely destroyed for recreational use and its pristine wilderness values were lost (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Law and Order

Law and Order as an indicator reflects changes to the communities' mechanism of balancing social stresses through close knit family groups:

> The traditional gathering times were most frequently happy social occasions, an opportunity to renew ties among families and clans. These times were also when self-governance was most actively practiced by the Split Lake Cree, in lengthy, regular meetings among the First Nation members to consider and take decisions on all matters of collective importance to the people (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

And:

> In the early days the First Nation government was not formally institutionalized. Rather, it functioned as was needed to maintain the traditional Aboriginal way of life. The family was the main governing and social unit. Next was the clan or group of families and beyond that the tribe followed by the Cree Nation as a whole. Certain members of a clan earned a level of authority based on their skills and knowledge in particular areas of resource harvesting. Clan leaders would emerge as a result of their general leadership skills, personality and effectiveness in dealing with outside contacts. Leaders could not force their views on families or individuals, who were free to obey or to ignore the leadership and even move away if they chose. First Nation laws and their enforcement were made and exercised through general clan opinion and concerns. Decisions were made by consensus. The people already followed the practice of selecting peacekeepers to maintain in their own customary fashion the peace, order and mutual respect that was central to the way of life. Elders report that their grandfathers carried out this collective governance function, leaving its actual origin shrouded in the mists of time (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

TCNs community research attributes changes to law and order to a heightened pace of resource exploitation by outsiders beginning in the 1950s. The community felt that their structure of governance was poorly equipped to manage such relatively rapid and unknown change:

> Little practical advice and support was available from the governments, which tended to either ignore the impacts, or to view them as 'short term pain for long term gain' (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

Cultural Products

Cultural products as an indicator for TCN is closely linked to the environmental and bio-physical changes that surround the community. As a result of outside influences, stressed resources, and environmental changes, the community struggled to facilitate local economic opportunities that could provide a self-reliant alternative to the diminishing traditional way of life:

> Notwithstanding the continuing attachment to resource harvesting, severe unemployment characterized the local economy for most of the year in the first half of the decade, with a corresponding increase in social assistance dependency. Women's handicraft production all but ceased... The customary division of labour became blurred as women began to work and men took more of a role in raising children (Split Lake Cree – Manitoba Hydro Joint Study Group 1996a).

WAR LAKE FIRST NATION

This section reviews the nine cultural indicators defined in Section 5.2.6 in relation to WLFN. In keeping with the philosophy of OWL, a participatory action research[1] (PAR) approach was taken for oral history interviews which was guided by the worldview and needs of the community. Community researchers were hired for the project.

Worldview

Worldview as an indicator for WLFN is a reflection of the holistic relationships held within the Mother Earth Ecosystem Model. This model was utilized by WLFN community researchers to represent life processes for community Members. Many teachings are held by WLFN Members, but there is a concern that the teachings are not being handed down and are being lost. Values such as honesty, trust, loyalty and respect are held in high esteem by WLFN Members:

> The Mother Earth Ecosystem Model is seen as a way of explaining the worldview of War Lake First Nation and reminding the larger society that the relationships that are found within the model are the way War Lake First Nation views the world. Members state that if one part of the model is affected then other parts will be affected and there will be a loss of harmony and balance (WLFN 2002).

Language

Language as an indicator for WLFN is considered to be a yardstick of cultural well-being. All the interviewees who participated in oral history interviews conducted by WLFN OWL researchers were very concerned about the loss of Cree language and identified different categories of Cree speakers:

- Those that speak and understand Cree and are fluent;
- Those that do not speak Cree but understand it; and
- Those that neither speak nor understand Cree (WLFN 2002).

Community Members who are considered fluent Cree speakers are those who use their language daily for communication and can include Elders, middle-aged adults and those who work as interpreters. An interesting observation by community researchers is that those people who dropped out of school for one reason or another prefer to use Cree as their first language (WLFN 2002).

The WLFN community Members that do not speak Cree but understand it include those who are a product of the residential school system and those who have had minimal interaction with their Elders. Other Members of the WLFN that do not speak or understand Cree were identified as school children who are being taught in English, or those people who had been away from the reserve for a number of years:

[1] Participatory Action Research is a community driven approach to research, which is directed by the needs of the community.

> At War Lake First Nation, the Elders have stated that Cree language must be kept alive and the way to do this is to teach the young people, taking the time to speak Cree instead of English. However, all acknowledge that the decision to speak Cree was personal and this was often dependent on whether or not Cree was spoken in the household (WLFN 2002).

Understanding the relationship of places to people is often captured through traditional knowledge and the cultural transmission of the names people in the community use to remember certain areas and events. While it is acknowledged that language is dynamic, people are speaking less and less Cree and the changing language has caused a communication gap, especially with the exposure to English-language TV and more recently computers and the internet.

Traditional Knowledge

For WLFN, traditional knowledge is viewed as a body of knowledge that has been passed down from one generation to the next and as a method of performing traditional pursuits and activities that contains the recipe for survival. Language is seen as a very important part of traditional knowledge. There is concern that if traditional knowledge is not soon passed on to younger generations it will be lost (WLFN 2002).

The oral tradition is still practiced by WLFN Members, but to a lesser extent than before. Certain skills are still communicated orally, such as teaching young people how to snare rabbits, fish and hunt. However, other practices such as preparing hides and tanning are being lost. The Elders are not being asked to pass their knowledge on to the younger generations and as a result the communities' body of traditional knowledge is losing strength (WLFN 2002).

Cultural Practices

Cultural practices as an indicator for WLFN represents a manifestation of the balance and harmony described in the Mother Earth Ecosystem Model. WLFN Members believe that the Mother Earth Ecosystem Model was affected by physical and cultural changes and was in a state of imbalance (see also CNP Keeyask Environmental Evaluation Report). Practices such as traditional ceremonies are not currently being carried out in the community. However, people occasionally do go outside the community to attend these ceremonies:

> In the past, ceremonies were held at the beginning of the trapping season to give thanks for the animals that were provided and pray for a good winter. Other ceremonies and feasts were held, for example when a young man made his first hunt. Young men were taught to respect the animals that gave themselves to the people and do certain things out of respect for the animals (WLFN 2002).

Health and Wellness

Health and wellness as an indicator for WLFN is strongly linked to worldview and exhibits the harmony and balance illustrated in the Mother Earth Ecosystem model. The community described four aspects of balanced health as physical, mental, spiritual and emotional.

Physical health was presented as a state of health that existed in the community both in the past and as a part of current health conditions.

Before the snowmobile was introduced, people used to walk long distances by foot or on snowshoes or travel by dog team. According to interviewees, people were physically active all the time and were always healthy. There was no need for a physical fitness program (WLFN 2002).

Diet currently presents the greatest challenge for the community with a diminished wild food harvest and a reliance on store-bought foods. Western medicine has almost completely replaced traditional medicines such as the use of different leaves, roots, berries, and barks (WLFN 2002).

Mental health or the way people dealt with mental problems in the past was an aspect of the health and wellness indicator that was not known or discussed. Generally, various forms of mental illness are found in all societies. The ethnographic record for the Cree in general indicates that people were accepted no matter what kinds of deficiencies presented (Mandelbaum 1994).

Spiritual health was considered to be too personal to discuss as everyone has their own way of keeping their spirit healthy (WLFN 2002).

Emotional health was well controlled and this is learned from the family. In general, people feel safe and secure in their community. There is a lot of emotional support in the community but there is also a need to share feelings which is a new experience for most people in the community and many feel uncomfortable talking about this topic. However, it was noted that there is a need for balance among the four kinds of health (WLFN 2002).

Kinship

Kinship as an indicator of cultural change is the glue that holds all other indicators together and allows a cultural group to make sense of relationships with its ecosystem. For WLFN, all things are related and until recently, the interaction between Elders and children within a family unit was a way of guaranteeing culture would continue:

> The terms that were used for family members were the same for both the father and mother's side of the family. Adoption was a means of ensuring that all children were looked after. Orphans were usually adopted by their grandparents, but other family members such as aunts and uncles and even older siblings also took responsibility for their extended families (WLFN 2002).

Leisure

Leisure as a cultural indicator for WLFN defines a time in which community members utilize the opportunity to interact with other community or family members on a harmonious level for the cultural transmission of necessary processes to maintain balance in life.

For example, Members from the community described a traditional game that was used to relay critical life skills:

> Certain bones were used as games. For example, the wishbone was broken and the person with the larger piece was considered to be the winner. In another game, the "a pahikun" or acetabulum (hip joint) of the beaver was used. The object was to try to get your finger to touch the ball joint with your eyes shut. If your finger touched the ball joint then you would find beaver. The ball joint was referred to as the beaver house and the foramen, or hole was called the lake. The entire bone was called os pi chi kuy (WLFN 2002).

Members of WLFN currently enjoy a variety of leisure activities, many of which involve community participation and planning. Baseball tournaments, fishing derbies, and winter carnivals are among the major events that take place. Jigging still takes place and there are competitions in the community as well as in other communities. Two special events, the kindergarten and grade eight graduation are celebrated to mark two very important life stages.

Law and Order

To a large extent, law and order as an indicator represents the current model of the Canadian legal system enforced at both provincial and federal levels of government in addition to the traditional leadership present in the community:

> There are two band constables that report to War Lake First Nation Chief and Council and Ilford Mayor and Council. The constables are hired for the Reserve and the community of Ilford. This is cost-shared. There used to be a police committee that was appointed by Chief and Council but the status of this is not known. The RCMP visits the community about once a month. Court is held at either Gillam or Thompson. There is a holding cell for people where they are kept for public safety or until the RCMP picks them up (WLFN 2002[1]).

As in other communities, WLFN has experienced unpleasant social issues such as crime. Chief and Council along with the general membership of WLFN strive to make the community safe and secure and are always looking for new programs that will help people.

Despite the dominant western forces of law and order that are pervasive within the community, customary law is still active within the First Nation:

> Sharing was, and continues to be, a very important part of the community. It occurs freely and without any expectation of payment. There was an unwritten law that existed at York Factory that Elders were looked after first, then the widows and children. This is still the practice at War Lake (WLFN 2002).

Cultural Products

Cultural products as an indicator of change for WLFN illuminates changes that have occurred with the transmission of traditional skills, such as constructing snowshoes or porcupine quillwork products. These have declined over the years to the point that these skills are perceived as lost. The decline of the production of traditional products that connect the communities' spirituality to the land is linked to the decline of traditional knowledge pursuits between Elders and the youngest generations within the community:

> The Elders are the people who know, and continue to create a variety of crafts but their skills are not being used and they are not passing their knowledge of craft-making on to the younger generation. Many of the Elders are going blind and have a difficult time doing beadwork. They are worried because few people are learning this art form. The younger generation is focusing on other things (WLFN 2002).

[1] Since the time of the 2002 report, there is now only one band constable.

5.3.6.1.2 Fox Lake Cree Nation

This section reviews the nine cultural indicators defined in Section 5.2.6 in relation to FLCN.

WORLDVIEW

Worldview as an indicator provides a cognitive map FLCN incorporates into their daily lives as a method of balance between cultural self awareness, spirituality and landscape understood as Mother Nature. Worldview becomes an overlying template for community decision making, leadership and daily living. Concern regarding changes to worldview was reflected in FLCN's grievance statement *Forgotten Nation in the Shadow of the Dams* by noting that:

> The research completed…provides a sound basis for Fox Lake First Nation to understand how, and to what extent, the First Nation's rights and interests were affected by Manitoba Hydro's developments since the early 1960s (FLCN 1997).

The community history Ninan presents part of their worldview as *Pimatisowin*:

> Pimatisowin, or more simply life or living well, refers to the knowledge people carry with them about life and how to survive. Pimatisowin can encompass a broad range of topics including medicines, spirituality, geography, climate, and ecology, and usually concerns, and is informed by the local environment and landscape (FLCN 2009a Draft).

Also:

> These values are part of the larger concept of maintaining respectful relationships generally, and are a key to traditional Inninu values (FLCN 2009a Draft).

The values developed through worldview also have moral implications for the community:

> The knowledge that there are consequences for inappropriate behaviours, that is, oochinehwin, was an important part of the people's worldview, and directly influenced the choices they made in their daily lives (FLCN 2009a Draft).

These values are also noted in Chapter 2 of the Response to EIS Guidelines.

LANGUAGE

Language is reflected by the community as critical in the role of an overarching support to preserve and propagate Cree life and spirituality within the FLCN community:

> Traditions were woven into the essential fabric of the Fox Lake community, and people continued to conduct themselves according to the values passed to them by teachings from the 'old people'. Relationships were well defined and understood within the community and were reflected and reinforced in particular relationship words that existed in the Cree language (FLCN 2009a Draft).

As an indicator, language is linked to traditional knowledge through community documentation and oral histories and discussed as an integral method of cultural transmission:

> Kitayatisuk, or the eldest members of society ('old people'), played a key role in the preservation of knowledge. Due to their life experience, kitayatisuk acquired an in-depth understanding of the world around them that younger, less experienced people typically did not have. Thus, kitayatisuk bore the greatest responsibility for ensuring that children and grandchildren received all types of knowledge (FLCN 2009a Draft).

TRADITIONAL KNOWLEDGE

Traditional knowledge for FLCN is a fundamental means of cultural transmission. In the community history research conducted by FLCN, this is discussed and reflects the synergy that is shared with all indicator discussion:

> …our ancestors passed down knowledge through storytelling, showing, games, art, dancing, music, and other forms of expression. This way of transferring information was highly suited to our ancestors' way of life, could be both enjoyed by the listeners and easily remembered, and allowed knowledge to be retained over long periods of time. For example, some legends known by Fox Lake Elders have likely been told for hundreds of generations. That this knowledge was passed down over long periods of time, and in a wide area, demonstrates the continuity between the generations, and the importance of our Elders and their stories to link us with our recent and ancient past (FLCN 2009a Draft).

Traditional knowledge also represents a mechanism for the maintenance of cultural practices within the community:

> In addition to contributing the family income, picking berries, and making moccasins and other crafts allowed the people to maintain some relationship with the land, and for mothers, in particular, to pass down traditional skills to their daughters (FLCN 2009a Draft).

CULTURAL PRACTICES

Cultural practices as an indicator defines the manifestation of traditional knowledge within FLCN:

> For hundreds of generations, Ininuwak travelled to time-honoured sites located at the estuaries of the Nelson and Hayes Rivers to take advantage of the spring and early summer geese and caribou migrations. Seasonal gatherings represented the first opportunity after the winter to socialize with friends and relations, hold ceremonies, trade, and arrange marriages. With the onset of colder weather people dispersed to their Winter hunting lands throughout a vast territory that included Kettle River (Askiyko Sipi) Fox Lake (Mekeso Sakahikan), Kaskattama River (Kaskattamaw Sipi), Shamattawa (Kisahmatawakh), Whitebear Creek (Wapusk Sipisis), and Whitefish Lake (Utlkumak Sakuhikun) (FLCN 2009a Draft).

Cultural practices illustrate the worldview and the seasonal lifestyle at the core of the Cree in Fox Lake. As historical events touched and challenged these practices, adaptation was critical to survival, as is noted in their community history:

> In essence the people had incorporated seasonal labour into other seasonal activities as they had in the past while working for CN (FLCN 2009a Draft).

And that:

> This, in turn, caused individuals to doubt the validity of their beliefs and life knowledge, leaving many with little to help them adapt to the many changes occurring almost simultaneously around them (FLCN 2009a Draft).

HEALTH AND WELLNESS

Health and wellness as an indicator for FLCN represents the physical aspects of wellbeing, and is understood as part of the balance that constitutes individual and community health. Community history research provides a baseline on types of country foods that were part of the community's diet in the past:

> In addition to caribou, moose and fish, rabbits and spruce grouse made up a regular part of the people's diet throughout the year. Berries including niskeminah (blueberries), wesahkeminah (cranberries), anouskanuk (raspberries), odahihminah (strawberries), ostikonihminah (cloudberries) oskisihkhominah (logan berries) and osapominah (gooseberries) were found in sandy areas, marshes and along riversides, and were enjoyed in late summer. Medicinal plants were in plentiful supply and harvested for use and trade in the coming winter. Frozen berries could be harvested throughout the winter, and kept frozen until spring, but required specialized knowledge to recognize nonpoisonous plants without their summer foliage. Hunting and fishing were generally practiced in tandem with other activities such as berry picking and plant gathering, with the entire family participating. Families chose their riverside campsites, in part, on the basis of whether they could obtain a variety of resources within the vicinity, and because they knew they would be able to support the needs of the gathered people who renewed relationships, dealt with political issues, arranged marriages, and were able to enjoy the abundance of summer with family and friends they had not seen over the winter (FLCN 2009a Draft).

In contrast, the community research also provides insight into current issues that affect the health and wellness of the community:

> In addition to increased turbidity, water quality was compromised by the release of mercury from the creation of Stephens Lake and similar reservoirs. Once the people became aware that mercury levels had increased in the fish and water, and learned the health risks associated with consuming the fish containing mercury, they responded by drastically reducing their consumption of all aquatic foods originating from the Nelson River. Not only did increased mercury affect the people's right to fish, it also affected their perception of the aquatic environment. In the eyes of our people, the river was no longer pristine, and the food from it was no longer healthy (FLCN 2009a Draft).

The same factors outlined in the community history research are also reflected in a study of sturgeon in the Nelson River. Concern for the health of the community also illustrates the connection to cultural practices and the spiritual connection to the land and waters of the region:

> As an indicator of the decline in water quality, Johnny Beardy (2008) explained that prior to the dams there was never a need to clean one's nets. Today, nets must be cleaned frequently because they quickly become covered with silt and algae. The Fox Lake people articulate very clearly that the health of the Nelson River is intrinsically related to the quality of the fish (FLCN 2009a Draft).

KINSHIP

As with all indicators, kinship links to other indicators. Changes to one aspect of community life (as viewed through indicators) has repercussions to all other connections within FLCN cultural processes. Kinship provides the foundation for Cree families and therefore community life. It is the connection between Elders and youth that preserves and directs community ethos:

> Until very recently, the force keeping the oral tradition alive was the fact that every person's survival depended on the transfer of knowledge held by older people to younger generations (FLCN 2009a Draft).
>
> Although the identity of belonging to a larger community still exists for today's Elders, it is much less prominent among younger people, in part, because they lack an understanding of their shared community, genealogy and history (FLCN 2009a Draft).

LEISURE

Leisure as an indicator for FLCN involves activities that are participated in during the cessation of dutiful activities. It is also a time for community members to find solace and a healthy mindset. Leisure also becomes critical in the process of cultural transmission between Elders and youth:

> In addition to imparting practical teachings, many old people were renowned as storytellers. Storytelling served many purposes, both practical and recreational, and was generally in the form of legends or histories. Oral histories, or atchmowina, were accounts about events in the past as remembered by the storyteller, and were considered factual (FLCN 2009a Draft).

LAW AND ORDER

Law and order as an indicator for FLCN Members depicts the values directly attributed and manifest through kinship and kin relationships. Fox Lake community history explains that:

> Through marriages and customary adoption, the people formed highly integrated and complex extended families throughout the territory that provided stability and support to family members and a model for appropriate behaviours (FLCN 2009a Draft).

And that:

> …people helped each other in keeping with established practices, were expected to live without violence or hostility. Customs that relate to helping each other were reinforced by the practical fact that one's life and success depended on working closely together with other people (FLCN 2009a Draft).
>
> …living closely with other people required rules to protect the privacy of individuals and cultural values, and, generally, to maintain a harmonious state within the home (FLCN 2009a Draft).

In regards to FLCN law and order, community history research concludes that:

> Old people played an important role in maintaining the standards of appropriate behaviour. These standards were communicated both through example and oral teachings. It was primarily the elder family members' responsibility to ensure the values, customs and belief systems of the people were passed down to other members of society (FLCN 2009a Draft).

CULTURAL PRODUCTS

Cultural products for FLCN are linked to economically driven cultural practices, both historically and currently. The connection between spirituality, land use and an adaptation to a changing cultural landscape through the construction of the Hudson Bay Railway is contextualized in Fox Lake history research:

> With the men away during the day, and sometimes the entire week, women carried out some of the activities that had traditionally been performed by men, such as hunting large game, which contributed significantly to the household economy. Women also sold their handicrafts, berries and other items to local non-Aboriginal people, and to tourists who came by railway to the area (FLCN 2009a Draft).
>
> Young Fox Lake girls often made money by selling berries, sewing and beadwork to the non-Aboriginal residents of Gillam as well as to tourists, who were usually travelling from the south to Churchill on the railway (FLCN 2009a Draft).

5.3.6.1.3 York Factory First Nation (YFFN)

This section reviews the nine cultural indicators defined in Section 5.2.6 in relation to YFFN.

WORLDVIEW

YFFN members who shared knowledge and information regarding the community's worldview discussed a decrease or an absence in some cases of the understanding of the relationships and interconnectedness of the natural environment and spirituality.

Impacts from historical events that have independently shaped the community's modern perspectives include the ongoing process of the incremental loss or decrease in the understanding of spiritual connections to the land. Worldview as transmitted through traditional values and education directly affect future leadership qualities due to a lack of understanding past, current and future needs of the community. YFFN's Evaluation Report, *Kipekiskwaywinan* presents a thoughtful reminder of the need to consider the worldview of it people.

LANGUAGE

Language as an indicator for YFFN is related to kinship and cultural practices with the community noting a decrease in the number of Members, especially children and youth, who speak Cree or write/understand syllabics. The community oral histories and workshops describe a decrease in Cree as a first or second language, which also involves a decrease in fluency (understanding Cree without the ability to speak or write). This has been linked by the community to a decrease in Cree language use in home environments as well as a decrease in cultural transmission of traditional knowledge between Elders and Children including gender specific information and kinship roles. For YFFN, the loss of Cree language affects the transmission and understanding of the value of their culture; for this reason, the YFFN adverse effects agreement has a Cultural Sustainability Program to assist in sustaining cultural identity and language (YFFN Evaluation Report (*Kipekiskwaywinan*)).

TRADITIONAL KNOWLEDGE

Community comments on traditional knowledge as an indicator focus on the extent to which community Members' understood their own traditional practices through oral narratives (oral traditions and oral history). YFFN has stated that their traditional knowledge "Ininiwi-kiskénihtamowin is absolutely fundamental and central to who we are as a people and culture. Our traditional knowledge is held by our Elders and passes from generation to generation. It is a dynamic, living process that is added to and adapted in the lives of successive generations of Cree people. It lives within our way of life." (YFFN Evaluation Report (*Kipekiskwaywinan*)). In recent years, a decline in the transmission of traditional knowledge has been linked to a decrease in Cree language use and a true understanding of oral narratives. Community Members also discussed a breakdown which has occurred in the process of passing down traditional knowledge affecting individual and community physical, social, emotional and mental well-being due to generational gaps and disruptions linked to residential school practices. To address this concern, YFFN's Adverse Effects Agreement includes a strengthening of traditional knowledge for their community through, for example, their Cultural Sustainability Program(see Section 5.4.2) (YFFN Evaluation Report (*Kipekiskwaywinan*)).

CULTURAL PRACTICES

Cultural practices as an indicator within the KCN region and for YFFN illustrates the type of activities that occur within the community that do not include leisure. Community Members of York Landing noted a decrease in cultural ceremonies as part of cultural practices within their lifetime and to a lesser extent a decrease in gender-based practices. The decrease in participation in subsistence and economically-based cultural activities is such that continued changes in physical and cultural landscapes will change cultural practices by the process of adaptation or abandonment. YFFN also noted [Our community comes] "together for traditional dances, goose camps, and feasts, and return to our territory at York Factory (*Kischewaskahekan*) as often as they can. They respect the teachings of our ancestors and look for ways to apply them in the modern world" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

HEALTH AND WELLNESS

For Members of YFFN, changes to the health and wellness of the community are linked to an increased availability of western modes of health and wellness such as nursing stations, visiting doctors, dentists, pharmacists, psychiatrists and psychologists. Changes in health are also linked to a decrease in the availability and extent of traditional health and wellness practices such as midwifery, gathering traditional medicines (plants, roots and herbs) and shamanistic practices. Within the sphere of health and wellness discussions, YFFN Members commonly indicated a fear of pollution and changes to water quality with the increased presence of mercury within the water systems utilized by the community. Pollution, it is believed, would ultimately cause further changes in diet, and traditional harvest. YFFN is hopeful however, that healing and reconciliation in the future will result in a more healthy community (YFFN Evaluation Report (*Kipekiskwaywinan*)).

KINSHIP

For YFFN, kinship as an indicator illustrates changes in family patterns associated with the adoption of western views by the nuclear family, resulting in the diminished extent of traditional extended family life. With the waning of extended family patterns there is also a decreased understanding by youth and other YFFN Members in regard to what or who is family. According to the community this has also affected family obligations such as subsistence sharing and marriage patterns which have been disrupted due to an enforced sedentary lifestyle associated with the relocation from York Factory to York Landing. YFFN community Members residing in the isolated community of York Landing also link 'sedentary lifestyle' to a diminished contact with other communities due to a lack of year-round access.

Understanding of traditional kinship relationships has decreased and affected Member's ability to determine the status and role of individuals which had normally been supported by an established fictive kinship. A decrease in traditional interaction between Elders and children (also reflected in cultural practices and language) has diminished the transmission of knowledge for example, in determining traditional male and female roles within the community (YFFN Evaluation Report (*Kipekiskwaywinan*)).

LEISURE

Leisure as an indicator for YFFN reflects an important aspect of the cultural transmission of traditional knowledge. The community indicated a general increase in leisure time that is not used for the cultural transmission of oral narratives (oral traditions and oral histories). This has been linked by the community to the availability of television programming. Other adverse effects linked by the community to a decrease in leisure time for transmission of traditional knowledge include alcohol and drug use and vandalism, especially among the children and youth within the community. The decrease of traditional leisure practices represents missed opportunities to share stories of the past, present, and the future through shared activities. This becomes substantial as there is a decrease in the types of children's activities that involve Elders, and a reliance on daycare and western schooling. Fear has been expressed by adults and Elders that a continued reduction of land area or specific sites like Sandy Beach and other beaches will continue to affect leisure activities (YFFN Evaluation Report (*Kipekiskwaywinan*)).

LAW AND ORDER

Law and order as an indicator for YFFN illustrates changes to community worldviews on social sanctions. There was a feeling expressed by some community Members that the historic enforcement of western law and modes of sanctioning has resulted in the loss of some cultural identity linked to a decreased understanding of the spirituality of their ancestors. YFFN oral histories suggest there is a community understanding that aspects of First Nation culture share a synergy with the concept of traditional knowledge as a basis for cultural transmission. Any disruption in traditional knowledge will result in the loss, decrease or absence of understanding traditional mores and folkways that determine customary law (YFFN Evaluation Report (*Kipekiskwaywinan*)).

CULTURAL PRODUCTS

Cultural products as an indicator for YFFN represent a manifestation of the cultural practices and beliefs that are also shared and transmitted through traditional knowledge. A considerable decrease in the number and type of cultural products that community Members produce or create has been affected by changes in the bio-physical environment. This has had an economic impact on supplemental incomes and is reflected in the reduction of furs for traditional clothing and beadwork. The community noted that there was also a reduction in subsistence processes such as smoking meat and fish, and preparing pemmican. The reduction in the availability of plants for traditional use was also noted and discussed as directly affecting the indictor health and wellness (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Despite the existing fear and skepticism expressed in YFFN's Evaluation Report (*Kipekiskwaywinan*), there is also the expression of hope and expectations of a better future.

5.3.7 The Way the Landscape Looks (Aesthetics)

Construction and operation of the Project would primarily affect the way the landscape looks *(e.g.,* aesthetics) in the area between Gull Rapids and the outlet of Clark Lake. In addition, Project-related population increases that would occur in Gillam would result in changes to the urban environment. This section describes the characteristics of the area around Gull Rapids; KCNs perspectives on the aesthetic quality of the area and perspectives on the aesthetic nature of the Town of Gillam.

5.3.7.1 Local Study Area

The Nelson River system flows northeast from Lake Winnipeg and drains into Hudson Bay. The nature of the river varies as it changes from riverine to lake environments depending on the width of the channel. The Nelson River has been substantially altered by numerous past hydroelectric developments, beginning in the south with the Jenpeg Generating Station, and travelling downstream to the Kelsey, Kettle, Long Spruce and Limestone generating stations. For the KCNs in particular, the area is no longer a pristine environment; rather is an altered river environment. The Project is located at the eastern end of Gull Lake, and the western end of Stephens Lake - the reservoir created by the construction of the Kettle Generating Station. All of these generating stations result in fluctuating water levels within their respective license ranges.

The area in proximity to the Project features gently sloping terrain with lakes of various sizes scattered across the landscape. Bogs and peatlands occur throughout much of the area. The area is also characterized by the presence of discontinuous permafrost. Gull Rapids are located immediately above Stephens Lake. The shorelines around Gull Lake and Gull Rapids are gently sloping with rocky outcroppings in some areas (see PE SV for more details).

Source: Manitoba Hydro, 2011.

Photo 5-1: Gull Rapids

There are two sets of rapids between Clark Lake and Stephens Lake: Birthday Rapids and Gull Rapids. Birthday Rapids consists of a single set of rapids with approximately two meters of drop, while Gull Rapids consists of multiple channels with 11 meters of drop flowing into Stephens Lake. In between Birthday Rapids and Gull Rapids is Gull Lake, which is a wide channel in the river where water flows at low velocities with wind and waves producing lake-like conditions. Although the area between Clark Lake and Gull Lake is navigable during open water conditions, Gull Rapids are generally considered unsafe to travel through. Navigation is also a challenge in winter as the formation of ice can result in border ice, anchor ice, and hanging ice dams, in addition to areas of open water, which results in unstable and unsafe ice cover as described in the Physical Environment supporting volume.

USE OF THE RIVERS AND LAKES ALONG THE NELSON RIVER

Navigability presents challenges to the use of Gull Rapids for any traditional or recreational pursuits, and as such the area is not frequently used for boating. The scenic value of the rapids is appreciated by the people who travel in and around the area, although descriptions of the rapids themselves indicate the powerful nature of the water and considerable drop into Stephens Lake. The water coursing over the rapids has both a visual and an auditory component, and can be heard well before it is seen when approached by boat.

The lakes above and below Gull Rapids are more accessible and thus are used more frequently by the KCNs and residents of the Gillam area alike. The following are typical patterns of use in the area:

- TCN Members are the predominate users of the Gull Lake area, and pursue activities such as hunting, fishing, and trapping. There are trappers' cabins around Gull Lake, in additional to traditional camp sites. The area is accessed by boat from Split Lake (CNP Keeyask Environmental Evaluation Report).
- Stephens Lake is used mostly by residents of Gillam (including FLCN Members) and has numerous cabins, which are largely located on islands. The area is typically accessed by boat from the Gillam Marina, although it is possible to launch boats where Stephens Lake comes into proximity with PR 280 (Gillam KPI Program 2009-2010).
- The area to the west of Stephens Lake is an important resource use area for FLCN, in particular for moose hunting (FLCN 2010 Draft).

5.3.7.1.1 Keeyask Cree Nations

The KCNs worldview is reflected in the ATK principles described in Section 1.2.3. These principles acknowledge that Cree traditional knowledge and technical knowledge are distinct worldviews (see also Chapter 2 of the Reesponse to EIS Guidelines). As such, the KCNs' perspectives on the aesthetic value of the Local Study Area relate to their understanding of their environment. The KCNs' traditions are rooted in a relationship with the land, and each of the communities recount stories about how their existence was intertwined with the rivers and lakes and how important a role the waterways play in many aspects of their lives, as is demonstrated by the following quotations:

- "Locations or features in the landscape, connected by routes travelled historically, act as memory tools for stories about people's relationships with their environment" (CNP 2010b; CNP 2010e).
- "Although the size of the territory frequented by the Fox Lake people was considerable, the river systems, in particular some of the larger tributaries of the Nelson River, including the Limestone, Weir, Kettle, Fox and Wabuttnakh Rivers (now called Butneau River), made it accessible by canoe in summer. The rivers provided drinking water for the people and habitat for the animals they hunted, and were the main routes of travel for generations of Ininuwak" (FLCN 2009a Draft).
- "The Hudson Bay Lowlands are a vast area of wetlands and across this expanse of low-lying, often frozen swamp are gravel beach ridges that outline former, ancient shorelines. Through these physical barriers, large and powerful rivers and many streams have carved their paths, replenishing the living ocean and providing a network of accessible travel routes for our people" (YFFN 2010).

The existing landscape that was the ancestral homeland of the KCNs communities is markedly different than the landscape their ancestors knew, and has witnessed substantial changes through the development of major infrastructure projects such as the Hudson Bay Railway, road development, and hydroelectric development (including generating stations, transmission lines and converter stations). The effects of hydroelectric development, in particular, have deeply affected the KCNs relationship to the land. CNP describes the Keeyask reach of the Nelson River as "much different today from (that) experienced by (their) ancestors" (CNP Keeyask Environmental Evaluation Report). FLCN observes, "The life knowledge that people acquired from their parents and grandparents about how to live well, could no longer predict environmental outcomes when the seasonal flows of the Nelson River were reversed" (FLCN 2009a Draft). FLCN Members have witnessed changes in their traditional territory associated with hydroelectric development. For example, one Elder is quoted as saying "When I was young we mostly stayed at Wabuttnow Sipi and Moose Nose, upper Nelson. There was a very large island at the Wabbuttnow Sipi. People used to live on this island. Today I hear from others that this island is not there anymore. It was completely flooded over" (FLCN 2009a Draft). YFFN notes "Hydro-electric development on the Nelson River system has affected our land, our families and each of us as individuals. The water, land and the people have been fundamentally damaged by hydro-electric development. The changes began with the water" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Since the construction and operation of past hydroelectric facilities (see Section 5.3.5), the Nelson River continues to be used for traditional and recreational purposes. Today, from Birthday Rapids into Stephens Lake, there are a number of cabins located along the shore that are used by both First Nation and non-First Nation resource users. Although Gull Lake is an area utilized by some Members of the KCNs, accessibility deters the area from being a high-use location. Stephens Lake has become a common recreation area for Gillam residents, with numerous cabins (55) located largely on islands. Stephens Lake and the environs around the lake are used by FLCN Members and resource harvesters from Gillam and Fox Lake (Bird). The Cache Lake area has also been an important location for FLCN Members, both before and after the construction of hydroelectric facilities, as it was adjacent to the CNR and therefore acted as a conduit to activities such as hunting, trapping, and gathering in more remote locations (FLCN 2009a Draft).

5.3.7.1.2 Gillam

The appearance of the town of Gillam has changed over time, as the community evolved from a predominately-Aboriginal community, to a seemingly-temporary trailer town to a permanent community. Long-term residents in the community have noted recent improvements to the town's appearance through efforts by the town's beautification committee. Others have noted derelict buildings and areas overtaken by weeds and litter. Residents speak of the need to improve certain facilities such as the mall, which is viewed as being outdated. FLCN, for which Gillam is also their home, continues to increase its visual presence within the community through the introduction of signage and buildings throughout the community.

People note that although many residents go to lengths to maintain their yards and properties, the overall transience of the population results in many properties being treated as short-term homes. One long-term resident noted that since the majority of homes are owned and maintained by Manitoba Hydro and other employers, some residents are more likely to put time and effort into the maintenance of cottage properties on Stephens Lake as there is a stronger sense of ownership (Gillam KPI Program 2009-2010).

Source: Manitoba Hydro 2011.

Photo 5-2: Aerial View of Gillam, Manitoba

5.4 ENVIRONMENTAL EFFECTS ASSESSMENT

5.4.1 Construction Effects and Mitigation

5.4.1.1 Community Governance, Goals and Plans

As noted in Section 5.3.1, community governance, goals and plans are linked, as it is typically a community's leadership and associated administration that are responsible for the execution of activities to achieve its goals and plans. The following sections present the construction effects on KCNs Governance, followed by KCNs Goals and Plans. Construction effects on Gillam and Thompson are also noted.

Activities associated with the construction of a major development, including employment and business opportunities and the potential socio-economic effects that stem from these opportunities, may affect the ability of the communities and their leadership to achieve their goals and plans. The capability of local governments to plan for and respond to these changes will influence the nature and extent of potential effects. The KCNs' respective leadership and the Town of Gillam have been and will continue to be key parties involved in considering and planning for the Project; they will also be key parties involved in responding to changes associated with the Project.

5.4.1.1.1 Keeyask Cree Nations

GOVERNANCE

During the construction phase, the KCNs will be involved with the implementation of the proposed Project and addressing its effects, including effects on their Members. KCNs' Future Development and Negotiations teams will need to continue to coordinate with their communities' Chiefs and Councils as the Project transitions from the planning phase into the construction phase. Among the activities likely to require attention on the part of community leadership are the implementation of the JKDA and AEAs (including participation in the various advisory committees identified therein) and decision-making regarding investment and equity participation in the Project.

Throughout these processes, any community concerns that arise as a result of the Project, be they inquiries about employment or business opportunities or complaints about worker interaction, are likely to be directed towards each community's leadership. As such, Chiefs and Councils will need to continue to be well-informed of Project activities in order to respond to their community's interests and concerns. Specific activities that would require attention are described in further detail in the following sections.

Implementation of the Joint Keeyask Development Agreement and the Adverse Effects Agreements

Through the negotiations of previous agreements with Manitoba Hydro, and throughout the process of entering into the JKDA and AEAs, the KCNs have increased their communities' abilities to assert their interests with regard to activities within their traditional land use areas. The JKDA provides $ 11 million in funding for the KCNs during the construction phase for participation in Project processes, including involvement in the KHLP Board and advisory committees established under the JKDA. These committees include the Advisory Group on Employment[1] (AGE), a Construction Advisory Committee[2] (CAC) and a Monitoring Advisory Committee[3] (MAC). These groups are forums for the KCNs to continue to play a meaningful role in the implementation of the Project. While the CAC and AGE are limited to the construction phase of the Project, MAC will continue through the life of the Project. As construction unfolds, Chiefs and Councils, with the support of their Future Development and Negotiations teams, will also be responsible for ensuring that obligations under the JKDA and AEA for their respective communities continue to be met.

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[1] Schedule 12-7 of the JKDA outlines the terms of reference for the Advisory Group on Employment which is intended to provide a forum for addressing employment-related issues, in particular Aboriginal employment, related to Project construction.

[2] Schedule 4-6 of the JKDA outlines the terms of reference for the Construction Advisory Committee which is intended to be a communications forum to discuss timely, accurate and pertinent information related to Project construction activities.

[3] Schedule 4-7 of the JKDA outlines the terms of reference for the Monitoring Advisory Committee which is intended to provide information regarding monitoring of the Project, and to discuss the environmental, social and economic monitoring activities, including ATK, during Project construction, commissioning, operations and decommissioning.

Equity Investment Participation

During the construction phase, each of the KCNs will be responsible for decision-making on equity investment and securing the funds necessary to enable participation in the Keeyask Hydropower Limited Partnership. The amount required to secure this participation will vary among the KCNs, with CNP eligible for 15% equity in the Project, FLCN 5% and YFFN 5%. Each partner will be required to make three payments to complete this obligation, including a nominal subscription payment, an initial closing payment, and a final closing payment that will ultimately determine their community's total equity in the Project. The KCNs communities can choose to invest in the Project in one of two ways: 1) a common equity option, which requires a higher level of investment and generates a proportionate share of distributions from the Project based on Partnership financial performance; or 2) a preferred equity option. The latter option involved a lower investment and a guaranteed return on investment. In the long-term, annual dividends may approach tens of millions of dollars, providing substantial long-term, sustainable income for the communities.

Addressing Community Interests and Concerns

Despite their involvement in the Project through the planning stages, the KCNs have noted some reservations about their participation. This is due in part to the fact that altering the natural environment is contrary to Cree worldview values and beliefs regarding stewardship of *Askiy*, in combination with each community's respective history with Manitoba Hydro (see Chapter 2 of the Response to EIS Guidelines and each of the KCNs Environmental Evaluation Reports). There is uncertainty among the KCNs that the effects will be exactly as predicted. Monitoring will be put in place to address some of this uncertainty (see Chapter 8 of the Response to EIS Guidelines). Involvement of KCNs' leadership and Future Development teams through the Board and advisory committees provides a forum for addressing community concerns.

GOALS AND PLANS

As identified in Section 5.3.1.2, the KCNs share several common interests in regards to their communities including increased influence in decision making within their respective RMAs and traditional territories, improving their financial resources so as to support community development and increased employment opportunities for their membership. In addition, the KCNs see the opportunities to maintain and renew their relationship to the land through traditional pursuits as essential to their cultural identity and viability. Each of the KCNs held a community ratification process to approve the JKDA as well as a separate vote on each community's AEA (see Chapter 2 of the Response to EIS Guidelines).

The KCNs have unique perspectives as to how the Project relates to their community's goals and plans, as is reflected in comments made in their respective Environmental Evaluation Reports:

- **CNP:** "Our belief that the long term benefits provided by the Keeyask Project are likely to help restore harmony and balance in our homeland ecosystem " (CNP Keeyask Environmental Evaluation Report).

- **YFFN:** "As we stated, our story is not tidy, balanced and objective. Our history of interactions with Manitoba Hydro is full of frustrations, miscommunications, mistrust and lack of mutual respect"; and "Our future generations are one of the main reasons we have decided to become partners in the Keeyask Project. We must maintain our future generations, their involvement in the Keeyask Project, and the different benefits and opportunities that will become available to them as key objectives as we move forward in partnership" (YFFN Evaluation Report (*Kipekiskwaywinan*)).
- **FLCN:** With greater involvement in the development of the Keeyask Project, FLCN may in a better position to work towards rebuilding a unified community that consists of both Gillam and Fox Lake (FLCN Environment Evaluation Report Draft).

Each of the KCNs has experienced some uncertainty with respect to entering into the Partnership. YFFN have noted the limited Partners need to further define how stewardship of the land can be maintained though effective monitoring and follow-up to deal with any uncertainty of the effects assessment. Manitoba Hydro has supported community research and involvement in the planning and assessment processes for the Project and continues to work with the KCNs to develop the Project.

Decision-making within Resource Management Areas

A key goal of the KCNs has been to increase their influence over decisions that affect their RMAs. For TCN and YFFN, this goal was advanced through provisions in their Comprehensive Implementation Agreements resulting from the NFA. For WLFN, an RMA was never designated, although the community does have representation on the Split Lake RMB. FLCN's RMA resulted from its 2004 Settlement Agreement. These agreements helped to enable direct negotiations with Manitoba Hydro in regards to the Project. Respect for the land, maintaining relationships with the land, and strengthening cultural identity are integral to the KCN's goals and plans. These values were considered throughout each of the KCNs' negotiations for the JKDA and their respective AEAs.

During the planning process the KCNs were able to influence key characteristics of the Project, including the following:

- In the early stages of Project planning, TCN insisted on the modification to the original design features from a high head design to a low head design to reduce the overall extent of flooding from over 120 km^2 down to 45 km^2;
- TCN also required Manitoba Hydro to reduce the forebay levels so that water levels on Split Lake would not be affected during open water conditions. This resulted in the limitations on the operating range of the reservoir (one meter) and agreement that open water levels on Split Lake will not be affected in the JKDA;
- Fundamental design features of the Project that cannot be altered without the written consent of TCN and YFFN as per the JKDA (construction and operating features); and without the consent of YFFN for operating features as per the JKDA;
- Measures that promote and enhance safe travel in open water and ice cover conditions;
- Measures to protect and preserve historic resources;

- Rehabilitation of disturbed sites used during construction; and
- No release on Manitoba Hydro's liability should unknown or unforeseen adverse effects arise from the Project (CNP Keeyask Environmental Evaluation Report; YFFN Evaluation Report (*Kipekiskwaywinan*)).

In addition to this, each of the KCNs participated in bi-lateral and multi-lateral processes detailed in Chapter 2 of the EIS. These processes allowed the KCNs to have considerable inputs into the environmental assessment studies and the overall effects assessment of the Project.

For the CNP and YFFN, the AEAs include programs which allow the community to undertake ongoing monitoring of resource use activities throughout their respective RMAs. The JKDA also includes provisions to provide on-going opportunities for the KCNs to be involved in Project-related monitoring through the Monitoring Advisory Committee described in the Section 5.4.1.1 above. ATK monitoring arrangements are also being negotiated with each of the KCNs for implementation during construction and operation. For YFFN, an important goal in becoming a partner is to increase the community's influence in the Project Partnership and the Project, particularly monitoring (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Improving Financial Opportunities

Another key goal of the KCNs is improving their abilities to support community development and increased opportunities for their membership. The KCNs' respective AEAs provide a defined stream of funding to enable the implementation of offset programs, some of which began in 2009, and others that are scheduled to come into place before the construction phase begins. This includes the payment of Guaranteed Annual Amounts from Manitoba Hydro to each of the KCNs. The Guaranteed Annual Amounts will be instrumental in each community's ability to implement the objectives of their respective AEA. The AEAs are a reflection of the practices and customs of each First Nation, and provide insight into the priorities each community holds.

In addition to the AEAs, participation in the Project provides the KCNs with opportunities to negotiate directly on a group of contracts (*i.e.*, DNCs) that include a wide scope of construction related activities. Schedule 13-1 of the JKDA identifies which contracts would be DNCs and indicates the KCNs communities being provided the opportunity to negotiate these contracts directly. The experience gained in implementing the DNCs are expected to strengthen the KCNs capacity to undertake future work. (See Section 3.4.1.3.1 for further detail).

Partnership in the Project also provides each of the KCNs the potential for long-term revenues from equity investment.

Increased Employment Opportunities

The KCNs generally feel that in past hydroelectric developments, employment opportunities for their Members were limited and generally only as unskilled labour. With the Keeyask Project, there was "significant emphasis placed on training to prepare Members years before construction begins. With existing hiring preferences and employment targets it is expected that our Members will be hired in both unskilled and skilled trade positions on the project" (CNP Keeyask Environmental Evaluation Report). The Hydro Northern Training and Employment Initiative (as described in Section 3.4) designed, developed and implemented community-based training programs to achieve this end. This, in combination with hiring preferences, DNCs and JKDA employment targets provide the opportunity for the KCNs to achieve goals associated with employment and training. Similarly, the Project should provide opportunities for KCNs businesses and partnerships to access contract opportunities (see Section 3.4.1.8). YFFN states "our members chose to support Chief and Council signing the JKDA to pursue the potential benefits for our current and future generations, to sustain and achieve respect for our Cree culture, and have a voice in this partnership (YFFN Evaluation Report (*Kipekiskwaywinan*)).

Traditional Land Use

The ability to maintain and enhance traditional customs and practices was paramount in the KCNs' negotiations of their respective AEAs.

The CNP described their process of arriving at the AEAs as several steps, starting with avoiding activities that would cause adverse effects, looking at ways to mitigate unavoidable adverse effects, and then looking at opportunities to provide replacements and substitutions where there were likely "infringements on our customs, practices and traditions" (CNP Keeyask Environmental Evaluation Report). The offset programs represent an opportunity that would "actually enhance our culture by providing increased opportunities to engage in the customs, practices and traditions integral to our distinctive cultural identity" (CNP Keeyask Environmental Evaluation Report).

In YFFN's *Kipekiskwaywinan*– Our Voices, they note that their approach to adverse effects was informed by a worldview based on traditional values: "We insisted on offsetting programs to support resource access and use, environmental stewardship (*Kanawaynichikaywin*) and cultural sustainability, as well as residual compensation, YFFN program control and flexibility. We insisted that the AEA reflect a strong environmental monitoring commitment and our participation and application of traditional knowledge in the monitoring of Keeyask Adverse Effects" (YFFN Evaluation Report (*Kipekiskwaywinan*)).

For FLCN, their AEA includes offset programs such as the Alternative Resource Use Program to "access alternate resource areas, within the Fox Lake Resource Management Area, to pursue their traditional activities'; and their Youth Wilderness Traditions Program, which enables youth to go out on the land and experience a traditional lifestyle (FLCN and Manitoba Hydro 2009).

Role of Fox Lake Cree Nation in the Town of Gillam

FLCN has worked in recent years to further enhance their role in the community of Gillam, and was able to reach a long-term goal in establishing a reserve on Kettle Crescent in 2009. The HGD process has also provided a forum for FLCN to voice its interests with stakeholders such as Manitoba Hydro and the Town of Gillam; and FLCN is a participant in the Gillam Land Use Planning process. The implementation of FLCN's AEA would further support FLCN's presence in Gillam (*e.g.,* the Gathering Centre that provides a permanent presence in Gillam).

5.4.1.1.2 Gillam

GOVERNANCE, GOALS AND PLANS

Gillam will be the closest Town to the construction site[1]. The influx of construction workers into the area may result in increased pressures on the Town's government and increased demand for local services (as described in Section 4.4.1.3). Services most likely to experience increased demand include health and social services and policing and enforcement services. As FLCN has indicated, these pressures will be experienced by FLCN Members who represent a large part of the community's population. The Town's Mayor, Council and Chief Administrative Officer, along with Manitoba Hydro and FLCN, will need to maintain communication on construction related activities, timing and the need for potential increased capacity for these services to ensure issues are addressed proactively.

The Town of Gillam and Manitoba Hydro have historically had an amicable working relationship. Through their funding agreement, it is anticipated that Manitoba Hydro will continue to communicate and work with the Town of Gillam and administration in order to ensure that the community has the capacity to deal with any potential construction related changes. The Harmonized Gillam Development process has also enabled FLCN to become involved in discussions about their interests and concerns for the future of the community. The current Gillam Land Use Planning process in place will allow for continued dialogue among stakeholders including FLCN.

5.4.1.1.3 Thompson

GOVERNANCE, GOALS AND PLANS

The governance, goals and plans in the City of Thompson are affected by a variety of factors, many of which relate to the community's role as a major service centre for northern Manitoba. Given the broad range of development that may occur in Thompson (by the City of Thompson, by industry, and by others), it may be difficult to detect if any effects are directly attributable to the Keeyask Project. As the largest community in the Local Study Area, Thompson has a greater capacity to react to any changes that may occur.

Effects on community governance, goals and plans would be indirect and arise from other predicted effects on the community including:

- The potential for an influx of workers into the area (during time off) adding to demand for services; and
- The use of Thompson as a storage and transportation hub *(e.g.,* off-loading of equipment and materials).

[1] Split Lake is the closest community to the Project site on the north side of the Nelson River.

5.4.1.1.4 Mitigation

KEEYASK CREE NATIONS

Key measures to address Project construction effects on KCNs governance are already in place through provisions in the JKDA and AEAs. These include implementation funding, participation in advisory and monitoring committees and AEA Offsetting Programs to address known adverse effects related to the Keeyask Project. It is recommended that the KCNs leadership *(e.g.,* Chiefs and Councils), and their Future Development and Negotiations teams or other designated party remain well-informed about Project activities to respond to community concerns.

Key measures to address Project construction effects on KCNs goals and plans are already in place through provisions in the JKDA and AEAs. These include the Guaranteed Annual amounts that support the implementation of AEA Offsetting Programs to "provide appropriate replacements, substitutions or opportunities to offset unavoidable Keeyask Adverse Effects on practices, customs and traditions integral to the distinctive cultural identity" of the KCNs, hiring preferences and DNCs, which facilitate employment and business opportunities related to the construction of the Project. The measures that will be required to address FLCN's goals of living in a safe environment in the Town of Gillam *(e.g.,* concerns over worker interaction issues) will require leadership and coordination among FLCN, the Town and Manitoba Hydro. These measures are identified under Section 5.4.1.4 Public Safety and Worker Interaction, and Section 4.4.1.3 Infrastructure and Services.

GILLAM

There will be continued coordination among Manitoba Hydro, FLCN and the Town of Gillam to ensure the needs of the residents are met, particularly in relation to influx of workers into the community. More detail on this mitigation is found under Section 5.4.1.4 Public Safety and Worker Interaction. No further mitigation or enhancements are required.

THOMPSON

Manitoba Hydro will continue to liaise with Thompson to ensure construction-related Project needs are aligned with Thompson's goals and plans. No further mitigation or enhancements are required.

5.4.1.2 Community Health

This section describes potential effects of construction of the proposed Project on health of residents in the Local Study Area. As discussed in Section 5.3.2.1, from a Cree perspective, health has as much to do with social relations, land, and cultural identity as it does with individual physiology and disease. This is similar to current day perspectives on population health research, which focus on broad social and economic determinants and their interactions with, and impacts on, health.

Both direct and indirect sources of change from the Project were examined. Potential direct pathways of change to human health are expected to be limited to the area in closest proximity to the Project, and are associated with changes to the water regime. This includes both safety concerns arising from changes to the water regime and associated navigability of the area, in addition to water quality concerns arising from

Project activities. The issue of potential changes in resource harvesting specifically related to mercury and human health were considered particularly relevant, and are discussed in Section 5.4.1.3. Changes to resource harvesting patterns as a result of changes to travel/access/safety in relation to the health benefits of eating country foods are also considered.

Other potential changes in the determinants of community health as a result of the Project were examined to the extent possible. These include changes in factors that can indirectly affect the health of people, such as housing conditions and income (see Section 5.2 for a discussion on the factors contributing to health).

The key determinants of health that are expected to be impacted by the Project (either positively or negatively, or both) include indicators of income and social status, employment and working conditions, social environments, physical environments and health services. In the case of the Project, key potential effects on health determinants include: employment, income, education and training, potential worker-interaction issues, pressure on local infrastructure and services, increased traffic on roadways in the Local Study Area, and changes to the environment. Although it is possible to list some of the factors that have the potential to affect health determinants, the ability to draw firm conclusions with any precision about these indirect effects of the Project on human health is limited. Sources of uncertainty associated with any such assessment include:

- Heath determinates are affected by many factors beyond those which may be connected to the Project, thus it is very difficult to isolate the specific effects of Project changes;
- Some influences may be positive and others negative; in fact, the same source of change can have both positive and negative consequences in some cases; and
- There are uncertainties associated with some predictions made in the assessment *(e.g.,* degree to which negative worker-interaction incidents will occur).

It is important to note that the Local Study Area includes a diverse range of communities. Although indicators have been identified, not all communities will be impacted to the same extent by changes to these determinants of health.

During the construction phase, direct pathways of effect to health may include changes to water quality and travel safety (including both land and water). Indirect pathways of effect may include changes resulting from people's ability to access country foods, employment and income, from issues associated with public safety related to worker interaction, and any effects to health services in Gillam and Thompson as a result of the Project.

5.4.1.2.1 Community Health Issues Directly Associated with Project Construction

WATER QUALITY

The KCNs have a special relationship with the land and waterways in the Local Study Area and note that "Spiritual, physical and emotional relationships with land and water are the essence of our culture" (CNP Keeyask Environmental Evaluation Report). As such, many Local Study Area residents have identified concerns regarding changes to the land and water as a result of construction activities, and in particular concerns about water quality. Concerns about water quality relate to consumption of water while spending time on the land, and include consideration about water and wastewater treatment and other changes to water quality associated with construction activities.

The construction phase represents the beginning of physical changes to the water of Gull Lake. Changes in water quality are expected to be limited primarily to changes in turbidity and associated sediment in the water and are isolated to the area in the vicinity of the construction site (including immediately up and down stream (PE SV). Changes to the water regime and shoreline erosion may lead to changes in sedimentation processes, including the transport and deposition of mineral sediment and peat material. Construction activities during river management *(e.g.,* cofferdam construction) will introduce additional sediment into the Nelson River near Gull Rapids. There is a potential that some of the additional sediment will flow downstream, which may affect the sedimentation environment in Stephens Lake (PE SV). However, it is important to note that the majority, if not all, changes regarding turbidity are expected to be limited to the construction site area. All of the communities in the Local Study Area are located beyond the anticipated open water hydraulic zone of influence, and as such, there should be no changes to community drinking water supplies. In addition to this, the areas in closest proximity to the construction site will be restricted from public access due to safety reasons. Therefore, most KCNs community Members as well as others, even if engaging in activities on the land, should not encounter increased turbidity in the water during the construction phase of the Project.

The other pathway to water quality would arise from the treatment of wastewater at the construction site. The construction camp will house workers at the Project work site; the workforce will vary over the approximately eight years of construction and will generally be higher during the summer construction season. The work camp will include treatment of liquid waste; effluent will meet provincial waste treatment and camp drinking water supplies will meet all regulatory guidelines (PE SV).

The AE SV provides additional information on water quality in relation to the Project and measures water quality in relation to the Manitoba Water Quality Standards, Objectives, and Guidelines for the protection of aquatic life. The guidelines for the protection of aquatic life are typically more stringent for things like metals (*e.g.*, mercury), while drinking water guidelines are more stringent for organic compounds (*e.g.*, benzene). The AE SV concludes that metals should generally remain within Manitoba Water Quality Standards, Objectives, and Guidelines for the protection of aquatic life in the reservoir and downstream. The key exceptions are iron and aluminum, which are currently present at concentrations well above these water quality guidelines. The Human Health Risk Assessment conducted in relation to mercury and human health does not identify any risk to human health associated with surface water (refer to Appendix 5C).

Public access, including resource users, to the construction site will be restricted for safety reasons. In addition to this, it is expected that noise from construction activities and the presence of the construction workforce will dissuade resource users from undertaking activities in close proximity to the site. Further, the KCNs have offset programs defined in their respective AEAs that enable community Members to pursue traditional activities at alternative locations. These programs will be in place prior to the onset of construction activities. As such, the potential for resource users to consume surface water in the area will be minimized. It is also important to note that, regardless of location, direct drinking of surface water is not a recommended practice; Health Canada indicates that all untreated water should be boiled for one minute before consumption (Health Canada 2008).

INJURY AND TRAVEL, ACCESS AND SAFETY

Section 5.4.1.5 describes the likely changes to travel, access and safety as it relates to travel on water/ice in addition to travel on roadways in the Local Study Area.

In terms of water/ice-based travel, KCNs community Members have expressed concerns related to accident and injury associated with past hydroelectric developments including hazards such as floating debris, creation of reefs, fluctuating water levels, and changes to how ice forms. As a result, Manitoba Hydro has implemented a Waterways Management Program (WMP) on Split Lake under TCN's 1992 Comprehensive Implementation Agreement to deal with unpredictable conditions (see Section 5.4.1.5). Other measures such as the Project Reservoir Clearing Plan and WMP (delineated respectively as Schedule 11-1 and 11-2 of the JKDA) will also be in place to address potential travel, access and safety concerns arising from Project construction along the Nelson River downstream of Clark Lake to Stephens Lake.

Project activities will also result in an increase in traffic volumes in the Local Study Area (see Section 5.4.1.5). KCNs community Members have expressed concerns about increased traffic and the risk of death and injury, particularly on PR 280 (CNP Keeyask Environmental Evaluation Report; YFFN KPI Program 2009-2010). The Government of Manitoba has been making improvements to PR 391 and PR 280 including road upgrades *(e.g.,* clearing and grading), signage, and pull-offs, which are all expected to continue to improve road travel conditions.

Section 5.3.2.1 notes that injury is the leading cause for physician visits and hospitalization for the KCNs; while the rate of physician visits associated with injury was lower than in the comparison populations, the rate for hospitalizations for injuries was higher in almost every year considered and shows a clearer trend towards a sharp increase in the most recent five years. Among KCNs Members, people age 19 and under accounted for 41.4% of hospitalizations for injuries, with the highest number of hospitalizations seen among male residents ages 15 to 19. As such, any increase to injury rates may pose concern to local health care providers in addition to KCNs community Members.

Project activities may produce the opportunity for increases in accidents in the Local Study Area due to changes on waterways and or increased traffic on roads, however it is difficult to predict with any accuracy what increase is likely. There is also potential that with the safety measures that have been and will be put in place, travel in the Local Study Area may become safer.

5.4.1.2.2 Community Well-Being

Community well-being is shaped by a broad range of factors, including how people perceive their current circumstances and their future. As described in Section 5.3.2.1 the Cree concept of *mino pimatisiwin* or "living a good life" (as noted in Chapter 2 of the Response to EIS Guidelines) has as much to do with "social relations, land, and cultural identity as it does with individual physiology" (Adelson 2000).

Through the community-based research process, in tandem with concerns identified in the KCNs' respective Environmental Evaluation Reports, various concerns about potential Project-effects on community well-being were identified. During construction, these concerns include:

- Changes to people's abilities to access country foods;
- Changes to community well-being as a result of worker-interaction issues;
- Changes to community health and well-being as a result of employment and income; and
- Potential Project-related demands on local health services.

As previously noted, the effects of the Project will vary for individuals and families, depending on the specific experience of sources of change. Determining, on balance, whether effects of construction phase activities will result in positive or negative effects on community well-being as a whole is difficult.

ABILITY TO ACCESS COUNTRY FOODS

As discussed in Section 5.3.2.1, the ability to access traditional foods and lands are essential to Cree concepts of health and living a good life. It is clearly beneficial if more people are eating country foods in recommended amounts (see Section 5.3.3.3 for examples) and if fewer people are accessing the land and eating country foods, the health of the community is impacted. During community-based research several residents remarked on the change in health status of people in the Local Study Area particularly related to diabetes and obesity, and noted that this may be related to eating less traditional foods and more packaged/prepared foods from the store. The higher cost of foods is also referenced as a reason that less healthy options are often chosen (*e.g.*, country foods can be less expensive) (FLCN KPI Program 2009-2011).

There have been concerns expressed by KCNs community Members about the potential effect of construction phase activities on people's ability to access country foods. Concerns identified by TCN Members include the impact on the actual land, access to land, noise and its effect on wildlife and the possibility that new construction workers will hunt in areas that are traditionally used by community Members (CNP Keeyask Environmental Evaluation Report).

As discussed in Sections 5.3.5 and 5.4.1.13, due to required restrictions near the Project construction site for safety reasons, the construction phase of the Project will affect access to traditional hunting and trapping areas. If community Members are not willing or able to access other areas, or access their traditional areas in proximity to the construction site through alternative routes, there is a potential negative effect on health as a result of less availability of healthy traditional foods. It is important to note that all KCNs communities have Offsetting Programs in their AEAs that enable them to access healthy country foods (including fish and wild game) in areas unaffected by the Project within their respective RMAs, and to practice traditional activities. In the case of TCN, WLFN and YFFN, there is also an element of food distribution within the communities as a part of their AEA Offsetting Programs. This will allow for country foods to be shared by those who are unable to go out on the land themselves. These programs ensure that there is no cost to community Members to access country foods in new areas and or by new routes within their respective RMAs.

WORKER INTERACTION ISSUES

More than 90% of the construction workforce will be at the main construction site north of the Nelson River, while less than 10% of the workforce will be involved in activities associated with the south access road and dykes. Section 5.4.1.4 outlines the projected numbers of workers by year and by quarter as numbers vary over time and season. While numbers peak at more than 1,600 workers, in the majority of the quarters for five years of construction activities, at least 500 people will be living at the main construction site. At the south construction site, numbers are much lower ranging up to about 100 workers. However, it is recognized that even small numbers of temporary construction workers have the potential to affect small communities.

Key person interviews indicate many health-related concerns about the potential outcomes of worker-interaction issues, particularly if a negative event occurs. Among the concerns identified in relation to community well-being are the following:

- Increased availability of drugs and alcohol resulting from increase income availability and presence of a non-local work force in the area. KCNs communities are "dry communities" and Members have concerns related to increased income, job stress, loneliness and potential impact on alcohol use. TCN and FLCN have expressed strong concern over increased use of alcohol and resulting effects on their Members.
- Potential for increased violence in the communities. The impact of alcohol is a concern both for the non-local workers as well as community Members who may also engage in the use of alcohol and or be involved in violence as a result of someone becoming intoxicated.
- Risk of inappropriate sexual behaviour between construction workers and community Members within the Local Study Area. This is not limited to community Members getting involved in the "party atmosphere" often associated with major construction camps, but also for the potential for non-local workers to abuse and or assault local community Members. Women and youth have been identified as particularly at risk for this sort of potential interaction.

Section 5.4.1.4 details the potential for public safety issues to arise in each of the KCNs communities in addition to Gillam and Thompson. Overall, the principle source of concern is the potential for non-local Project construction workers to travel to communities in the Local Study Area during their leisure hours to socialize at the bar, restaurants, community events or in resident's homes. The impact on each community may be different, depending on its size and amenities available.

Section 5.3.2 notes that between 1984 and 2006, physician visits and hospitalizations associated with mental health and behavioural disorders increased for residents of the Local Study Area (although 10 year average annual rates appear stable as the population increased by more than the number of events). In addition, the 10 year average annual hospitalization rate (1997-2006) was statistically higher for the Local Study area in comparison to the BRHA overall. Concerns about the social problems observed during previous hydro development including increased alcohol and drug use among community members have also been noted by the KCNs. Since worker interaction issues have the potential to adversely affect individual and community mental health and well-being, mitigation measures have been proposed in Section 5.4.1.4. Mitigation measures focus on construction workers on site (*e.g.,* measures to make it more attractive to stay on site), and the KCNs communities and Gillam.

Further to this, worker-interaction presents the risk of inappropriate sexual behaviour between construction workers and community members. Although sexually transmitted infection rates were not presented in Section 5.3.2 to respect the confidentiality of communities in the Local Study Area, there is evidence to suggest that resource projects in Canada can pose public health issues through increased rates of sexually transmitted infections associated with temporary or transient workforces (Goldenberg *et al.* 2008). While the potential risk of increased sexually transmitted infections resulting from worker interaction is impossible to predict, it is suggested that discussions with the BRHA be coordinated prior to the onset of construction so that public information campaigns can be in place.

EMPLOYMENT AND INCOME

Employment and income have the potential to affect community health and well-being in various ways. Employment opportunities, for example, may provide opportunities for individuals to gain new skills and experience, which may contribute to an individual's self-esteem. At the same time, employment may create pressure on the worker's family who would be separated from the worker while they are at the construction site for several days or weeks. If a family member is away for an extended period of time, the remaining parent may be faced with greater responsibilities in managing the household, and associated increased stress (Clover Taylor and Graetzs Simmonds 2009; YFFN Future Development 2010). It is difficult to predict precisely how an individual or family will react to the outcomes of employment, although there is likely to be a balance between the potential positive and negative outcomes. The KCNs' negotiation of the JKDA and involvement in pre-project training suggest that the communities are hopeful that Members will benefit from construction employment opportunities.

Similarly, the potential increase in income for local residents who are employed during the construction phase can have both positive and negative effects. Increased income is often associated with better health and longer life expectancy. For example, increased income allows people to purchase higher quality foods, heat for homes or to pay for advanced education opportunities. Many of these factors, particularly costs of healthy foods have been identified by KCNs community Members in the community-based research as affecting current health status of community Members. On the other hand, "with more disposable income, alcohol and substance abuse problems are likely to increase" (National Aboriginal Health Organization 2008). Higher levels of disposable income have been linked to "intense drinking and drug use" in other resource projects in Canada (Goldenberg *et al.* 2010).

It should be noted that most research that shows the positive relationship between a higher income and improved health, uses data from people who have these higher incomes over longer periods of time. This is related to "higher socio-economic status", not necessarily those who experience sudden increases in income for limited periods of time (which does not necessarily change long-term socio-economic status) (Scott and Lessard 2002). Construction employment opportunities will vary seasonally and annually (see Section 3.4.1.6). While research suggests that after one or two years communities can adjust to increased income levels through an increase in social stability and improved services (National Aboriginal Health Organization 2008), without mitigation there is potential that the variations in income availability over the eight-year construction phase may not allow for a shift in community well-being to occur. That said, the mitigation measures identified in relation to public safety and worker-interaction (see Section 5.4.1.4) should help to alleviate some of the potential negative influences of new disposable income, while also putting mechanisms in place to identify and address issues if they arise. Further to this, FLCN's and YFFN's DNC for Employee Retention and Support will provide counselling services at the construction site that could be extended to a worker's family members if needed.

5.4.1.2.3 Health Services

During the construction phase there will be anywhere between approximately 100 and 1,600 workers on site at the main construction camp, while there will be approximately 100 employees at the south construction camp at any point in time. Although there will be emergency health services provided on site for accidents, more serious incidents may require treatment in Gillam, Thompson or Winnipeg where a broader range of services are provided. Similarly, the resident construction workforce may require medical care for minor ailments from time to time, and may choose to access services in the Local Study Area. Section 4.4.1.3 notes that infrequent use of health services in Gillam or Thompson are likely to be accommodated by the existing services. As noted in Section 4.4.1.3, the main construction camp will provide some health care services, largely in relation to emergency medical response. This includes the provision of a minimum of two accredited primary care paramedics on duty at all times, in addition to one on-shift advanced care paramedic during the day shift. Emergency medical and ambulance services will be available 24 hours a day, seven days a week. Further to this, there will be a health monitoring clinic to manage things on site such as flu outbreaks or other situations that could affect the camp occupants. There may be some health issues, particularly as it relates to diagnostics[1] that are referred to the hospital in Gillam or Thompson.

5.4.1.2.4 Mitigation

There are no specific mitigation measures proposed directly related to community health; however those measures identified in relation to public safety and worker interaction, to travel, access, and safety, to culture and spirituality, and to infrastructure and services should help to alleviate some of the potential pressures that could affect community health and well-being. It also is suggested that discussions with the BRHA take place prior to the onset of construction to help them prepare and plan for the construction

[1] In Manitoba primary care paramedics and advanced care paramedics only provide services as per the Emergency Medical Response and Stretcher Transport Act C.C.S.M. cE83 and the Land Emergency Medical Response System Regulation 22/2006.

period, including the potential need for public information campaigns to address such issues as sexually transmitted infections.

5.4.1.3 Mercury and Human Health

Section 5.3.3 described the risks to human health associated with mercury in the existing environment. To briefly reiterate, mercury is a naturally occurring metal found in the environment and occurs naturally in the soil around Gull and Stephens Lake and in the fish found in these lakes and other lakes in the region. One form of mercury, called methylmercury, can bioaccumulate (build up and become more concentrated at higher levels in the food chain). For people, the vast majority of exposure to methylmercury is through the consumption of fish. Fish with the highest methylmercury[1] levels tend to be the large and long-lived predatory fish; however, most fish contain some levels of mercury. Fish that often contain higher levels of mercury include lake trout, burbot, jackfish and pickerel, depending on the localized environment (see AE SV). Mercury accumulates mainly in the tissue of fish, although it is also present in other organs.

Without the Project, it is assumed that the current levels of mercury in traditional food sources such as fish, wild game, furbearers, and waterfowl would remain at similar levels to today, and that similar consumption guidelines would prevail (see Section 5.3.3 for guidelines). With the Project, flooding of soils is expected to release mercury into the environment and food chain (see PE SV for further details regarding flooding and the total area expected to be flooded).

There are no anticipated effects of the Project during the construction phase in relation to mercury and human health. Although impoundment will commence in the latter years of the construction phase, increased mercury levels in the environment do not occur until 3-7 years after impoundment, which occurs during the operation phase. Communication products on existing mercury levels in country foods (which coincide with the construction phase) have been described in Section 5.3.4. Communication products on increased levels of mercury in country foods (applicable during the operation phase) and consumption recommendations will be prepared through the Monitoring Advisory Committee (MAC) and distributed to local communities just prior to impoundment – these are detailed in Section 5.4.2.3 below.

5.4.1.4 Public Safety and Worker Interaction

In the Local Study Area, construction of the Project may result in effects to public safety arising from Project activities. These effects may arise primarily due to two main pathways of effect: 1) the influx of non-local construction workers, and 2) the availability of new and sporadic disposable income for residents employed during construction. Potential effects, if they arise, would likely be confined to the construction period, since the main pathways relate to construction employment.

[1] From this point forward for ease of reading, reference to methylmercury is shortened to mercury, unless otherwise noted.

CONSIDERATIONS IN EVALUATING EFFECTS TO PUBLIC SAFETY

The principle sources of concern for potential adverse effects to public safety from worker interactions relate to Project construction workers who travel to communities in the Local Study Area during their leisure hours to socialize at the bar, restaurants, community events or in residents' homes. In order to assess the potential for adverse effects it is important to understand the number, timing and location of construction workers, factors that affect where workers choose to spend leisure time and the social context of the potentially affected communities.

THE NUMBER, TIMING AND LOCATION OF CONSTRUCTION WORKERS

More than 90% of the total construction workforce is expected to be based at the main construction camp located on the north side of the Nelson River near the end of the north access road. Workers will be based at the main construction camp over the entire construction period with the quarterly peak number varying from 110 towards the end of construction to over 1600 in the middle of 2016 and 2017 (see Table 5-20). There are estimated to be in excess of 1000 workers at the main construction camp for most of the period between 2016 to 2017. During 18 consecutive quarters from the third quarter of 2014 to the fourth quarter of 2019, more than 500 workers are expected to be living in the main construction camp, with peak quarterly estimates of over 1,000 workers during seven of these quarters.

Table 5-20: Main Construction Camp Quarterly Employment Peaks

Quarters/Years	2014	2015	2016	2017	2018	2019	2020	2021
Q1	0	291	598	532	603	596	319	123
Q2	123	450	1,167	1,615	1,071	613	312	145
Q3	503	498	1,610	1,522	1,019	638	323	146
Q4	404	536	1,135	924	849	509	262	110

Notes:
- Derived from data provided by Manitoba Hydro, 2010.
- The quarterly peak numbers include Contractor Supervisory and Manitoba Hydro Site Staff.
- The Project is scheduled to start in June 2014 and finish in March 2021. Quarterly employment peaks for Q2, Q3 and Q4 of 2021 include main camp decommissioning, security, catering, first aid, maintenance, employee retention and support job categories.

It is likely that some workers will leave the Project site for leisure time visits to communities with amenities including shopping, banking, bars, liquor vendors, hotels and restaurants. The nearest communities with these types of amenities are Split Lake, Gillam, and Thompson. Traveling to these communities would involve traveling from the main construction camp along the north access road and onto PR 280.

Less than 10% of the total construction workforce will be involved in building the south access road and south dyke. These components of the Project are located on the south side of the Nelson River and will be accessed from Gillam via the Butnau Road and the South Access Road. This will consist of approximately 100 people including construction staff, service staff (catering, security, first aid, *etc.*) and Manitoba Hydro employees starting in Q3 2014 until Q3 2015 (not inclusive of the time required to set-up the camp). Gillam would be the main choice available for these workers looking for offsite leisure-time amenities. Construction of the south access road and south dyke has a much shorter duration and involves a much smaller workforce than construction activity occurring on the north side of the Nelson River. As this contract to develop the south side access road is identified as a potential DNC for CNP, a sizeable portion of the workforce is expected to be comprised of Members of KCNs communities. Still, even an influx of a small number of non-local workers poses the potential for negative interactions with community members.

FACTORS INFLUENCING LEISURE TIME DECISIONS

The decision by workers to travel in their off hours will depend on a number of factors. Some factors will influence them to remain in the camp, while others will serve to push them away from the camp towards a nearby community. Where workers decide to go will also depend on how much time off they have *(e.g.,* evening vs. day off), the location of the amenities they seek and the distance they have to travel.

- **Working hours:** The Burntwood Nelson Agreement indicates that most workers will work 10 to 12 hour days, six days a week and have only one day off, typically Sunday, although the exact working hours for the general civil contract will not be finalized until after the contract is awarded. This limits the amount of leisure time workers have available to make offsite trips, particularly for the main construction camp, which is a considerable distance from Gillam or Thompson, and less than 100km from Split Lake (see Table 5-21). Such trips are most likely to occur on the evening before their day off and the following day when they are not working. End of shift visits for leisure amenities outside the main construction camp are less likely due to the long work days and distances from the camp to the nearest communities. Exceptions could be workers who have spare time while waiting for commercial flights or out-of-province workers who may have extended periods of time off *(e.g.,* one week) depending on the terms of the general civil contract.
- **Leisure amenities at camps:** The main construction camp will have a lounge and high quality recreational facilities and programming on site. It will also provide free meals for workers. These factors are expected to result in a large portion of workers choosing to remain at the camp during off-hours and not wanting to go offsite for leisure amenities, particularly during their shifts. The situation is different for south side construction activities that will be accessed from Gillam. Because of its size and the short duration of the south access road/south dyke construction activities, the camp is unlikely to have a bar and recreational facilities. Workers would have to leave the camp area to find leisure amenities.
- **Travel distances to communities with amenities:** Split Lake is the closest community to the Project, at approximately 72 km from the main construction camp, and offers a few amenities such as a gas bar, Northern Store, and fast food outlet. Thompson and Gillam have the key leisure

amenities that workers would be seeking, *e.g.*, shopping, banking, bars, restaurants, hotels, liquor vendors and recreational facilities. The return trip to/from Gillam will take about three hours total while the return trip to/from Thompson is about an hour longer. These long travel times will likely constrain evening-only visits, but in the event workers did choose to leave the main camp in the evening it is likely they would choose to travel to Split Lake or Gillam because they are closer. For visits on off-days, either Gillam or Thompson would be feasible.

- **Services and amenities available in the Local Study Area:** Thompson offers a much greater number and variety of the amenities typically sought by construction workers than does Gillam, making it a much stronger attraction for workers (see Table 5-21). The greater selection of available amenities is likely to result in more workers at the main construction camp choosing to travel to Thompson for day-off visits, despite the somewhat greater travel time. However, some workers may still choose to travel to Gillam.

From the south access road, Gillam will be much closer than Thompson for making off-hour visits. If the camp is located near the community, the travelling time will be virtually negligible; and if located away from the community, travelling time will be under 40 minutes. Gillam will be close enough that workers could easily make the two-way trip to and from Gillam on evenings after finishing the shift for that day. Because of their lack of relevant amenities, Fox Lake is not expected to attract off-hours construction workers, although some visits may be made simply to see the communities. In the case of Split Lake, some off-hour visits may occur to access the gas station and Northern Store as well as to see the community. There may be some interest in fishing on lakes in between the construction site and these communities.

Table 5-21: Leisure and Recreation Amenities of Communities in the Local Study Area[1]

	Gillam	Thompson	Fox Lake	Split Lake[2]
Leisure Amenities Sought by Workers	1 bar 1 vendor 1 liquor store (ltd) 2 hotels 2 restaurants 1 gas station Fishing on Stephens Lake	10 or more bars and lounges 2 or 3 beer vendors 1 LCBO 7 hotels, 2 hostels, 1 B&B 30 or more restaurants 5 or more gas stations	Fishing Dry community	1 hotel 1 store 1 gas station 1 restaurant Good fishing lakes Dry community
Distance via North Access Road[3]	142 km	208 km	130 km	72 km
Distance via South Access Road[4]	0 to 17 km[5]	337 km	88 km	201 km

Notes:
1. Only communities with all-weather road access in the Local Study Area are included.
2. Refers to TCN at Split Lake.
3. Distance from main construction camp to a community.
4. Distance from the south construction camp to a community.
5. The precise location of the south access construction camp is yet to be determined. The range presented is from a) just outside the town of Gillam to b) near the Butneau Dam.

In addition to the above factors, the overall size of the community also requires consideration. Although Split Lake has a larger population than Gillam and is located about 72 kms from the north camp, the community may be more sensitive to visits from non-local workers as this is not as common an occurrence as it is in Gillam and Thompson. Thompson's population is over 10 times larger than Gillam and as such the effects of workers visiting the community are more likely to be buffered than in a smaller community. This is not to say that KCNs Members residing in Thompson are never going to experience any form of worker-interaction, rather that there may be fewer opportunities for interactions to occur due to the relative size of the community. Gillam is a smaller community and as such is more likely to notice a non-local workforce. FLCN Members living in the community have experienced serious negative impacts from past hydroelectric projects as a result of interactions with visiting construction workers. This combination of factors makes FLCN Members living in Gillam much more vulnerable to worker interaction problems than what people in Thompson and perhaps even the rest of Gillam may experience. A relatively small number of incidents could have a damaging effect on the FLCN population in their home community of Gillam.

5.4.1.4.1 Keeyask Cree Nations

The KCNs' past experience with hydroelectric projects such as Kettle, Long Spruce and Limestone generating stations indicate that influx of non-local workers can result in a broad array of adverse effects on public safety for those residing in communities close to the developments, as described in Section 5.3.3. FLCN expects effects from the Project similar to effects experienced during past projects.

EFFECTS RELATED TO WORKER INTERACTIONS

The presence of a temporary workforce leads to concerns about the potential for harmful interactions between workers and vulnerable community members. The potential for these interactions also leads to broad concerns about adverse effects on general public safety in the community. Adverse effects on public safety can also change how community members feel about the community, leading to impacts on community cohesion and well-being. TCN has expressed concerns that non-local workers will visit Split Lake as it is the closest community to the north construction camp, is en route to Thompson and offers amenities such as a gas station, northern store and fast food outlet. With these visits, there is potential for adverse interactions with community Members, with particular concern expressed in regards to women. FLCN Members have identified potential adverse effects of construction worker interaction with community Members, in particular women and youths, as their greatest concern associated with new major projects being developed in their traditional territory. YFFN has noted that many of their youth attend high school in Thompson and there is the potential for adverse interactions with construction workers. The communities' concerns are based on direct experience with the construction of previous hydroelectric generation projects, with FLCN's experience centred in the Gillam area (see Section 5.3.3.3). With respect to the changed perceptions, Vanclay (2007) indicates, "the impacts that will likely result from these change processes are changed perceptions about the nature of the community, changed perceptions about personal attachment to the community, and possibly annoyance and upsetness as a result of the project."

The KCNs' past experience with hydroelectric projects such as Kettle, Long Spruce and Limestone generating stations indicate that influx of non-local workers can result in a broad array of adverse effects on public safety for those residing in communities close to the developments, as described in Section 5.3.3. TCN and FLCN have expressed concerns that effects from the Project will be similar to effects experienced during past projects.

EFFECTS RELATED TO INCREASED DISPOSABLE INCOME

Increased disposable income may lead to inappropriate spending on alcohol and drugs and associated effects on health, well-being and public safety. New income and the "boom and bust" cycle that a major construction project creates will result in relatively short-term periods of increased (high paying) opportunities. Past experience with resource development projects across North America, including the KCNs' past experience with hydro development indicate that increases in disposable income can result in increased spending on activities that are deleterious to the health, well-being and safety of individuals, families and communities. The KCNs have expressed concerns about new income providing increased disposable income to spend on things that might otherwise not be afforded, such as alcohol and or drugs.

COMBINED EFFECTS OF WORKER INTERACTION AND INCREASED DISPOSABLE INCOME

These two pathways can have combined effects. The correlation between alcohol and violence/aggression has been documented by many (Bushman 1993; Chermacks *et al.*, 1997; Parker Nash and Auerhahn 1998), as well as witnessed within the KCNs community context (FLCN KPI Program 2009-2011; TCN 2010). The potential for aggressive and even violent behaviour that threatens an individual or group's safety is at the root of the KCNs concerns. Social and health effects have been known to follow heavy use of alcohol, including a large percentage of crimes such as assaults that relate directly or indirectly to drug and alcohol abuse (Gibson and Klinck 2007). Such concerns are common to development projects across Canada, in particular where Aboriginal communities are located in proximity to worksites (Goldenberg *et al.* 2007; Vanclay 2002).

Workers may or may not be prepared for the intense work regime (long daily routine, little time off during work rotation schedule), the separation of living in a work camp (away from their home community), and the sudden increase in income. These conditions may result in stress for some workers. Substance abuse is a known coping factor for stress (Gibson and Klinck 2007), with alcohol in particular identified as a coping mechanism for a host of issues (Gallo *et al.* 2001; Holahan *et al.* 2003; Ofrord *et al.* 2001; Martin *et al.* 2003). Concerns around alcohol include the fact that the KCNs communities are dry communities and alcohol is not readily available. An increase in income and access to a lounge on the construction site may provide KCNs Members with access to alcohol they are not accustomed to having in their home communities.

The presence of temporary construction workforces is often associated with a 'work hard, play hard' mentality (Vanclay 2002), which can exhibit itself in 'binge partying' that is bolstered by the availability of disposal income (Goldenberg *et al.* 2007). FLCN noted the community identified the "arrival of outside workers and abundance of alcohol as two of the most detrimental effects of the Kettle Project" (FLCN 2009 Draft). CNP noted concerns regarding the risk to women associated with the presence of a construction workforce (CNP Keeyask Environmental Evaluation Report). The availability of new income also poses an opportunity for spending on substances other than alcohol, and the presence of illicit drugs and associated gangs is also known to occur in tandem with major projects (The Economist 2007; Shandro *et al.* 2011). The KCNs feel that this may pose a particular risk for youth in their communities (CNP 2010b; FLCN KPI Program 2009-2011; YFFN KPI Program 2009-2010).

The temporary/transient nature of construction workforces exacerbates conditions for several reasons. First, work in remote locations is often most feasible for individuals with limited financial responsibilities *(e.g.,* no families) (Gibson and Klinck 2007). Second, higher than average levels of disposable income have been known to contribute to a disproportionately high amount of wasteful, "if not socially abusive" (Hobart 1982) spending on things such as alcohol and or drugs (Goldenberg *et al.* 2007), in part because of a lack of alternative expenditure opportunities. In addition, construction workers, in particular those who are not drawn from the local workforce, do not develop an affiliation or attachment to the location, which can result in behaviours that might not be exhibited in their 'home' communities (Vanclay 2002; Goldenberg *et al.* 2007). Service providers in the oil and gas industry in Northern B.C. have described how this affects the local community in saying "the influx of workers (erodes) a local sense of community, negatively affecting the ways in which people related socially and sexually" (Goldenberg *et al.* 2007).

This, in combination with past experience with the construction of hydroelectric projects, has resulted in concerns about worker interaction, particularly in relation to workers visiting communities to "party" and interacting with local community members, in particular young women and youth. From TCN's and FLCN's perspective, it is not a question of 'if' such effects will occur, but rather a question of 'when' (FLCN KPI Program 2009-2011; CNP, *pers. comm.* 2012). This is particularly relevant as the social impacts of project-development "tend to be more prominent in small (communities)" (Lawrence 2004).

In summary, adverse worker interactions and increased alcohol and drug use both present a potential risk to the safety of individuals, families, and communities as a whole. Public safety effects resulting from negative worker-interactions are particularly relevant to those communities in closest proximity to the Project, namely Gillam, whose population consist of a substantial number of FLCN members, and Fox Lake (Bird), and Split Lake. The KCNs have also noted that their Members residing in Thompson have the potential to come into contact with non-local workers. Effects stemming from the misspending of new income on alcohol and drugs have the potential to affect any individual working on the Project.

5.4.1.4.2 Gillam

The Project-related effects to public safety in Gillam are similar to those described for the KCNs. Gillam residents, however, sometimes hold different perspectives on issues related to worker-interaction. Some Gillam residents, including some who have resided in the community through the construction of previous hydroelectric projects, perceive the construction employment as an opportunity for the community to benefit from influx of new people. Further, some residents also see this as an opportunity for local businesses and the local social scene to flourish (Gillam KPI Program 2009-2010). This difference in perspective highlights the fact that context is crucial in understanding socio-economic effects, and that individuals may experience the same effect in different ways (Lawrence 2004).

Some workers are likely to make trips to Gillam, despite the limited number of amenities available. The number of visits cannot be reliably predicted. However, for the following reasons the number of visits is expected to be small:

- Availability of a lounge, recreational facilities and programming at the main camp;
- Thompson offers substantially more amenities than Gillam with little added travelling time for workers at the main construction camp; and
- Fewer workers will be employed on south access construction activities that will make Gillam the most accessible community (see Table 5-21).

Most visits by construction workers would likely be benign with no occurrences of adverse effects. However, based on TCN and FLCN knowledge, a proportion of the visits could still result in some adverse public safety effects as a result of interactions between construction workers and residents (see Section 5.3.4.1). The following points are also worth noting:

- Problematic encounters with construction workers would not be limited to FLCN Members. These interactions could extend to other Aboriginal and non-Aboriginal residents of Gillam, including family members of Manitoba Hydro employees living in the community;
- Construction worker visits to Gillam and or Split Lake may cause an increase in traffic on PR 280, PR 290, the access road into Split Lake and the Butnau Road, which could result in increased traffic accidents. This could be particularly problematic if workers drive back to the construction site after consuming alcohol;
- Workers arriving in or leaving Gillam by plane or bus have been identified as a potential source of worker interaction problems; and
- While the current Gillam and Thompson RCMP caseload is considered manageable, additional call-outs as a result of worker-interaction issues in Gillam or Split Lake could strain their capacity.

The number of workers involved in building the south access road and south dyke will be quite small and the south access road specifically is a DNC for CNP, meaning that many employees may be KCNs Members; however, because of the proximity of Gillam and lack of recreational facilities or lounge at the camp, workers are likely to visit Gillam in the evening after work. As such, the prospects of interacting socially with residents are increased, raising the potential for problems arising from the interaction of community members and construction workers.

5.4.1.4.3 Thompson

The majority of construction workers from the main construction camp seeking amenities outside of the camp, particularly during their days off hours, are likely to travel to Thompson, due to the superior number and variety of services and relatively small additional travelling time. Given that Thompson is the largest community in the Local Study Area, effects are more likely to be buffered than in a smaller community. As noted in Section 3.3.1.4 the economy in Thompson is more diverse than other communities in the Local Study Area. The fact that Thompson already hosts various short term and contract workers also suggests that it would be difficult to observe or determine whether worker-interaction/public safety issues are directly attributable to Project-construction.

Irrespective of how Project effects to public safety could be measured in Thompson, it is important to note that the KCNs have expressed concerns in this regard in relation to their Members who reside there.

5.4.1.4.4 Mitigation

Due to the concerns of the KCNs in relation to public safety and worker interaction, in particular for FLCN in relation to Gillam and TCN in relation to Split Lake, a suite of mitigation measures were developed. Mitigation includes preventative measures, mechanisms to assist people in coping should negative effects arise, and monitoring to determine if further mitigation measures are required. Mitigation is geared not only towards the KCNs, but also to construction workers on site, and the broader community in Gillam. Additional mitigation measures are noted under Population, Infrastructure and Services Section 4.4.1.3.

MITIGATION MEASURES AT THE CONSTRUCTION SITE

Several activities will be undertaken at the main construction camp to reduce the potential risk for adverse effects to arise. For example, facilities will be provided to ensure that construction workers have recreational options on site to minimize the attractiveness of going into Gillam for entertainment. Amenities available on site will include a lounge, a gym, exercise equipment, and a TV viewing area, similar to the amenities available at the Wuskwatim construction camp. In addition, individual rooms will be equipped for cable and or internet hook-up, should workers want to bring a TV or computer for their personal use. The recreational facilities at the main construction camp will be restricted to employees working on site, and unauthorized public visits to the camp will be restricted. A staffed security gate will prevent unauthorized visitors to the main construction camp, and the south access road will also be a private road for the duration of construction *(e.g.,* there will be no public access to the road).

Other mechanisms to encourage construction workers to stay on site include discouraging non-northern workers from bringing their personal vehicles to site and restrictions on using company vehicles for personal purposes. A shuttle service to- and from- airports in Gillam and Thompson will be provided to ensure workers can arrive at the site to start their shifts. As a part of orientation for all workers at the main site, workers will be required to participate cultural awareness training as a part of the Employee Retention and Support DNC expected to be implemented by FLCN and YFFN. This will provide opportunity for the KCNs to explain parts of their culture, and their community's histories with hydroelectric development. In addition, this will provide an opportunity to describe local expectations for respectful behaviour by construction workers both on site and when visiting communities. Cross-cultural training was developed and provided by NCN at the Wuskwatim construction camp, and thought to be a successful mechanism to promote understanding within the workforce. The cross-cultural and retention support contract at Wuskwatim also included provisions for on-site counselling for employees. The Employee Retention and Support Contract is being developed in consultation with YFFN and FLCN and will also include a counselling component.

MITIGATION MEASURES FOCUSED ON PREVENTION AND COPING

Measures addressing prevention and coping are focused primarily on Gillam and Fox Lake (Gillam and Fox Lake (Bird)) and Split Lake. Considerable uncertainty exists concerning the expected number of visits by non-local construction workers in Local Study Area communities (especially Gillam) and the expected number and types of adverse occurrences. Ongoing dialogue between Manitoba Hydro and Gillam and Thompson RCMP, who are responsible for policing in the KCNs communities, during the construction phase will assist in identifying whether worker interaction is an issue in Gillam, in other

KCNs communities (*e.g.,* Split Lake) or in Thompson. Discussions will also begin prior to the start of construction among Manitoba Hydro, the Town of Gillam, FLCN and TCN to determine the best mechanism for tracking and addressing worker interaction issues and concerns across all of Manitoba Hydro's proposed projects in the vicinity of Gillam. It is anticipated that local justice and social agencies will be involved in these discussions, where appropriate, to gather data and to participate in the development of suitable mitigation measures.

5.4.1.5 Travel, Access and Safety

Section 5.3.5 described the existing environment regarding travel, access and safety within the Local Study Area. Without the Project, it is expected that the present water and ice conditions, and the way that people use the waterways, would continue as in the past. The open water regime (flows, velocities and levels) on the Nelson River, which has been modified by the LWR and CRD projects, would continue as it currently exists and winter ice processes on the river would also continue to vary from year to year depending on specific water flows and meteorological conditions (PE SV).

In the Local Study Area, construction and operation of the Project and related activities may affect the waterways, roadways and trails. These activities could impede travel along the Nelson River, affect shoreline access, affect navigation safety on the river and increase traffic levels and associated traffic accidents. As the pathways of effect for travel on waterways are different from the pathways for travel on land, the effects on access and safety for water and ice-based travel and road-based travel are considered separately.

The key traffic routes in the Local Study Area, PR 391 and PR 280, will continue to be maintained by Manitoba Infrastructure and Transportation (MIT) and traffic volumes will vary according to the fluctuations of the local populations using the highways. As noted in Section 5.2.5.1, Project-related traffic has the potential to affect overall safety of the public travelling on PR 391 and PR 280, but also the condition of the highways.

There is limited potential for measurable effects to roadways in the Regional Study Area *(e.g.,* PTH 6). This is due to the existing traffic volumes and road design criteria of accommodating 6,000 vehicles per day. As such, while PTH 6 is described in the environmental setting (Section 5.3.5.1) it is not carried forward to the effects assessment.

5.4.1.5.1 Water / Ice-based Travel

Resource harvesters and others who use the Nelson River for transportation and for traditional activities such as hunting, fishing and trapping could be affected by Project-related effects on water and ice travel, access and safety. In general, boat and snowmobile access and travel will be restricted in areas where construction activity is occurring to ensure safety of both construction workers and the resource users likely to travel through the area. Restrictions can be anticipated in relation to the construction of the cofferdam, dykes, and the south access road. There are very few resource users currently travelling on open water and ice on waterways in the immediate vicinity of the construction site *(e.g.,* in and around

Gull Rapids and the immediate vicinity), but those that do will have to modify their travel patterns while construction is taking place.

Other construction activities that could affect water/ice based travel include:

- **Changes to water flows associated with construction of cofferdams**
  - The presence of the cofferdams will cause the water in the vicinity of the Project to flow through a channel that is much narrower than the existing channel. Flow rates will increase making travel through the channel even more hazardous than existing conditions, which are already described as dangerous by the KCNs (see Section 5.3.5); and
  - Construction, along with the presence of the cofferdams, will mean that access will be restricted to prescribed shoreline areas and landing sites on the north shore of the Nelson River in the immediate vicinity of the Project.
- **Installation of the ice boom**
  - An ice boom to protect the construction area from ice will be installed in the central part of the river. Boats travelling along the river will have to travel near the shoreline and avoid the middle of the river. A gap of about 80 m between the ends of the boom and each river bank will allow boat access around the boom during the open-water season.
- **Reservoir clearing**
  - Although the purpose of reservoir clearing is ultimately related to improved safety during Project operation, the activity itself will remove trees and alter the landscape during construction, including trails used for accessing the river.

KCNs Members are the predominant users of the waterways up and downstream of the Project. Waterways are an important cultural and economic resource for KCNs Members and have been an integral part of their traditional activities. For several decades, Manitoba Hydro and signatory First Nations to the Northern Flood Agreement have been implementing programs to facilitate safe travel under open water and ice conditions on the Nelson River. Through these programs, much has been learned about what is required to ensure safe travel along the river.

During construction, the Project will affect accessibility and navigation in areas where and when construction is occurring. Implementation of the Keeyask Reservoir Clearing Plan and Waterways Management Program (Schedule 11-1 and Schedule 11-2 of the JKDA respectively) will mitigate potential effects on water travel upstream, downstream and in the vicinity of the Project. These plans, developed jointly with the KCNs and Manitoba Hydro, build on previous experience and will help to accommodate existing users of the Nelson River and manage safety liabilities associated with the Project. In addition, each of the KCNs has negotiated AEAs with Manitoba Hydro to enable resource harvesting activities to occur in areas not affected by the Project.

MITIGATION

Notable features for addressing construction related effects on water and ice travel include:

- Posting signs on access trails, shorelines and in waterways identifying restricted access areas and warning of potentially dangerous boating and snowmobiling (PD SV);
- Identification of safe water and ice routes and use of safety signage and buoys to mark these locations. Their condition will be regularly monitored as well as the extent of their use (WMP);
- Identification of areas where water or ice travel is unsafe using signage and buoys to mark these locations (WMP);
- Operation of a multi-purpose boat patrol that will monitor waterway activities and liaise with individuals and groups using the Nelson River (WMP);
- Issuance of timely, community notification bulletins to inform local users about the disruptions around the Project footprint (PD SV). This will enable local users to plan their travels accordingly;
- Safe trails and portages will be cut and maintained (WMP);
- Installation of strategically located safety cabin and shelters (WMP);
- Undertake, maintain and monitor shoreline stabilization measures at sensitive stream locations (WMP);
- Development of a number of safe landing sites along the future reservoir shorelines to facilitate access that has been compromised by Project activities. These sites will be cleared of stumps, peat and other vegetation to ensure safe access/egress to the shoreline; and will include required docks and shelters (WMO); and
- Ice monitoring and water gauges for measuring water levels to assist in establishing safe and unsafe travel areas (WMO).

Concerns have been raised about the ability of KCNs Members working on Project construction jobs being able to access the job site by boat or snowmobile from the Nelson River. There are no major snowmobile trails (or networks of trails) in the vicinity of Gull Rapids however one KPI respondent noted that if a road is constructed from the town to the Project site, then more trails might be created in the area (Gillam KPI Program 2009-2010). For safety reasons associated with a major construction site, access to the Project site will be restricted to using the north and south access roads only. The Access Management Plan already developed and being implemented for the Keeyask Infrastructure Project will control access by land on the north side of the Nelson River to the Project site and waterways located near the construction site (Keeyask Hydropower Limited Partnership 2009); and the Keeyask Construction Access Management Plan will cover the operation of the north access road and the construction and operation of the south access road. Unauthorized use of the north access road and its extension to the ice boom area, as well as the south access road will be controlled through security protocols (*e.g.,* security gates and guards) and restrictions for firearms and access. In terms of use of Stephens Lake from the Gillam area for recreational use (including fishing), the majority of the lake will be unaffected by construction activities. The exception will be an area in the immediate vicinity of Gull Rapids where construction activities will take place. Appropriate safety signage and community notification in Gillam will provide the necessary warning to recreational users to avoid the area around Gull Rapids.

It should be noted that YFFN has expressed concerns related to travel safety related to ice and open water travel across Split Lake as their Members will be using these means to access transportation to the site for Project employment. Manitoba Hydro does not expect any Project-related changes to open water travel on Split Lake during the construction or operation period; and expects effects to the ice regime on Split Lake infrequently (*i.e.,* on average every 20 years) during the operation period (see PE SV). It is anticipated that current conditions on Split Lake will continue throughout these time periods.

No additional mitigation measures are required to address construction effects related to water travel, access and safety.

5.4.1.5.2 Road-based Travel, Access and Safety

Increases in traffic volume due to construction activities could affect road conditions and the safety of road users. This section examines the nature, extent and effects of Project-related construction traffic.

LOCAL STUDY AREA

During construction, effects on road travel will stem from increased vehicular traffic associated with delivery of materials, equipment, and construction personnel and travel by construction service providers on public roads in the Local Study Area. Increased traffic volume on public roads could affect the condition of the roads and traffic safety.

Existing roads between Thompson and Gillam along PR 391 and PR 280 will be affected. These are shown on Map 1-1 Socio-Economic Local Study Area. The distance between relevant junctions and communities in the Local Study Area is shown in Table 5-22.

For purpose of assessing the effects of Project-related construction traffic, the potentially affected roadways have been divided into four road sections:

- Road Section 1 (PR 391): Thompson to PR 280;
- Road Section 2 (PR 280): PR 391 to Split Lake Junction;
- Road Section 3 (PR 280): Split Lake Junction to Keeyask Junction; and
- Road Section 4 (PR 280): Keeyask Junction to PR 290.

Background traffic levels (under existing conditions) for these road sections are presented in Section 5.3.5. Due to the seasonal variation of background traffic flow, the estimates for Project-related traffic are shown for both summer and winter. The north and south access roads will be private roads to the Project during construction, with traffic restricted by a security gate to those with authorization to use the roads. The north access road, which will have been built as part of the Keeyask Infrastructure Project, will be in place and ready for use from the start of Project construction. The south access road is being built as part of the Project and will be operated as a private road during the construction phase.

A Project Construction Access Management Plan will be in place prior to construction to address the ongoing implementation and maintenance of the north access road, and access related to the south access road. Similar to the north access road, the south access road will remain a private road until the end of the construction phase, and will be gated to prevent public access.

Project-related traffic will be generated to move freight (equipment and materials), construction workers and contractors providing incidental services. The vast majority of this traffic is expected to travel between Thompson and the Project, along PR 391 to the PR 280 junction and along PR 280 to the north access road junction. A small portion is expected to originate at Long Spruce Siding and Gillam and approach the Project site from the northeast (KGS-Acres 2010). Detailed summer and winter forecasts of Project related traffic levels were developed to assess the effects of construction traffic on infrastructure and travel safety. The forecasts are based on the following assumptions:

- Project-related traffic would access the Project site from the north side of the Nelson River via PR 280;
- The Project traffic would travel from Winnipeg, Thompson, Split Lake, Gillam or other communities, before turning onto the north access road;
- All traffic during construction is assumed to access the Project site via PR 280 with the exception of materials required for the construction of the south dykes and associated access road. A very small proportion of the Project-related traffic is expected to use this route (KGS-Acres 2010); and
- Travel between the north access road and the south access road across the Nelson River would not occur during the construction phase.

The Project-related traffic projections are organized by three categories:

- Heavy trucks hauling freight;
- Incidental support service vehicles traveling to the camp and construction work areas; and
- Vehicles transporting people to and from the Project site.

Freight Traffic

Freight traffic includes heavy transport trucks hauling bulk cement, fuel, reinforcing steel, heavy construction equipment, construction supplies and equipment for installation in the generating station. It also includes trucks used to haul construction camp buildings, catering supplies and miscellaneous items associated with the Project. Projected traffic volumes are based on estimates of the amount and size of equipment and materials required for construction and shipped from manufacturers and suppliers to the

Project. It does not include traffic to move aggregate materials as this will all occur on roads dedicated to Project traffic, not on public roads.

Incidental Service Traffic

Incidental service traffic is intended to cover routine traffic providing various services to the camp and construction work areas. It potentially includes removal of recyclable refuse, mail/courier, venders/suppliers, commercial service vehicles and visitors traveling to and from the site each day. The estimated volumes of traffic for this category were based on experience and judgment. The forecast for incidental service traffic has been assumed to be constant over the duration of the Project, although it may be somewhat lower in years when construction activity is lower (KGS-Acres 2010).

Construction Personnel Traffic

The labour force for the Project will be made up of personnel from various local communities, including Thompson, Split Lake, York Landing, Ilford, Gillam (including FLCN), and other northern Manitoba communities. Workers from the south are expected to fly to Thompson or Gillam and then be transported to the Project site by shuttle transportation. Virtually all workers will live at the construction site while on the job. This means most will travel to and from the site at the beginning and end of their shifts. The forecasts for shuttle vehicle usage and personal vehicle usage were based on experience and judgment and were calculated based on the 2008 monthly manpower estimate for the Project (KGS-Acres 2010).

Table 5-22 below summarizes what sources of traffic are expected in each road section based on the assumptions presented above.

Table 5-22: Roadways Used by Project Traffic

Road Section 1 (PR 391): Thompson to PR 280	• All of the freight for the Project • Incidental service vehicles for both projects traveling from Thompson and south of Thompson • Construction personnel for the Project traveling by personal vehicle from Thompson and any point south of Thompson
Road Section 2 (PR 280): PR 391 to Split Lake Junction	• All of the freight for the Project • Incidental service vehicles for the Project traveling from Thompson and south of Thompson • All construction personnel for the Project traveling by personal vehicle or shuttle bus via Thompson
Road Section 3 (PR 280): Split Lake Junction to Keeyask Junction	• All of the freight for the Project • Incidental service vehicles for the Project traveling from Thompson and south of Thompson • All construction personnel for the Project traveling by personal vehicle or shuttle bus via Thompson and the Split Lake area
Road Section 4 (PR 280): Keeyask Junction to PR 290	• All of the incidental service vehicles for the Project traveling from Gillam • All construction personnel for the Project traveling by personal vehicle or shuttle bus from Gillam

Source: KGS-Acres (2010).
Note:
- Personnel traffic attributable to the small number of workers who might fly into Gillam and be transported out to the Project site could not be predicted and is not included.

Project-related traffic projections based on the above considerations are presented in Table 5-23 for each road section and season during construction. This table also shows how the projected volumes compare to background volumes and what the combined projected and background volumes are estimated to be[1]. Table 5-24 illustrates the percentage increase in traffic on each road section and in each season during construction from Project-related freight traffic, which is the source of greatest concern for wear and tear and road safety (including the potential for accidents with other users of the road).

[1] Since the traffic projections were completed in 2010, workforce estimates were updated. A supplemental filing will be undertaken to update the traffic projections. It should be noted that these estimates are not expected to produce materially different percentage increases in traffic levels due to the Project; however, absolute numbers will change. The estimates are reasonable data for which to undertake the traffic assessment and are not expected to change the conclusions.

Table 5-23: Forecast of Combined Background and Project-related Traffic (2014-2021)

	Road Section 1 (PR 391) Thompson to PR 280			Road Section 2 (PR 280) PR 391 to Split Lake Junction			Road Section 3 (PR 280) Split Lake Junction to Keeyask Junction			Road Section 4 (PR 280) Keeyask Junction to PR 290		
	BG Traffic	Project Traffic	BG and Project Traffic	BG Traffic	Project Traffic	BG and Project Traffic	BG Traffic	Project Traffic	BG and Project Traffic	BG Traffic	Project Traffic	BG and Project Traffic
2014 Summer	518.9	11.8	530.7	108.6	13.7	122.3	96.9	19.2	116.1	39.2	4.4	43.6
2014 Winter	432.4	8.6	441.0	88.3	9.6	97.9	80.7	13.7	94.4	31.5	3.5	35
2015 Summer	525.6	32.6	558.2	110.0	43.2	153.2	98.1	61.8	159.9	39.7	12.8	52.5
2015 Winter	438.0	13.1	451.1	89.4	17.4	106.8	81.8	26.5	108.3	31.9	6.7	38.6
2016 Summer	532.4	34.0	566.4	111.4	46.6	158.0	99.4	68.3	167.7	40.3	14.8	55.1
2016 Winter	443.7	12.7	456.4	90.6	16.7	107.3	82.8	25.2	108.0	32.3	6.3	38.6
2017 Summer	539.4	19.8	559.2	112.8	28.5	141.3	100.7	44.3	145.0	40.8	11.0	51.8
2017 Winter	449.5	14.8	464.3	91.7	21.4	113.1	83.9	33.9	117.8	32.7	8.9	41.6
2018 Summer	546.4	17.5	563.9	114.3	26.1	140.4	102.0	41.8	143.8	41.3	10.9	52.2
2018 Winter	455.3	14.2	469.5	92.9	20.6	113.5	85.0	32.8	117.8	33.1	8.7	41.8
2019 Summer	553.5	11.8	565.3	115.8	15.1	130.9	103.3	22.7	126.0	41.9	5.8	47.7
2019 Winter	461.2	10.8	472.0	94.1	13.5	107.6	86.1	20.2	106.3	33.8	5.2	39.0
2020 Summer	580.7	8.0	588.7	117.3	8.0	125.3	104.7	10.6	115.3	42.4	2.5	44.9
2020 Winter	467.2	9.1	476.3	95.4	9.4	104.8	87.2	12.4	99.6	34.0	2.8	36.8
2021 Summer*	568.0	unavailable	--	118.8	unavailable	--	106.0	unavailable	--	42.9	unavailable	--
2021 Winter	473.3	unavailable	--	96.6	unavailable	--	88.4	unavailable	--	34.4	unavailable	--

Source: Adapted from KGS-Acres 2010; Manitoba Infrastructure and Transportation.
Notes: BG = background. These numbers represent round trip estimates.
*The original traffic analysis did not provide Project-related traffic estimates beyond 2020. An updated traffic projections based on 2011 workforce estimates and construction schedule will be provided in a supplementary filing (see previous footnote).

Table 5-24: Percentage Increase in Traffic Levels Resulting from Project-related Traffic (2014-2021)

	Road Section 1 (PR 391) Thompson to PR 280		Road Section 2 (PR 280) PR 391 to Split Lake Junction		Road Section 3 (PR 280) Split Lake Junction to Keeyask Junction		Road Section 4 (PR 280) Keeyask Junction to PR 290	
	% Freight	% Project Traffic	% Freight	% Project Traffic	% Freight	% Project Traffic	% Freight	% Project Traffic
2014 Summer	33.0%	2%	28.5%	11%	20.3%	17%	0.0%	10%
2014 Winter	11.9%	2%	14.6%	10%	10.2%	15%	0.0%	10%
2015 Summer	53.9%	6%	40.7%	20%	28.4%	39%	0.0%	24%
2015 Winter	25.2%	3%	19.0%	16%	12.5%	24%	0.0%	17.3%
2016 Summer	50.9%	6%	37.1%	29%	25.3%	41%	0.0%	27%
2016Winter	25.2%	3%	19.2%	16%	12.7%	23%	0.0%	16%
2017 Summer	32.3%	4%	22.4%	20%	14.4%	31%	0.0%	21%
2017 Winter	20.9%	3%	14.5%	19%	9.1%	29%	0.0%	21%
2018 Summer	23.4%	3%	15.7%	19%	9.8%	29%	0.0%	21%
2018 Winter	19.0%	3%	13.1%	18%	8.2%	28%	0.0%	21%
2019 Summer	22.9%	2%	17.9%	12%	11.9%	18%	0.0%	12%
2019 Winter	20.3%	2%	16.3%	13%	10.09%	19%	0.0%	13%
2020 Summer	21.3%	1%	21.3%	6%	16.0%	9%	0.0%	6%
2020 Winter	27.5%	2%	26.6%	9%	20.2%	12%	0.0%	8%
2021 Summer*	unavailable	unavailable%	unavailable	unavailable	unavailable	unavailable	0.0%	unavailable
2021 Winter	unavailable	unavailable%	unavailable	unavailable	unavailable	unavailable	0.0%	unavailable

Source: Adapted from KGS-Acres 2010; Manitoba Infrastructure and Transportation.
Notes: These numbers represent round trip estimates.
*The original traffic analysis did not provide Project-related traffic estimates beyond 2020. An updated traffic projections based on 2011 workforce estimates and construction schedule will be provided in a supplementary filing (see previous footnote).

The largest increase in traffic is expected to occur during the summer seasons during the peak construction periods. As shown in Table 5-23 the greatest overall amount of Project-related traffic in the summer season is expected to occur in the summers of 2015 and 2016, with the latter experiencing the highest volumes. The greatest amount of Project-related winter traffic is expected to occur in winter 2017 and 2018, with the highest levels reached in the winter of 2017. Overall, Road Section 3 will experience the largest percentage increase in Project-related traffic. As shown in Table 5-24, for Road Section 1 (PR 391 - Thompson to PR 280), the expected volume of traffic in Summer 2016 based on normal traffic growth is 532 vehicles/day and the number of Project-related vehicles using this road is expected to add another 34 vehicles for a total of 566 vehicles/day during the core construction period. Of those Project-related vehicles, 51% of them are expected to be freight vehicles while the remainder of traffic will come from incidental service and personnel vehicles. The overall increase in Project freight traffic on this section is 6% or less in all periods. As, noted in the existing environment Section 5.3.5, PR 391 is designed with a capacity of up to 6,000 vehicles per day. The increase in traffic on the road as a result of the Project should be readily accommodated by the road design.

During the peak construction period on Road Section 2 (PR 280 - PR 391 to Split Lake Junction), the expected background traffic volume is estimated to be 111 vehicles/day, and the number of Project-related vehicles using this road is expected to add another 47 vehicles for a total of 158 vehicles/day during the core construction period. This is an increase of 29% over the expected background traffic. Of the Project-related traffic, 17 vehicles (37%) are expected to be transporting freight. The remainder of the vehicles will be incidental service and personnel vehicles. On Road Section 2, the Project is expected to increase the number of vehicles on the road in summer months in excess of 20% in years 2015 (20%), 2016 (29%) and 2017 (20%). During the winter months Project-related traffic will increase the number of vehicles on the road and will peak in winter 2017 (19%) and winter 2018 (18%).

Road Section 3 (PR 280 - Split Lake Junction to Keeyask Junction) is expected to experience the greatest amount of combined Project-related traffic. Road Section 3 will have three types of Project vehicles traveling along it including: heavy trucks hauling freight, incidental support service vehicles traveling to the camp and construction work areas and personnel vehicles transporting people to and from the Project site. In summer 2016, the expected background traffic volume is estimated to be 99 vehicles/day, and the number of Project-related vehicles using the road is expected to add another 68 vehicles for a total of 167 vehicles/day during the core construction period. Although Road Section 3 will see the greatest total amount of Project traffic in summer 2016, only 25% of the Project traffic will be made up by freight traffic. The majority (66.6%) will be attributable to personnel traffic. On Road Section 3, the Project is expected to increase the number of vehicles on the road in excess of 20% in both summer and winter seasons for the years 2015-2018. As construction ramps up, the increase in Project traffic on Road Section 3 is expected to be approximately 39% in summer 2015 and is expected to reach a peak of 41% in summer 2016. The greatest increase in traffic due to the Project in the winter months is expected to occur in 2017 when the Project is estimated to increase traffic by 29%.

On Road Section 4 (PR 280 - Keeyask Junction to PR 290) during the peak construction period, the expected background traffic volume is estimated to be 40 vehicles/day, and the number of Project-related vehicles using this road is expected to add another 15 vehicles for a total of 55 vehicles/day. In summer 2016, this is an increase of 27% over the estimated background traffic. The only Project traffic expected to travel along this Road Section is incidental service and personnel vehicles. Road Section 4 is expected to have increases in traffic volume in excess of 20% in the summer in years 2015-2018, and in winter in years 2017-2018. Although the Project will contribute to increases in traffic volume greater than 20%, as shown in Table 5-24, none of the Project-related traffic is expected to be from freight vehicles.

In summary, the percentage increase in traffic due to the Project on Road Section 1 (PR 391) is low and should be readily accommodated by the roadway design tolerances. Road Sections 2, 3, and 4 all have percentage increases in traffic from Project-related traffic that exceed 20% at peak times although the total volume of background and Project-related traffic is well below the roadway design tolerances. Low background traffic levels in each section are accentuating the extent of the percentage increases.

Local residents and regular haulers already travelling these routes are likely to notice the increase in the number of vehicles that they meet or have to travel behind or pass. This contributes to concerns about added potential for accidents to occur. As well, many of the Project-related vehicles will be large trucks. TCN interviewees have noted that large trucks travelling on PR 280 can stir up large amounts of dust reducing driving visibility and can be intimidating to drivers of smaller vehicles (CNP *pers. comm.* 2011). Other KCNs Members and residents of the Local Study Area have expressed concern about the safety and conditions of PR 280 prior to the improvements, citing numerous examples of damaged windows and vehicles, traffic accidents as well as concern over dust from trucks causing visibility hazards. At the time of submission, it was not known whether planned road improvements will fully address the concerns voiced by the KCNs.

MITIGATION

In anticipation of increased traffic levels and truck usage on PR 280 related to construction of the Project, highway improvements will be made by MIT starting in 2012 at numerous locations on PR 280 between the PR 391 junction and the Project turnoff. These improvements include widening, curve shaving and grade improvements.

While these improvements are intended to address the added traffic volume from the Project, MIT may need to provide increased signage during peak construction seasons (May to October) to advise motorists to expect increases in traffic, and to monitor accidents and dust complaints from truck traffic on the roads between Thompson and Gillam during the peak years of construction of the Project. If problems arise, MIT may need to consider additional mitigation such as speed reduction and more aggressive dust control.

THOMPSON

Thompson is likely to experience increased traffic levels within the City comparable to those for Road Section 1. The highest percentage increase over background levels is 6% for freight traffic in summer

2016. This is a fraction of the total traffic measured for Thompson Drive North in 2000[1], which was 14,360 vehicles per day (ND Lea Engineers and Planners Inc.2002).

5.4.1.6 Culture and Spirituality

5.4.1.6.1 Keeyask Cree Nations

As noted in Section 5.3.1, culture and spirituality represent a composite of worldviews, values, beliefs, perceptions, principles and traditions that are based on individual and collective history, experience and interpretation. These cognitive values act as a unified force to direct the flow of cultural change. In the context of this assessment, cultural indicators are used to capture cultural issues and perspectives of importance to the KCNs. The nine cultural indicators used in the effects assessment are: worldview, language, traditional knowledge, cultural practices, health and wellness, kinship, leisure, law and order, and cultural products. The assessment of effects examines how the existing and projected characteristics of each indicator could be altered by Project-induced changes in the physical, aquatic and terrestrial environment, by participation in Project opportunities and by the KCNs' participation in the Project partnership.

As described in Chapter 2 of the Response to EIS Guidelines, the Cree worldview indicates that everything is alive, is interconnected and needs to be respected. The Cree view themselves as important stewards of Askiy (land, water and living things). As part of everything, it is important to give thanks and respect for the gifts given through rituals[2], ceremonies, vigil and offering of prayer. Through KCNs efforts and their desire to uphold this worldview, processes and measures have been put in place to address, in a meaningful and enduring manner, the potential effects of Project construction and operation on Cree culture and spirituality. These measures and processes, tailored to the specific circumstances and priorities of the KCNs, strive to moderate and offset potential effects on culture and spirituality that are expected to be experienced as a result of the Project. The following are especially important in this regard:

- Being partners in the Project;
- The AEAs negotiated and signed by each of the KCNs; and
- The Employee Retention and Support Services direct negotiated contract.

Each of these factors is described in further detail below.

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[1] Traffic volumes are not regularly measured within the City of Thompson. As such, the 2000 data collected by ND LEA is the most recent data available.

[2] The culture and spirituality study conducted for the Project does not discuss ritual as part of an environmental effects assessment. However, ritual, in the context of religious practice is included as a self-descriptor by the KCNs. The term *ceremony* however is used in the culture and spirituality descriptions of potential environmental effects and mitigation.

PARTNERSHIP

Being partners in the Project provides KCNs with meaningful involvement in Project decision-making and legitimate influence over how the Project has been planned, and will be constructed and operated. Through this mechanism, the KCNs are able to bring to bear the Cree worldview and implications for Cree culture and spirituality in Project decision making. As a partner in the planning, as well as the assessment and implementation of the Project the KCNs have been afforded an opportunity to care for *Askiy* for the Cree today and for future generations (see Chapter 2 of the Response to EIS Guidelines for more details on the KCNs' worldview). The KCNs can provide oversight of the Project to partner as stewards of the Project through involvement in the Keeyask Hydropower Limited Partnership Board, the Construction and Monitoring Advisory Committees, and community-specific ATK monitoring(see also Section 6.6.5.1 Governance, Goals and Plans). Further details on each of the KCNs being partners in the Project are included in their respective Environmental Evaluation Reports.

ADVERSE EFFECTS AGREEMENTS

The AEAs between Manitoba Hydro and the individual KCNs Partners were designed to address and resolve all known and foreseeable Project adverse effects[1]. Within each agreement, a set of Offsetting Programs were developed which deal directly with the potential adverse effects of the Project on culture and spirituality. Programs agreed upon in the AEAs deal with traditional lifestyles, Cree language, land/environmental stewardship, access programs for resource harvesting of healthy country foods, wellness counselling and a cultural sustainability program that can assist in maintaining cultural success and tempering Project effects. The AEAs provide an opportunity for economic development in addition to reconciling differing worldviews by addressing and acknowledging the need for continued stewardship of the land, culture and spirituality that binds the KCNs to their environment.

Each of the AEAs differs among the communities; however, most of these programs will be in place by the start of construction. During the construction phase, the AEA programs will be ongoing to minimize the loss of use of the Project site. In addition, the AEAs will actively engage the mechanisms of cultural transmission, stewardship and spirituality within the communities. AEA programs will also proactively engage the health and wellness of the communities to promote employment and business opportunities, and increased country food usage; and offer the return to cultural sharing practices. During the operation phase, AEA programs will continue to address physical changes to the landscape, inter and intra cultural and community interactions and long-term employment and business goals.

EMPLOYEE RETENTION AND SUPPORT SERVICES CONTRACT

The Employee Retention and Support Services contract implemented by the KCNs, which will extend over the entire construction phase, will include cultural training of construction workers. Counselling for construction workers will be available, and if necessary may be extended to a worker's family in KCNs

[1] The AEAs also include a process for program changes that requires agreement by the respective First Nation and Manitoba Hydro prior to implementation.

communities. There will also be opportunity for conducting ceremonies at key Project milestones, all of which will provide opportunities for cultural engagement at the construction work area. The ceremonies component of the contract can be used to give thanks and show respect for *Askiy* when a noteworthy feature of *Askiy*, such as the rapids, is being disturbed or lost for the benefit of future generations.

Anticipated construction effects on the cultural landscape and intangible culture and spirituality within the Footprint/hydraulic zone of influence and Local and Regional study areas are summarized below, according to each of the nine cultural indicators.

Worldview: Being a Partner in the Project has facilitated a greater than normal ability to express and gain acceptance of Cree culture and worldview, including having a Project oversight role. A Project feature aligned with the Cree worldview is the AEA Offsetting Programs of each Cree Nation; as well as actively participating in the development and implementation of monitoring (including ATK monitoring) and follow-up programs. The KCNs involvement in Project planning, assessment and monitoring, along with ceremonies at Project milestones will address the KCNs noted incremental loss or decrease in the understanding of the spiritual connection to the land (which could affect community organization). However, while working at the construction site, there is potential for other worldviews *(e.g.,* non-Aboriginal) to be in conflict with the Cree worldview. Anticipated grief associated with the loss of part of the cultural landscape, in particular the rapids, may express itself in anxiety which could lead to social distress.

Language: KCNs Members working at the construction site are expected to have reduced opportunities to use Cree language as the language of Project construction will be English. However, ceremonies and rituals at Project milestones are opportunities for conducting traditional activities in Cree. The development of cultural centres and conducting cultural transmission programs will provide the opportunity for maintaining and or strengthening the use of the Cree language. Each of the KCNs also has Cree language programs identified in their AEAs.

Traditional knowledge: There is concern by some KCNs Members that traditional knowledge within the construction area will undergo rapid change and be lost. Accelerated change and loss of Aboriginal traditional knowledge are linked to parts of the physical landscape disturbed by Project construction and changes in water regime. Traditional knowledge provides the opportunity for interaction between generations – it provides a 'how-to' manual that guides the next generation through cultural ways of doing that is based on years of experience and observation. Traditional knowledge is dynamic and interactive. While this interaction is notably in decline because of other factors, the process of loss may be accelerated. On the other hand, traditional land use and related studies undertaken with funding from the Project have contributed to the retention and transmission of aspects of ATK. Further, ATK monitoring programs implemented as part of the Project are expected to provide opportunities for Elders, resource users and youth to undertake site visits and participate in monitoring based on traditional knowledge. Traditional activity programs in each of the AEAs will provide the opportunity to foster ongoing traditional knowledge related to the offset areas.

Cultural practices: Changes to cultural practices and traditional activities within the Project site will occur due to physical changes to the Project environment requiring adaptation, abandonment or relocation to other areas. This will include the inability to access certain construction-related areas for future gathering of medicinal and edible plants, and harvesting of animals and fish and continuation of the oral tradition of knowledge. However, the AEA Offsetting Programs that provide access to resource harvesting at alternative sites present substantial opportunity to continue undertaking traditional activities in areas away from the disturbed environment.

Health and wellness: Loss of traditional medicines and knowledge of resource habitat in the Footprint area may result in adverse effects on health and wellness, particularly if resource harvesting levels decline resulting in changes in country food diet. There may also be stress resulting from the destruction of *Askiy*. This can be offset by increased opportunity to pursue traditional activities through the access programs in other 'offset' areas and the implementation of ATK monitoring programs that address community-specific interests and concerns related to the Project. See also Section 6.6.5.2 Community Health for a review of effects on health and wellness within on a western analytical framework.

Kinship: Kinship relationships are built on old and established practices that are characteristic of northern Cree bands. Traditionally, multiple bonds were created between limited numbers of relatives and others such as clan members where certain rules and obligations were followed (Smith 1974). Kinship terminology has been modified to reflect a western tradition; however, subtle, inherent rules still apply. The new cultural and traditional lifestyle programs available through the AEAs should help to maintain kinship ties.

Kinship effects may also be felt through the separation of family members as a result of construction employment. For example, Wuskwatim monitoring reported that NCN families with members working at the Wuskwatim construction site reported some negative effects related to long work schedules, income issues and other family-related stresses (Wuskwatim Power Limited Partnership 2010.

Leisure: Leisure activities *(e.g.,* playing sports, skating, bingo) may be decreased due to being away from their home community while employed on the Project. However, other forms of leisure will be available to construction workers on-site at the recreation centre *(e.g.,* gym, weight room, computer lab) and activities such as fishing are accessible to workers.

Law and order: At the construction site, KCNs workers will be exposed to a set of rules as different from their traditional customary law. However, being partners in the Project and having an oversight role as stewards of *Askiy* provides a balance that includes traditional customary law as it is interpreted by the KCNs. Cultural awareness training provides a linkage between activity on site and traditional customary law (see also Section 6.6.5.1 on governance).

Cultural products: The preparation of cultural products may be affected by changes to the environment and or availability of time to commit to making cultural products due to Project employment. This is counterbalanced by the offset programs and their opportunity for pursuing traditional activities leading to provision of furs and other items for creation of cultural products.

5.4.1.6.2 Mitigation

Mitigation to address the potential for loss and grieving associated with, for example, the loss of the rapids include:

- Ceremonies and rituals at key Project milestones *(e.g.,* stream crossings, road cleaning); and

- Counselling services as part of the Employee Retention and Support DNC to assist in Cree Members in coping with changes to the landscape through construction activities, the inevitable loss of the rapids and the changes in Gull Lake due to flooding. Counseling services may be extended to a worker's family members in the KCNs communities.

See also effects of construction activities on heritage resources (Section 6.8.3.1 which is more focused on the tangible resource) for proposed mitigation measures that have overlapping concern related to culture and spirituality.

KCNs Members are anticipated to experience culturally-related disturbances and losses during project construction, particularly in conjunction with losses in their cultural landscape and from working at the construction site. These effects would be offset by the combination of processes and measures established during the planning stage of the Project, including the AEA programs, and moderated by the proposed mitigation measures. No further mitigation is required.

5.4.1.7 The Way the Landscape Looks (Aesthetics)

The characterization of Project effects on the way the landscape looks considers all site alterations arising from Project activity, the project visibility within the landscape context *(e.g.,* characteristics that make the location distinctive in contrast with the presence of the Project), and value to the viewer and associated sensitivity levels, as described in Section 5.2.6.

Construction activities will result in physical alteration of the landscape, noise, dust, and increased human presence. During construction there will be changes to the way the landscape looks along the south access road (from the Project site to Gillam) and in proximity to the construction site itself. Changes to the landscape that affect aesthetics include the excavation/development of identified borrow areas as well as development of the construction site (*e.g.,* dyke construction).

The construction of cofferdams[1] will change the overall flow of the Nelson River, diverting water into the south channel of the river so that construction of various components of the Project *(e.g.,* the powerhouse and the spillway) can occur in dry conditions. Eventually, water will be diverted through the spillway to enable completion of the dam. There are likely to be temporary visible changes to water quality during certain phases of construction *(e.g.,* diversion of water to enable construction may expose shorelines to erosive forces that wouldn't be experienced under normal flow conditions, as described in the PE SV). These effects will occur for a short time in association with specific activities and would typically be limited to the construction site, although some effects could extend downstream into Stephens Lake.

Construction effects to aesthetics will be limited in duration, and in many instances, decommissioning activities will strive to return disturbed areas to their previous state *(e.g.,* rehabilitation of borrow areas using native plant types to the extent feasible). Access to the construction site will be limited by security measures *(e.g.,* staffed gate), meaning that the highest proportion of people likely to witness the aesthetic effects will be limited to those employed at the construction site, including Members of the KCNs.

[1] All but one of the cofferdams will be constructed "in the wet" as described in the Project Description volume.

Although activities will be visible from both up and downstream of the Project site, it is unlikely that the effects to the way the landscape looks will be witnessed directly by many people aside from construction workers as well as resource users and the families that actively use the area. In addition, site tours with KCNs community Members and those participating in ATK monitoring will be a witness to changes to the landscape. It is anticipated that construction activities and noise will result in the resource users avoiding the area, thus minimizing the extent to which an effect is experienced by viewers.

In order to minimize the overall extent of the effects of flooding, two main activities will alter the aesthetic quality of the future reservoir. First, dykes will be constructed on the north and south side of the river to limit the extent to which water can inundate the surrounding lands. These will be earthen filled structures, similar to those in place at other generating stations in the Local Study Area. In addition to this, a Reservoir Clearing Plan is being implemented as per the JKDA in order to minimize the overall amount of debris resulting from flooding. This will clear the area of brush and trees using a combination of mechanical and hand clearing methods depending on the proximity to the Nelson River. Where mechanical clearing is employed, loose and dead woody debris, along with hummocks of sphagnum moss will be accumulated and removed, thereby minimizing the amount of debris left in the reservoir when it is flooded. The clearing of the reservoir will ultimately transform the area from a vegetated to a clear-cut environment, although this effect will be limited in duration.

Perceptions of the aesthetic effects of construction may vary depending upon an individual's worldview and perspectives. For example, a construction worker from Winnipeg may simply view the appearance of the landscape during construction as his/her worksite. A Gillam resident with a cabin on Stephens Lake may view the Project as an obstruction to certain views, and if the cabin is in close enough proximity to the construction, there is potential for noise to alter the auditory environment, and increased sediment to alter the water quality. Others may perceive very limited change from what is already a reservoir environment.

KCNs Members are more likely to have adverse reactions to the aesthetic changes associated with Project construction, as their worldview inherently values characteristics of the landscape including the earth, the trees, the water, the rocks, the rapids and other features. The CNP express concerns about changes to the land in saying:

> We live in a world where all things are both related and interrelated and can exist in a state of harmony and balance if proper care is given and respect is shown for Mother Earth and all her beings. In return for respecting and caring for Mother Earth, she will provide all that is required for our well-being. Conversely, if proper care and respect is not shown, there will be serious consequences for us. This relationship is an integral part of our culture (CNP Keeyask Environmental Evaluation Report).

FLCN explains:

> Nipe, or water is vital to life and all living things. Mary Beardy remembered learning about how it is crucial for people to look after the water. Through her traditional teachings she learned that water is a medicine that needs to be protected. Water, she mentioned, is a part of the four elements essential to life (personal communication, September 2009) (FLCN 2010 Draft).

It is also demonstrated by a story shared in the YFFN Evaluation Report (*Kipekiskwaywinan*):

> We were taught to respect everything. Even the littlest insect, you're not supposed to hurt because it's there for a reason. I remember we got in big trouble once as kids when we tied a piece of string around a bulldog [horsefly] to watch it fly on the string. Oh, my mother gave us a LONG talking to. She never used to yell at us, but when you got a talking to, you knew you'd done something wrong! My grandmother sat us down and she explained to us that every little thing is there for a reason. It has a spirit, and it's there for a reason. Everything is connected, so you don't hurt even one little thing (YFFN Evaluation Report (*Kipekiskwaywinan*)).

KCNs' expectations that Project construction will be destructive in nature are likely to result in different perspectives as to the severity of changes to the aesthetic environment. Similarly, the construction of Keeyask will alter the sound of Gull Rapids as water is diverted through channels and the spillway, thereby dampening the sound. The AEAs agreed to by the KCNs address known and foreseeable adverse effects of the Project, including the changes to the way the landscape looks and loss of the rapids. Specifically, the AEA Offsetting Programs will provide for replacement opportunities to access resources off-system to the Nelson River in areas not disturbed by hydro development. Further mitigation in the form of nature tails within the north construction camp will allow KCNs construction workers to find beauty (*e.g.,* access to water, views of sunsets or sunrises and quiet). The KCNs are considering the incorporation of ceremonies and rituals as a part of the Employee Retention and Support Services Contract (expected to be implemented by FLCN and YFFN). A video taken of the rapids and Gull Lake prior to construction will be available for viewing in a visitor space at the generating station once the station is in operation. In addition, a park/rest area with boat launches is proposed at the location of the north construction site as well as a commemorative plaque/memorial to recognize people who have used and continue to use the Gull Lake area (see Section 5.4.2.6 for further detail).

5.4.1.7.1 Mitigation

No further mitigation or enhancement is required.

5.4.1.8 Construction Monitoring

As noted in Chapter 8 of the EIS, monitoring of socio-economic effects will be organized into a coordinated Socio-Economic Monitoring Program (SEMP) whose details will be developed after the Project has been filed. It will be adjusted upon receipt of the Project's approvals and licence to incorporate any required terms of the licence. The program will define in detail the process, scope, methods, documentation and application of the socio-economic monitoring for the Project. It will be part of a larger strategy to identify where the proposed approaches to conducting the Project and mitigating its effects may have to be adjusted in order to address observed Projects effects that do not align with what had been predicted. This adaptive management approach will be inherent in the design and implementation of the SEMP.

The plan will be designed to satisfy licence conditions and to address monitoring proposals set out in the EIS. The SEMP will be developed by the Keeyask Partnership with representatives of the KCNs expected to play a central role in its development and implementation.

In relation to personal, family and community life, monitoring of construction phase effects is proposed for selected VECs.

PUBLIC SAFETY AND WORKER INTERACTION

There is potential for adverse interactions between non-local construction workers residents of the Local Study Area, particularly those who live in Gillam, including FLCN Members, and in Split Lake. Since it is difficult to predict the frequency and nature of issues that may occur during the construction of the Project, monitoring is proposed to identify potential problems and allow for mitigation measures to be developed for problems if they arise.

Manitoba Hydro, working with FLCN and TCN will determine the best mechanism to track the number and type of adverse incidents on a regular basis, including possible discussion with local justice and social agencies in the gathering of the data.

Manitoba Hydro will work closely with RCMP in Thompson, Gillam and other KCNs communities to discover if incidents indicate that worker interaction involving Project construction workers are an issue. If they are an issue, the above noted stakeholders will evaluate the situation and if needed, develop strategies to reduce of the likelihood of future occurrences.

TRAVEL, ACCESS AND SAFETY

Concerns were expressed regarding travel safety related to ice and open water travel . Open water and ice monitoring is part of the WMP, which the KCNs will play a role in implementing.

Concerns were expressed about increased traffic on PR 280. The Partnership will track statistics collected by MIT on traffic volumes and incidents. If traffic incidents and or complaints have increased considerably, the Partnership will work with MIT to determine if additional mitigation measures are appropriate *(e.g.,* speed reduction and dust control), and how these measures could be implemented.

CULTURE AND SPIRITUALITY

There is uncertainty as to how the construction phase of the Project would affect KCNs culture. This includes uncertainty about how employment experience during Project construction would affect the culture of workers and their families. Adverse Effects Agreements have been negotiated with each of the KCNs based on each community's assessment of the project's potential effects, including any interference with its traditional customs and practices. The AEAs include various Offsetting Programs designed to support and enhance cultural practices.

In terms of monitoring, each community undertakes its own internal evaluation of the AEA Offsetting Programs on an annual basis. This evaluation would determine whether the programs continue to address the adverse effects of the Project. If required, the AEAs provide flexibility for the Offsetting Programs to be modified to more adequately address Project effects as they are experienced. The agreements also provide the opportunity for the communities and Manitoba Hydro to negotiate additional programming if unforeseen or unanticipated effects arise. Within this context, the Partnership could undertake further evaluation of the effects of Project construction on culture.

5.4.2 Operation Phase Effects and Mitigation

5.4.2.1 Community Governance, Goals and Plans

5.4.2.1.1 Keeyask Cree Nations

During the operation phase there will be a continuing role for the KCNs in the limited Partnership (KHLP). Each of the KCNs will have representatives appointed to the Board of Directors of the General Partner and MAC[1] (see PD SV). Through these roles they will have the opportunity to continue to shape the Project; and will be involved in long-term monitoring. Under provisions of the JKDA, the KCNs are eligible to own up to 25% of Project equity (TCN and WLFN 15%, FLCN 5% and YFFN 5%), although the actual amount will not be determined until six months after the completion of construction. As limited partners, the KCNs will be entitled to receive annual distributions from their equity investment on the Project's profits. This income may be used to support projects and programs that assist the communities in achieving their goals and plans. However, specific uses by the KCNs for this potential new income have yet to be determined.

Research suggests that as new wealth is created it can be invested and stimulate the economy (Raybould 2006). The KCNs will likely need to develop strategies for the financial management of their equity income. Given the long lifespan of the Project, there is opportunity to address community priorities as they arise as well as achieve long-term community goals and plans. This may initially increase pressure on community leadership as they determine the optimal ways to use investment income to support community needs and interests.

5.4.2.1.2 Gillam

Gillam will experience an increase in operational jobs available to community Members or people moving into the community. Operation of the Project will result in 46 operational jobs located in Gillam, which is expected to result in the growth of population of Gillam between 120 to 150 people (see Section 4.4.2.1). The Town of Gillam, including Members of FLCN who call Gillam home, will need to respond to the needs of the growing population and associated changes. Gillam is already undertaking land-use planning in coordination with Manitoba Hydro and FLCN to plan for increases in population. As well, it is expected that the ongoing implementations of Harmonized Gillam Development will continue to play a role in identifying and addressing concerns of each party.

The increased presence of Manitoba Hydro employees and their families may also increase the opportunity for achieving community goals and plans through indirect means. Overall, a larger population may add to the vitality of the community by increasing local income and spending on local businesses and services (see Section 3.4.2.2). It may also contribute to the overall number of volunteers available to undertake various roles in the community.

[1] The General Partner would be owned and controlled by Manitoba Hydro.

5.4.2.1.3 Thompson

There are no anticipated effects from the operation of the Project on community governance, goals and plans in the community of Thompson.

5.4.2.1.4 Mitigation

No further enhancement or mitigation is required.

5.4.2.2 Community Health

During the operation phase, the direct effects to health are expected to be limited to the area in proximity to the Project. The effects associated with changes in the water regime include effects related to mercury and human health, water quality and travel safety (including both land and water). The indirect effects may include changes resulting from the ability to access country foods, employment and income, and any effects to health services in Gillam as a result of increases in population associated with the Project.

5.4.2.2.1 Community Health Issues Directly Associated with Project Operation

MERCURY AND HUMAN HEALTH

The KCNs have expressed concern about continuing to eat local fish and wildlife due to fears of mercury exposure. The operation of the Project will result in a release of methylmercury into the environment. As discussed in Section 5.3.3, there are health effects associated with exposure to mercury and these can be mitigated by following consumption guidelines provided in Section 5.4.2.3.

WATER QUALITY

In the operation phase, the main physical change to water relates to impoundment and associated changes in the anticipated open water hydraulic zone of influence. The PE SV notes that the backwater effect will not extend beyond approximately 41 km upstream of the Project site or about 3 km downstream of the Clark Lake outlet. Accordingly, the open water levels at Split Lake and Clark Lake, and typically winter levels as well, are not expected to be affected by the Project[1].

Upon impoundment, the new generating station will flood land and existing waterways resulting in peatland disintegration and associated shoreline changes. Total releases of organic sediments, peat and debris are expected to decline quickly during the first five years of operation. Over time, there will be a reduction in peat shoreline length, and an increase in mineral shoreline length. Mineral sediment releases are also expected to decline quickly during the first five years of operation. Downstream of the Project, the mineral shoreline erosion rates and sediment load will decrease because the hanging ice dam below Gull Rapids will no longer form. Peatlands are absent downstream of the Project.

[1] On average, effects to the ice regime could see Project operation effects every 20 years (see PE SV).

York Factory First Nation's Evaluation Report *Kipekiskwaywinan* notes that many community residents express concern about the ongoing impact of the Project on water quality as well as the fish in the water. Members of YFFN for example, strongly believe that the effects of the Project will go beyond the predicted open water 'hydraulic zone of influence'. This perception in and of itself can be considered an effect, and is discussed further in subsequent sections of this document.

It is anticipated that during operation the KCNs will change resource use locations to areas identified in their respective AEA Offsetting Programs. As such, it is unlikely resource users would be at risk of consuming surface water upstream of the Project. It is also important to note that, regardless of location, direct drinking of surface water is not a recommended practice; Health Canada indicates that all untreated water should be boiled for one minute before consumption (Health Canada 2008). Manitoba Water Quality Standards, Objectives and Standards note the following: "It is therefore assumed that all raw surface water supplies will be disinfected as the minimum level of treatment prior to consumption" (Manitoba Water Stewardship 2011). This applies to potential areas identified for the purpose of offset programs, in addition to downstream resource users and cabins on Stephens Lake. This caution is applicable even without the Project moving forward.

INJURY AND TRAVEL, ACCESS AND SAFETY

Operation phase effects to health stemming from travel, access and safety would stem from the creation of a reservoir and associated changes to the water regime. Upstream waterbody characteristics will change from a turbulent river to a reservoir environment, generally resulting in safer open water and ice conditions between the generating station and Clark Lake (see Section 5.4.5 for a full description). Similar to the construction phase, the WMP will remain in place to address potential travel, access and safety concerns arising from Project operation. Operation specific measures are detailed in Section 5.4.5.

Accidents and injury are preventable, and although it is impossible to predict whether any accident or injury will occur during Project operation, it is expected the mitigation measures put in place will reduce the overall potential for incidents to occur.

Project related traffic levels will be much lower during the operation phase than during construction. During operation the number of additional vehicles travelling on the roadways are not expected to be noticeable compared to existing background traffic levels, and would be comprised of cars, vans and small trucks. This level of additional traffic is not expected to have a noticeable effect on the traffic levels and safety in the Local Study Area. As such, the measures put in place to improve road conditions during construction should continue to improve the overall driving conditions and safety in the Local Study Area.

5.4.2.2.2 Community Well-Being Indirectly Associated with Project Operation

ABILITY TO ACCESS COUNTRY FOODS

As discussed in Section 5.3.2.1, the ability to access traditional foods and lands are essential to Cree concepts of health and living a good life. It is clearly beneficial if more people are eating country foods (in recommended amounts - see Section 5.3.3.3 for examples); and if fewer people are accessing the land

and eating country foods, the health of the community is affected. The operation of the Project will result in changes to the way people are able to spend time on the land, and in particular access to harvesting areas will be affected by the creation of a reservoir. Flooding will result in changes to habitat and subsequent changes to wildlife use/availability in the area (see the TE SV). Further to this, creation of the reservoir will result in the release of methylmercury into the environment. Precautionary guidelines for the safe consumption of fish and wildlife will be implemented in the Local Study Area (see Section 5.4.2.3). These factors will displace resource users who will be required to find alternative resource use locations in order to harvest resources.

TCN, WLFN and YFFN have long-term AEA Offsetting Programs that enable them to access healthy country foods (including fish and wild game) in areas unaffected by the Project. In the cases of TCN, WLFN and YFFN there are also food distribution programs within the communities so that country foods can be shared by those who are unable to go out on the land themselves. These programs ensure that there is no cost to community Members to access country foods in new areas and or by new routes.

EMPLOYMENT AND INCOME

During operation, fewer jobs will be created than during the construction phase, however these positions will be long term and permanent. Similar to the construction phase, operation employment and income have the potential to affect community health and well-being in various ways. Overall, the health benefits associated with higher income is expected to be more pronounced during operation, as the jobs available will be of a permanent nature, and not subject to the "boom-bust" cycle that is typical of construction. Conversely, the loss of construction employment when the Project transitions to operation may affect some people as the end of employment will result in an associated loss in income.

INVESTMENT INCOME

In the long term, the KCNs' equity participation as Project partners will result in new revenues for the communities. Although the KCNs have not yet determined precisely how their respective investment income will be spent, there is potential for spending to benefit overall community health and well-being through investment in infrastructure, services, and other community initiatives. These priorities are likely to contribute, to some extent, to improved community well-being (see Section 3.4.2.3 for details on the potential substantial contribution the KCNs return on investment can have).

HEALTH SERVICES

The operation of the Project will result in an increase in the population of the town of Gillam, by approximately 120 to 150 people (see Section 4.4.2). Population growth is a driver for health care services, not only from an emergency response perspective, but also in terms of providing for on-going health care needs. Section 4.4.2.3 notes that the hospital facility in Gillam, which is the primary health care provided for the community, can only accommodate a modest increase in population. During the operation Phase, population growth may result in the need for expanded health services. Community planning between Manitoba Health, the Town of Gillam, FLCN, and Manitoba Hydro will be necessary to address the community's longer-term health service needs. This will include consideration of services that Manitoba Hydro already funds, such as the cost of travel for health service providers for specialty services that might not otherwise be provided in a remote northern community (see Section 4.3.3.2). Changes to the Gillam Hospital may also be required to make the facility more functional, such as improving existing spaces.

RESIDENTS' SCEPTICISM AND MISTRUST

The First Nations Regional Longitudinal Survey (2005) notes that various types of trauma contribute to First Nations peoples' mental health and wellness, and attributes some of this to the intergenerational effects of colonialism. For the KCNs, the onset of past Manitoba Hydro's activities have acted as a continuation of colonization, and were particularly challenging as they affected the communities' abilities to understand their surrounding environment (see Section 5.3.2.1). Becoming members of the Keeyask Hydropower Limited Partnership marks an important departure from the KCNs' history with Manitoba Hydro, as participation in the Partnership has changed their position from affected community to Project-proponent. Although this shift has resulted in a certain degree of stress for some KCNs Members, it also means that the communities have been able to participate in Project planning in a meaningful way, including access to benefits that were not realized with previous developments.

Even though the KCNs have assumed a different role in this Project than with past hydroelectric developments, many Members still experience a certain level of scepticism and mistrust, particularly as it relates to the prediction of effects. Some KCNs Members have expressed concerns that the anticipated open water hydraulic zone of influence will extend beyond Clark Lake and will reach into Split Lake. While Manitoba Hydro has a high degree of confidence in the hydraulic modelling, and no changes to open water conditions on Split Lake is a fundamental feature of the Project in the JKDA, the KCNs' experience with past hydroelectric projects does not support such confidence. The KCNs point out that previous hydroelectric projects by Manitoba Hydro have caused changes to the lake and river systems that, from their perspective, have drastically increased the risks associated with traveling (YFFN Evaluation Report (*Kipekiskwaywinan*)). This is of particular concern to YFFN who reside on Split Lake, and already face challenges in accessing the community at York Landing due to the lack of an all-weather road. Monitoring of open water and ice conditions on Split Lake is described in Section 5.4.2.8.

5.4.2.2.3 Mitigation

There are no specific mitigation measures proposed directly related to community health; however those measures identified in relation to travel, access, and safety, to culture and spirituality, and to infrastructure and services should help to alleviate some of the potential pressures that could affect community health and well-being.

5.4.2.3 Mercury and Human Health

In order to characterize the effects of impoundment on mercury levels and subsequently human health, exposure to mercury under post-impoundment conditions was calculated in a human health risk assessment (HHRA) by a toxicologist on the Project (Wilson Scientific). A HHRA is a process that is accepted by Canadian and international health agencies for evaluating the potential for chemical, biological and physical agents to cause adverse health effects in people (Wilson Scientific 2012).

Regulatory agencies that use risk assessment to assist in making health-based decisions include Health Canada, the World Health Organization and the US Environmental Protection Agency.

Section 5.3.3 provides summary level detail of the methods used to estimate human health risks associated with mercury in country foods; also refer to Appendix 5C for the full HHRA report.

Concentrations of mercury were predicted for foods identified by KCNs community Members, including fish, wild game, waterfowl and surface water. The predicted mean mercury concentrations in the peak year were made by the aquatic team for fish and surface water, and the terrestrial team for wild game and waterfowl. These values are reported on in the HHRA; and provided input into calculating the risk assessment related to consumption of country foods.

In order to assess the risk of exposure to mercury as a result of the Project, the HHRA considered post-impoundment conditions for Gull Lake and Stephens Lake as these are the waterbodies that will have increased levels of mercury, particularly Gull Lake where flooding for the reservoir will occur. The HHRA evaluated the potential exposure to mercury for the KCNs, as these are the communities at greatest risk due to their use of country foods in the Gull and Stephens lakes area. To be cautious, the predictions for the KCNs are applicable to other users of Gull and Stephens lakes; although it is recognized that other users may not consume the same amount of fish at the same frequency levels.

As discussed in Section 5.3.3, specific species were selected for evaluation based on KCNs' inputs through the Mercury and Human Health Technical Working Troup (or TWG). Serving sizes and rates of eating for all foods studied were based on information obtained from KCNs community Members. The foods selected for evaluation included:

- Fish: lake whitefish, jackfish (northern pike), pickerel (walleye) and lake sturgeon;
- Wild game: beaver, muskrat, moose and snowshoe hare;
- Waterfowl: ducks and gull eggs; and
- Wild plants: northern tea, blueberries and Seneca root.

Details on the proceedings of the Technical Working Group and the details of the approach used in the HHRA are found in Appendix 5B and 5C.

5.4.2.3.1 Estimates of Mercury in Traditional Foods and Surface Water Post-Impoundment

FISH SPECIES

To estimate maximum mercury concentrations in whitefish, jackfish, and pickerel following impoundment, various modeling approaches have been used (see AE SV). Based on the modeling results and taking into account the strength and weaknesses of the different models used, the best estimates of average post-impoundment concentrations that would occur in the maximum year would be equal to the values provided in Table 5-25. No model is available to predict and monitor maximum post-impoundment mercury concentrations in lake sturgeon; therefore values in Table 5-26 are "best guess" estimates provided by North South Consultants (Wilson Scientific 2012).

As shown in Table 5-25, as compared to Table 5-26 (existing conditions), mercury concentrations of certain fish are predicted to increase markedly following impoundment while other fish would be much less affected. Jackfish and pickerel from Gull Lake will be the most affected fish as their mercury concentrations are predicted to increase from 0.22 ppm and 0.23 ppm, respectively, to 1.0 ppm wet weight. Lake whitefish from Stephens Lake is predicted to have the lowest increase in mercury concentration following impoundment (from 0.09 ppm under existing conditions to 0.15 ppm post-impoundment).

Table 5-25: Average Estimated Mercury Concentration in Fish Muscle for Standardized* Fish from Gull and Stephens Lakes: Predicted Maximum Post-Impoundment Concentrations

Fish Type	Average Estimated Mercury Concentration in Fish Muscle (for Standardized Size)[1] (ppm; wet weight)	
	Gull Lake	Stephens Lake
Whitefish	0.19	0.15
Jackfish (Northern pike)	1.0	0.50
Pickerel (Walleye)	1.0	0.50
Sturgeon	0.30	0.25

Source: Wilson Scientific 2012, as reported by Aquatic Study Team.
Notes:
1. Standard lengths: lake whitefish 350 mm; jackfish 550 mm; pickerel 400 mm, lake sturgeon 1,300 mm. Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.

- ppm wet weight is the same as µg/g wet weight as noted in the HHRA; ppm is used in the EIS as it is more readily understood.

WILD GAME

In the case of mercury concentrations in wild game following impoundment, Wildlife Resources Consulting Services considered that the best estimate of concentrations during the maximum year post-impoundment would be equal to the values provided in Table 5-26. Mercury in wild game was estimated as total mercury concentrations.

Table 5-26: Total Mercury in the Muscle Tissue of Wild Game from the Project Area: Predicted Maximum Post-Impoundment Concentrations

Species	Total Mercury Concentration in Muscle (ppm; wet weight)	Most Likely Range in Total Mercury Concentration in Muscle (ppm; wet weight)
Beaver	0.01	<0.01 – 0.05
Muskrat	0.04	<0.01 – 0.12
Moose	0.07*	<0.01–0.17
Snowshoe Hare	0.05*	<0.01–0.12

Source: Wilson Scientific 2012, as provided by Terrestrial Study Team.
Note:
- Mercury concentration in moose and snowshoe hare was a literature based estimate and likely has greater uncertainty than other species for which measured concentrations were obtained from the study area.

As shown in Table 5-26 as compared to Table 5-27 (existing conditions), mercury concentrations in beaver, moose and snowshoe hare are not expected to be affected by the Project (the values and the range of concentrations remain unchanged). Muskrat is predicted to have an increase of total mercury concentration of 0.03 ppm (from 0.01 to 0.04 ppm), with the range increasing to an upper limit of 0.12 ppm (over 0.06 ppm under existing conditions). Post-impoundment mercury levels in muskrat are still below levels that would cause concern.

WATERFOWL

In the case of the mercury concentrations in waterfowl following impoundment, the best estimate of concentrations during the maximum year post-impoundment would be similar to or less than concentrations in whitefish. Consequently, the mercury levels provided for ducks are those previously provided for whitefish *(e.g.,* ≤ 0.19 ppm wet weight for Gull Lake and ≤ 0.15 ppm wet weight for Stephens Lake). Compared to current estimated concentrations for waterfowl of ≤0.07 ppm wet weight (Gull Lake) and ≤0.09 ppm wet weight (Stephens Lake), it is evident that the concentration increases in ducks are expected to be relatively modest following impoundment. No estimates are provided for gull eggs as no information on mercury concentrations in gull eggs is available; therefore, gull eggs would need to be directly measured in the field if further information is required.

WILD PLANTS AND SURFACE WATER

Although many types of wild plants can be consumed from the Project Local Study Area, the key plants that were identified from discussions with KCNs community Members were northern tea (also known as Labrador tea), blueberries and Seneca root. As there is no information available on present mercury concentrations in these plants, future concentration estimates could not be calculated. If samples are provided through the volunteer sampling program for wild plants, mercury analysis can be undertaken to predict and monitor future concentration estimates for these plants under post-impoundment conditions.

Project-related increases in mercury in surface water are not expected to be detectable or to cause or contribute to exceeding the drinking water quality guideline in or downstream of the Keeyask reservoir *(e.g.,* <0.05 µg/L) (see AE SV). Concentrations of mercury are expected to remain below the Manitoba water quality guideline of 1 µg/L and below the analytical detection limits from the combined effects of peatland disintegration and flooding. Mercury was not detected in the Nelson River between Clark and Stephens lakes and the predicted average increases due to peatland disintegration and flooding are expected to be very small (see AE SV). However, during periods where organic particulate materials are notably elevated as a result of re-suspension or peatland disintegration, total mercury concentrations may be higher than existing conditions. Effects on Stephens Lake are also not expected to be detectable (Wilson Scientific 2012; AE SV).

5.4.2.3.2 Post-Impoundment Risks and Recommendations

Post-impoundment risk estimates were based on the predicted mean mercury concentrations in lake whitefish, jackfish and pickerel that would occur in the maximum years *(e.g.,* approximately 3 to 8 years following impoundment). Concentrations are predicted to return to current concentrations approximately 25 to 30 years after they peak (see AE SV).

Based on the predicted post-impoundment mercury concentrations in lake whitefish, jackfish and pickerel in Gull Lake and Stephens Lake and the respective serving sizes and rates of eating, a range of risks were calculated for the same groups.

The greatest risks were estimated from eating jackfish and pickerel from Gull and Stephens lakes. It was recommended that young children and women of child-bearing age should avoid eating these species of fish from either of these lakes. Adult men and women past child-bearing age should avoid eating these species from Gull Lake; and restrict their consumption to one meal per week from Stephens Lake (see Table 5-27 below). For lake sturgeon, standard size fish from either lake *(e.g.,* 1,300 mm) is predicted to contain mercury concentrations that would not be advisable for young children and women of child-bearing age to eat. Adult men and women past child-bearing age could eat up to one meal per week of lake sturgeon (1,300mm or smaller).

Risks from lake whitefish from Gull Lake and Stephens Lake were the lowest of the fish evaluated. Consumption recommendations indicate that lake whitefish of standard length *(e.g.,* 350 mm) from either lake may be eaten on an unrestricted basis (Table 5-27).

Consumption categories based on the size of fish are not available for the post-impoundment scenario. In order to create the size-based categories, fish would need to be caught and analyzed under such conditions. However, general consumption categories were generated from the model results for the standardized lengths of fish (see notes in Table 5-25 for standard lengths).

Table 5-27: Fish Eating Recommendations Based on Fish Size Class: Post-Impoundment Conditions

Receptor Group of Concern	Lake Whitefish (350 mm)	Jackfish (Northern Pike) (550 mm)	Pickerel (Walleye) (400 mm)
Gull Lake			
Women of childbearing age and toddlers	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Avoid eating	Avoid eating
Stephens Lake			
Women of childbearing age and toddlers	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Eat up to 1 meal per week	Eat up to 1 meal per week

Source: Wilson Scientific 2012.
Notes:
- Based on serving sizes of 400 grams per serving for men and women and 100 grams per serving for toddlers.
- A Hazard Quotient of 1 was assumed to be acceptable; however, all fish with mercury concentrations less than 0.2 ppm were classified as acceptable mercury concentrations and no consumption recommendations from current frequencies were recommended.

An alternative to reduce post-impoundment mercury exposure is to encourage eating fish from appropriate offset lakes. Adverse Effects Agreements have been signed between Manitoba Hydro and each of the four First Nations to provide offset harvesting programs to enable harvesting of country food in locations away from Gull Lake and Stephens Lake. TCN's and WLFN's AEAs specifically include Healthy Food Fish and Community Fish programs respectively to access fish from identified off-system lakes to replace fish with increased mercury levels in Gull Lake. YFFN's AEA includes a program that provides access to "off-system lakes and rivers for purposes of harvesting fish and other resources, to replace fish supplies that have the potential to be affected by Keeyask Adverse Effects" (YFFN 2009). FLCN's AEA provides for an Alternative Resource use Program to access resources within their RMA.

It is stressed that it will still be necessary to consider size and species of fish for people wanting to reduce their mercury exposure even from offset lakes. Mercury concentrations in fish from the offset lakes are variable. However, some mercury testing in offset lakes has indicated that certain fish from specific lakes have mercury concentrations that warrant consumption recommendations, with the highest levels in jackfish and pickerel (see AE SV). This does not preclude harvesting of fish from offset lakes since not all lakes have the same background levels of mercury; however, it bears caution.

Risks from eating wild game (beaver, muskrat, moose and snowshoe hare) were estimated for post-impoundment conditions. As noted previously in Section 5.3.3, the serving size and how often wild game is eaten were based on information provided by the KCNs.

Based on the predicted post-impoundment total mercury concentrations in beaver, muskrat, moose and snowshoe hare and the respective serving sizes and how often these foods are eaten, no unacceptable risks were calculated for the groups evaluated *(e.g.,* toddler, women of child-bearing age or adult males/women beyond child-bearing age). KCNs Members can continue to eat these foods at the amounts and frequencies that they are accustomed to under current conditions as well as post-impoundment conditions.

It is noted that some aquatic mammals such as otter and mink may experience appreciably higher increases in total mercury concentrations than the mammals considered in the risk assessment. However, feedback from KCNs Members received through the TWG indicated that these mammals are not eaten by Members of the KCNs communities. It is important to note that risks from consumption of these aquatic mammals were not considered in the HHRA.

For post-impoundment conditions there is some uncertainty in regard to the moose and snowshoe hare concentrations of mercury and it is recommended that monitoring of these species be completed to confirm that the assumed mercury concentrations were reasonable (see Chapter 8 of the EIS).

Risks from eating ducks were estimated for post-impoundment conditions. The serving size and how often waterfowl are eaten were based on information provided by the KCNs. Based on the predicted current and post-impoundment total mercury concentrations in ducks from Gull Lake and Stephens Lake and the respective serving sizes and how often waterfowl are eaten, no unacceptable risks were calculated for the groups evaluated *(e.g.,* toddler, women of child bearing age or adult males/women beyond childbearing age).

Although geese were not considered in the HHRA, geese are not expected to have higher mercury concentrations than ducks as geese are not more piscivorous (fish-eating) than the ducks considered in the HHRA.

No risk estimates were available for gull eggs as no estimate of the mercury concentration of these eggs was available. To provide an estimate of risks from eggs, sampling and monitoring of gull eggs would be required.

No risk estimates were available for northern tea, blueberries or Seneca root as no estimate of the mercury concentration of these wild plants was available. To provide an estimate of risks, sampling and monitoring of wild plants would be required.

As noted in Section 5.3 3, for the sole purposes of the assessment, it was assumed that the KCNs communities would drink surface water as their drinking water source. The risk assessment calculated that there are no changes in surface water mercury concentrations post-impoundment; therefore, contact with surface water will not pose unacceptable health risks from mercury under the post-impoundment conditions.

The risk assessment also considered potential risks to people who may be exposed to mercury from various elements of the environment *(e.g.,* people who drink the water and eat the identified country foods or people who may eat moose, fish and duck all in one week).

In the case of adding mercury-related risks from surface water exposures to eating country foods, the combination of these activities does not change the conclusions or recommendations presented above.

This is because the Hazard Quotients for contact with surface water are so low that when the Hazard Quotients are added together, the value essentially remains unchanged.

In the case of interactive effects from eating many types of country food, there are too many possible combinations to fully evaluate all possible interactions that may occur. However, it is clear that eating fish is the main contributor in terms of risks. Because the most risk comes from eating certain fish species, the recommendations for eating fish should be followed in order to reduce the risk from eating the fish but also to reduce the risk of additive exposure from eating other foods that may contain mercury. In particular, toddlers and women of child-bearing age should not eat the larger predatory fish (northern pike, walleye and lake sturgeon) from either Gull or Stephens lakes.

It is important to note that the risk assessment was completed using a series of assumptions that are intended to over-estimate actual health risks and thereby ensure a conservative assessment. Given the conservative assumptions used in this assessment, it is quite possible that actual risks may be substantially lower than estimated in the HHRA (see Appendix 5C for further details). Certain assumptions were key determinants in the acceptability of risks, most notably the serving size and frequency of eating certain country food; and the modeled post-impoundment estimates that in some cases had wide ranges (see Appendix 5C for a more detailed discussion of uncertainty).

It is unlikely that human health risks have been underestimated in the risk assessment and it is quite possible that already low risks have been overestimated. However, it is possible (but not likely) that risks may have been underestimated for certain receptors in some cases. The two main conditions where risks may have been underestimated would include:

- Any situations where environmental sampling or modeling has underestimated mercury concentrations either currently or that would occur following impoundment; and
- Any situations where people are not accurately represented by the assumed receptor assumptions.

Risk management measures should be undertaken to ensure that neither of the conditions described above occur. If such conditions do occur, additional risk analysis would be recommended to address potential increases in human health risks.

Overall, the bottom line is that with following the consumption guidelines, the continued consumption of country foods is considered safe and a very healthy source of nutrition for community residents.

5.4.2.3.3 Mitigation

It is important to balance the eating of traditional foods such as fish with the knowledge of what the mercury levels are in different food sources. Country foods including fish are very important to people's diet and contribute to overall health. Due to fears and lack of information from trusted sources, many KCNs community Members have indicated that they have either stopped or decreased the consuming of fish and other traditional foods, which has its own health effect. Because fish are very healthy components to a diet in the right quantity, it is important to address the community concerns, while still encouraging community Members to eat appropriate amounts and types of fish.

In their respective AEAs the KCNs have Offsetting Programs to enable them to pursue continued use of country foods from areas unaffected by the Project and within their respective RMAs. For CNP, this includes programs specific to the harvesting and distribution of fish in their communities (see Section 5.4.2.3.2 above). In addition to these AEA Offsetting Programs, additional mitigation measures will be put in place, along with monitoring programs (see Section 5.4.2.8 and Chapter 8 of the EIS) to address Project effects. These include the following:

- The Partnership, working through the MAC, will prepare a risk communication strategy and series of communication products for the KCNs, Gillam and other users of the affected lakes prior to impoundment. The strategy will include communication products and development of a monitoring program. The strategy will also include a balanced message to encourage residents to eat country foods (including fish from unaffected areas provided via AEA Offsetting Programs for the KCNs communities), and to avoid high mercury fish from affected areas.(see further details below);
- Prior to impoundment, preparation and distribution of communication products *(e.g.,* poster, placemat, fish yardstick, maps and video) to inform KCNs communities and Gillam about increases in mercury concentrations post-impoundment, and implementation of monitoring;
- Based on monitoring of fish and terrestrial species noted in the AE and TE SVs, additional human health risk assessments will be undertaken every five years after peak mercury levels have been reached to determine if adjustments can be made to the consumption recommendations;
- The HHRA will be updated (as needed) until mercury levels return to pre-Project conditions. These monitoring results will be communicated as they become available; and
- Liaison with provincial and federal health authorities and Manitoba Conservation and Water Stewardship regarding preparation of restrictions at Gull and Stephens lakes.

A communication strategy was identified as a very important component by the Mercury and Human Health Technical Working Group. As discussed in Section 5.3.3, the TWG developed this communication strategy and a series of products to be used in the KCNs communities to ensure people are aware of the issue and can make the right choices when harvesting and eating country foods. Under post-impoundment conditions, the Monitoring Advisory Committee (MAC) on behalf of the Keeyask Hydro Limited Partnership, will be the group responsible for developing post-impoundment communication about mercury levels and what types of country foods are safe to eat. In addition, monitoring of selected country foods will be undertaken during the operation phase of the Project (see the AE SV and TE SV for further details). Monitoring plans will be developed after filing the EIS, and will include KCNs involvement in the development and implementation of these plans.

Table 5-28 presents a summary of the conclusions regarding the expected post-impoundment experience as well as information regarding suggested plans for monitoring and for continued communication with community Members and stakeholders concerning eating safe country foods. No further mitigation is required.

Table 5-28: Summary of Risk-Based Conclusions and Recommendations

Exposure	Post-Impoundment Scenario Risk Based Conclusion	Recommendations for Further Action
Fish consumption from Gull Lake and Stephens Lake	Average sized or smaller lake whitefish can be consumed without restriction by the entire population from both lakes. For jackfish, pickerel and sturgeon various consumption recommendations are provided. No size-specific recommendations can currently be provided; however, smaller and less predatory fish will have lower concentrations. It is possible that size-specific recommendations will be possible if sampling was completed.	Consult on findings and approach with communities, health agencies and stakeholders. Continued monitoring. Appropriate education *(e.g.,* presentations in the community, newsletter, pamphlets, *etc.*) with emphasis on consumption recommendations specific to fish species and fish size.
Wild game consumption	Beaver, muskrat, moose and snowshoe hare can be consumed at current frequencies by all members of the communities.	Consult on findings and approach with communities, health agencies and stakeholders. Periodic volunteer sampling of wild game submitted by hunters. Appropriate education that clearly states that wildlife is safe to eat.
Waterfowl consumption	Ducks and geese can be consumed at current frequencies by all members of the communities.	Consult on findings and approach with communities, health agencies and stakeholders. Periodic volunteer sampling of wild game submitted by hunters. Appropriate education that clearly states that waterfowl is safe to eat.
Wild plant and gull egg consumption	No conclusions possible (no measurements of mercury have been collected).	Consult on findings and approach with health agencies and stakeholders. Periodic volunteer sampling of plants submitted by community members. Monitoring required if risk-based conclusions are desired.

Table 5-28: Summary of Risk-Based Conclusions and Recommendations

Exposure	Post-Impoundment Scenario Risk Based Conclusion	Recommendations for Further Action
Surface water ingestion and contact from Gull Lake and Stephens Lake	Surface water is safe to bathe and swim in; solely from a methylmercury perspective, the water can be used as a drinking water source by all members of the communities.	Consult on findings and approach with health agencies and stakeholders. Communicate on other risks associated with drinking untreated surface water and lack of issue related to mercury.

Source: Wilson Scientific 2012.

5.4.2.4 Public Safety and Worker Interaction

Effects to public safety are associated largely with the influx of non-local construction workers. Since operation employment is expected to be permanent and long-term, there is limited anticipated effect to public safety since the number of workers involved in the operational workforce is small, workers may be a combination of KCNs Members as well as non-local people, and workers will be living in Gillam long-term resulting in a stake in the community. These factors will assist in minimizing the potential for adverse worker interactions. As noted, a coordinated approach to addressing issues related to worker interaction across all Manitoba Hydro projects in the vicinity of Gillam is planned. Any related processes and measures implemented during the construction phase could be extended into operations if required.

5.4.2.5 Travel, Access and Safety

5.4.2.5.1 Water / Ice-based Travel

The operation of the Project is expected to alter the existing water and ice regimes within the Project's anticipated open water hydraulic zone of influence which extends approximately 40 km upstream from the Project site to the outlet of Clark Lake (see PE SV). The most notable aspects of the Project expected to affect the travel along the Nelson River and shoreline access during the operation phase are the following:

UPSTREAM EFFECTS

- Creation of a reservoir for the Project is expected to alter upstream waterbody characteristics, changing some parts of the watershed from a riverine to a reservoir environment. This will affect water levels, velocities and water surface profiles (PE SV).
- During open water conditions, these changes are expected to result in safer boat travel conditions between the generating station and Clark Lake by stabilizing flows and levels along most of this reach of the river. There would continue to be some fast-flowing sections, for example at Birthday Rapids, which although dampened by the backwater effect, will not be eliminated entirely.

- During winter conditions, ice cover is expected to occur earlier in winter, developing a thermal ice cover extending approximately 25 km upstream of the station and resemble that of Stephens Lake. The ice cover in the reservoir would create safer ice travel conditions than the existing environment. In the reach between Two Goose Creek and the outlet of Clark Lake, higher water levels will result in earlier formation of the ice cover (PE SV).
- Some hinging of the ice in the Project reservoir along the shoreline is expected as a result of water level fluctuations of reservoir water levels. There may be areas along the shoreline where cracks that form fill with water and subsequently create slush ice conditions, which could create hazardous travel conditions within the reservoir. This is most likely in the early winter when the cover is relatively thin (see PE SV).
- Reservoir impoundment will also result in the flooding of portions of land-based trails along the Nelson River requiring access points and boat launch and landing sites to be relocated.
- Reservoir flooding is expected to create navigation hazards from mobilized debris, floating islands, bogs, submerged rocks and islands.

Hydraulic modelling of the Project water regime indicates that changes in open water and ice conditions from the Project are projected to extend no further than Clark Lake. Further, this prediction has been incorporated as a fundamental feature of the JKDA that states that operation of the Project will not affect water levels on Split Lake during open water conditions. However, some CNP and YFFN Members have expressed concern that backwater effects may occur upstream of Clark Lake and possibly into Split Lake; thus resulting in safety concerns regarding boat travel.

Members of YFFN strongly believe that the effects of the Project will go beyond the predicted open water hydraulic zone of influence. Since York Landing does not have all-year road access, travel access and safety are a constant part of life for YFFN Members. YFFN Members have expressed concern the Project may result in additional effects on ice processes on Split Lake that could affect the winter road system. YFFN Members believe that unreliable winter road conditions already exist in part because of the seasonal reversal of water levels on Split Lake as a result of hydroelectric development (YFFN 2004; YFFN Evaluation Report (*Kipekiskwaywinan*)). The addition of the Project to the Nelson River system further exacerbates the community's concerns about the accessibility of York Landing, and associated travel safety and costs (YFFN Evaluation Report (*Kipekiskwaywinan*)).

While Manitoba Hydro has a high degree of confidence in the predicted open water hydraulic zone of influence, KCNs' experiences with past hydroelectric projects provides a different perspective. Some of the KCNs believe that past assertions made by Manitoba Hydro about anticipated changes in the water regime are now different to what the communities have experienced. Given this difference in the confidence of the modelling results and the important implication to travel for KCNs Members if open water and ice conditions were to be affected by the Project, it will be important to monitor water and ice conditions on Split Lake.

While the moderating and smoothing of ice conditions will make winter travel on ice safer from Clark Lake to the generating station, uncertainty exists about the change in ice development on the rivers and lakes in some locations.

A comprehensive Physical Environment Monitoring Program (PEMP) will be developed and will include monitoring of water and ice regime conditions. This will help to verify the results of the water and ice regime assessment as well as monitor changes in the ice regime both during and after construction. This information will be used to help identify and map safe and unsafe travel areas (PE SV). Monitoring will be reviewed and discussed at the MAC.

PRESENCE OF THE GENERATING STATION, DYKES AND THE SOUTH ACCESS ROAD

- The generating station will be a barrier to continuous water-based travel between the area upstream and downstream of Gull Rapids. The area around the generating station and spillway poses distinctive hazards to water travel.
- The presence of a series of earth dykes along the north and south sides of the Nelson River along with inundation of the surrounding lands will alter the ways in which people can access this reach of the Nelson River by inundating or impeding use of existing access points and launching sites.

DOWNSTREAM EFFECTS

- During open water conditions, boaters will continue to be required to use a portage trail around the generating station (as opposed to around Gull Rapids). There should be no further changes to open water travel on the majority of Stephens Lake (exception noted below).
- During winter conditions, the existing hanging ice dam that occurs immediately downstream of Gull Rapids is not expected to form in the future; instead a thermal ice cover will form (PE SV Section 4.4.2).
- Immediately downstream of the powerhouse, an area approximately 800 m long is expected to remain ice free all winter; and a portion of the south channel of Gull Rapids near the spillway is expected to be dry when the spillway is not operational (approximately 88% of the time based on historical records) (PE SV).
- Travel during winter will require a modification of snowmobile routes to go around the facility and avoid the spillway.

As with the construction phase, effects of the Project operation on water travel, access and safety are addressed through a comprehensive program of mitigation measures contained in the Waterways Management Program (WMP) (Phase II) (Schedule 11-2 of the JKDA). The WMP was developed to address the issues of flooding of portions of land-based trails, relocation of access points, new boat launches and safe landing sites. The WMP also includes provision to identify navigation hazards (including debris) and provide alternative safe open water routes and ice trails.

Travel access and safety measures that will be implemented during the operation phase, as identified in Phase II of the WMP include:

- Marking safe travel routes by installing and maintaining navigation and hazard markers along primary travel routes and along charted routes to shore access points at locations where there is a serious risk of striking a rock or reef depending on water levels;

- In locations where it is expected that travel on the ice will be dangerous and where ice conditions will be unknown or uncertain, safe trails over the ice will be marked, and the ice will be monitored until ice travel maps are considered reliable;
- Preparation of reservoir depth charts to illustrate the depth of water throughout the reservoir upstream from the Keeyask Generating Station as an aid for boat travel. The depth charts will also illustrate safe travel routes that should be used during all water level conditions;
- Installing and maintaining water level staff gauges to provide information required to interpret the reservoir depth charts and determine the depth of water along travel routes under conditions prevailing at the time;
- Recognizing that the reservoir will be used for resource harvesting, boat travel and a variety of other pursuits, a number of potential landing sites have been identified along the shoreline. At these landing sites, required docks and shelters will be constructed and maintained;
- Maintenance of trails and portages;
- Collection of floating debris; reservoir clearing will minimize the source of such debris; and
- Monitoring waterway activities and liaising with individuals and groups.

As noted in the Project Description SV, the following measures will be implemented to ensure safe travel immediately upstream and downstream of the generating station infrastructure:

- Similar to current practice to avoid travelling through the rapids, access to Stephens Lake will be via a new portage around the new generating station;
- Posting signs on both sides of the shoreline on the upstream and downstream side of the generating station, warning people of potentially dangerous boating and swimming conditions;
- Fencing off potentially hazardous areas *(e.g.,* slopes leading to the spillway discharge and tailrace channels);
- Installing safety railings on the spillway deck, powerhouse reservoir deck, the main dam and tailrace deck; and
- Installation of a siren system to provide advance warnings of the movement of the spillway gates.

EFFECTS OF CHANGES TO OPEN WATER AND WINTER ICE ON GILLAM

Residents in the town of Gillam who use Stephens Lake for recreational and traditional activities are unlikely to notices changes in Stephens Lake water and ice conditions due to downstream flows from the Project. Immediately downstream of the generating station, safe trails over open water and ice will be marked, and the open water and ice will be monitored until open water and ice travel maps are considered reliable.

5.4.2.5.2 Road-based Travel, Access and Safety

Project-related traffic levels will be much lower during the operation phase than during the construction phase. It is expected that the daily workforce at the Keeyask site will consist of approximately 37 maintenance staff (Manitoba Hydro 2009). The required workforce to operate the plant will result in a negligible amount of traffic on PR 391 as employees will be housed in Gillam. Daily commuting to the Project by employees in addition to occasional delivery vehicles on PR 280 are not expected to have a noticeable effect on the traffic volumes in comparison to background traffic levels in the Local Study Area.

MIT plans to re-route PR 280 along the north access road, across the generating station and along the south access road to Gillam, thus reducing travel distance between Thompson and Gillam by 54 km; travel patterns may change as a result. FLCN Members living in the community of Fox Lake (Bird) have expressed concerns about any closure since their trip to Thompson is shorter on the existing route than via the south access route.

5.4.2.5.3 Mitigation

No further mitigation is required.

5.4.2.6 Culture and Spirituality

5.4.2.6.1 Keeyask Cree Nations

The operation effects on known intangible culture and spirituality within the Core, Local and Regional Study Areas are summarized below, according to the nine cultural indicators:

Worldview: Long-term, some KCNs Members may question their decision to be partners in the Project because of its disturbance to *Askiy*. The Partnership however, provides the opportunity for the Cree to offer respect for the giving of the land and the rapids for future generations through ceremony and ritual at key Project milestones (some of which may occur in the early stages of the operation phase as units are coming on line and components of the site are re-established are rehabilitated). As well, there is the opportunity for oversight and long-term monitoring of effects, thus partially fulfilling their stewardship role to care for *Askiy* (see Chapter 2 for more details on the KCNs worldview statement). This includes environmental and stewardship programs identified in TCN's and YFFN's respective AEAs, in addition to participation in ATK monitoring.

Language: Cree place names and other mnemonic devices act as catalysts for language and the oral narrative. Loss of Cree language associated with loss of place names/landmarks affected by the Project could cause grief and unhappiness because the Cree words that describe an area may be rendered meaningless once those areas are disturbed or lost. This is balanced by the AEAs Offsetting Program (re: language) to strengthen long-term use of Cree in the communities; as well as the overall AEAs agreed to by the KCNs.

Traditional knowledge: There will be rapid change and loss of applicable Aboriginal traditional knowledge associated with physical and biophysical changes in the environment affected by the Project. This will be offset by the retention and transmission of ATK that continues to flow from the land use and related studies already undertaken with funding from the Project, the development and implementation of ATK monitoring programs, and the implementation of offset programs as defined in the AEAs to promote traditional land use and transmission of knowledge.

Cultural practices: Cultural practices and pursuit of traditional activities within the Footprint study area will diminish and may not be transferable to other areas. The reservoir area will be restrictive to current traditional activities. Winter access will be altered due to changing water levels and ongoing shoreline erosion, and summer access could be dangerous in the vicinity of the generating station. KCNs Members who regularly camp will likely have to find new areas for their traditional campsites. This will be balanced by the ongoing Waterways Management Program (new camp sites and trail access). In addition, opportunities are available for conducting traditional activities and cultural practices in areas visited as part of the AEA Offsetting Programs where such activity was more difficult due to access or ability to reach these locations. This will also result in an overall benefit to health and well-being.

Health and wellness: Overall health and wellness may increase due to access to healthy country foods (fish and wild game) through the access programs, as well as opportunities for wilderness camps and actively undertaking traditional activities. See also Section 5.4.2.2 for a review of effects on western modes of health and wellness.

Kinship: Kinship and family ties have the potential to be strengthened during the operation phase through the AEA Offsetting Programs.

Leisure: There is not expected to be any Project operation effect on leisure *(e.g.,* playing sports, bingo, skating).

Law and order: Customary law and order is not expected to be affected by the operation of the Project.

Cultural products: The emotional and historic connection to particular areas for harvesting of traditional plants and resources for making cultural products will be altered due to physical changes to the environment during operation. However, the ability to collect materials and create cultural products from the offset areas identified in the AEAs will provide opportunities for completing traditional tasks and continuing the flow of ATK.

The same AEA programs noted above during the construction phase also apply during the operation phase. Degree of confidence for all indicators is high.

5.4.2.6.2 Mitigation

KCNs Members will continue to experience culturally-related disturbances and losses in conjunction with losses in their cultural landscape. These effects would be offset by the combination of processes and measures established during the planning stage of the Project, including the AEAs, and moderated by the proposed mitigation measures including the following:

- Prior to construction, prepare a video of Gull Rapids and the river between the outlet of Clark Lake and Stephens Lake (including the sound of the rapids). In a visitor space at the generating facility, include the video and interpretative boards that enable KCNs and other community Members to visit, remember the area prior to construction of the Project and pay ongoing respect for *Askiy*.
- Cultural training to be provided to Keeyask operation staff.

No further mitigation is required.

UNCERTAINTY

The AEAs Offsetting Programs and associated success ultimately will be determined by each of the KCNs communities. These programs were developed based on each of the KCNs' individual experiences with past hydro development that affected their community. The KCNs communities held ratification votes and ultimately agreed to the implementation of the programs. There is also latitude within the programs for adjustment or reallocation of funding to areas deemed of greatest importance. Therefore, from a culture and spirituality perspective, the degree of confidence in mitigating the adverse effects identified above is high.

5.4.2.7 The Way the Landscape Looks (Aesthetics)

The characterization of effects from Project operation on the aesthetic environment included consideration of the Project description, the Project visibility within the landscape context, and the viewer value and sensitivity levels, as described in Section 5.2.6.

5.4.2.7.1 Local Study Area

Upon completion of construction and final commissioning of the generating station, the Project will affect the aesthetic nature of the area, including the following:

- The flooding of 45km^2 between the generating station and the outlet to Clark Lake;
- Changes from a riverine to a reservoir environment;
- Ongoing shoreline erosion;
- Loss of the rapids, including the loss of the sound of the rapids;
- Replacement of the rapids with a physical barrier (the dam and generating station) resulting in a transition from a natural to built environment);
- Re-routing of PR 280 via the north access road, over the dam, and via the south access road into Gillam; and
- Potential changes to the Town of Gillam as a result of an increase in population.

Operation effects to aesthetics will be permanent in nature and will change the overall character of the area. The reservoir will resemble the environment present at Stephens Lake, although the extent of debris is likely to be less given the Reservoir Clearing Plan. There-routing of PR 280 will increase overall access to the area, and thus a higher number of viewers and users are likely.

The effects of the Project's operation on the way the landscape looks (*e.g.*, aesthetics) will depend largely on an individual's perspective, and as such are likely to vary considerably. For example, an engineer may view the dam as a marvel of construction. A Gillam resident may view the area as an opportunity for recreation. A cabin-owner on Stephens Lake may feel their view is obstructed; and a resource user may feel their environment has been changed forever.

KCNs Members may be more likely to experience an adverse reaction to the aesthetic changes associated with the Project's operation, as the creation of a reservoir is a reminder of other changes to the landscape that have historically altered their connection to the land. FLCN describes their experience with a past project on the Nelson River saying "The flooding of the Nelson River and loss of land during the following construction of the Kettle Generating Station left a permanent scar on the landscape of the home environment of the Fox Lake people. This once unaltered area, a major local source of country food, medicinal plants and places of cultural importance was changed forever – following the impoundment and the creation of Stephens Reservoir. Old timers witnessed the large-scale receding movements of animals out of the territory as the water rose" (FLCN 2010 Draft). The AEAs and above-noted mitigation will help to address the considerable changes to the way the landscape looks.

5.4.2.7.2 Gillam

The Project will require an operational workforce that cannot be accommodated in existing housing in Gillam. As such, additional housing is being considered by Manitoba Hydro, although the exact location for new developments is being determined in concert with the Gillam Land Use Planning process.

The Project will also result in changes to the physical appearance of the town of Gillam through the construction of new housing and infrastructure to accommodate growth of the community currently under consideration. It is expected that these new additions will enhance the overall aesthetic quality of the community.

5.4.2.7.3 Mitigation

A park/rest area associated with boat launches both upstream and downstream of the generating station on the north side of the Nelson River are planned. A video taken of the rapids and Gull Lake prior to construction will be available for viewing in a visitor space at the generating station once the station is in operation. As well, a commemorative plaque and memorial is planned to recognize people who have used and continue to use the Gull Lake area. Rehabilitation of site construction areas such as borrow areas are to follow the principles set out in Schedule 7-1 of the JKDA, including using local plant species in disturbed areas.

5.4.2.8 Operation Monitoring

As noted in Chapter 8 of the Response to EIS Guidelines, monitoring of socio-economic effects will be organized into a coordinated SEMP whose details will be developed after the Project has been filed. It will be part of a larger strategy to identify where the proposed approaches to conducting the Project and mitigating its effects may have to be adjusted in order to address observed Projects effects that do not align with what had been predicted. In relation to personal, family and community life, monitoring of operation phase effects is proposed for selected VECs.

MERCURY AND HUMAN HEALTH

The operation of the Project will result in increased mercury levels in country foods used by communities in the Local Study Area. Mercury monitoring will occur under the Aquatic and Terrestrial monitoring programs and follow-up programs will involve the KCNs in various capacities. For example, follow-up programs include having KCNs Members collect (on a voluntary basis) samples of wild game, waterfowl and plants for mercury testing to confirm mercury concentrations remain acceptable for domestic consumption. Other monitoring would include periodic surveys of consumption of country food in KCNs communities. Monitoring will also help to ensure that KCNs communities are aware of the Health Canada program for voluntary testing of mercury levels in people (subject to cross-check that program is still available). Finally, the KCNs would be involved in designing and implementing communication strategies for reporting of mercury sampling results to their home communities.

TRAVEL, ACCESS AND SAFETY

During operation, travel, access and safety concerns have been expressed in relation to KCNs Members who use Split Lake and Gull Lake for traditional activities. Monitoring is contained under the Waterways Management Plan Phase II (Sch. 11-2 of the JKDA) in relation to Gull Lake area. Further to this, MIT will maintain responsibility for the monitoring and ongoing maintenance of ferry landing sites and winter road conditions on Split Lake. Manitoba Hydro will continue to monitor water levels on Split Lake.

CULTURE AND SPIRITUALITY

There is some uncertainty as to how much operation of the Project will affect the culture of the KCNs. Adverse Effects Agreements have been negotiated with each of the KCNs based on each community's assessment of the Project's potential effects, including any interference with its traditional customs, practices and traditions. In terms of monitoring, each community would undertake its own internal evaluation of the AEA Offsetting Programs and determines whether they continue to address the adverse effects of the project. If required, these agreements provide flexibility for the AEA Offsetting Programs to be modified to more adequately address Project effects as they are experienced. The agreements also provide the opportunity for the communities and Manitoba Hydro to negotiate additional programming if unforeseen or unanticipated effects arise. These mechanisms will be used to ensure the AEAs continue to mitigate adverse effects of the Project on the KCNs communities.

5.5 SUMMARY OF RESIDUAL PROJECT EFFECTS

This section summarizes residual effects of the Project (after mitigation) on socio-economic VECs related to personal, family and community life for both the construction and operation phases.

5.5.1 Construction Phase

Table 5-29 provides a summary of expected Project construction effects, high-level mitigation and monitoring identified to address those effects, assessment characteristics used (*e.g.*, magnitude, geographic extent and duration) and the residual effects (after mitigation) pertaining to the Local Study Area. Effects beyond the Local Study Area are not anticipated.

Table 5-29: Summary of Construction Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Mitigation measures, monitoring and follow-up	Residual socio-economic effect	Assessment characteristics[1]
GOVERNANCE, GOALS AND PLANS			
KCNs: • Need for KCNs to participate in implementation of the Partnership • Ongoing opportunity for oversight of the Project and participation in advisory committees.	Measures already in place in the JKDA and AEAs	Increased demand on KCNs to address construction issues and participate in Partnership committees and the KHLP board. Increased capacity of KCNs representatives from intensive involvement in project planning and development	Direction: Positive Magnitude: Moderate Geographic Extent: Medium Duration: Long-term
Gillam/Thompson: Increased demand on community leadership,	Involvement in Gillam Land Use Planning process underway	On going demand for community planning	Direction: Neutral

Table 5-29: Summary of Construction Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Mitigation measures, monitoring and follow-up	Residual socio-economic effect	Assessment characteristics[1]
COMMUNITY HEALTH			
Increased demand for community health and social services.	• Health and safety services provided at the construction camps. • Measures identified in the KCNs AEAs, as well as measures identified for other VECs (e.g., public safety).	On-going demand for health and social services.	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Medium-term
MERCURY AND HUMAN HEALTH			
No construction related effects			
PUBLIC SAFETY			
KCNs and Gillam Risk to public safety related to influx of non-local construction workers	• Preventative measures focused on construction workers at Project • Coordinated discussion among Manitoba Hydro, the Town of Gillam, TCN and FLCN (where appropriate) to determine the best mechanism for tracking and addressing worker interaction issues • Socio-economic monitoring and adaptive management	Risk to public safety	Direction: Adverse Magnitude: Moderate Geographic Extent: Medium Duration: Short to medium-term

Table 5-29: Summary of Construction Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Mitigation measures, monitoring and follow-up	Residual socio-economic effect	Assessment characteristics[1]
Thompson Risk to public safety related to influx of non-local construction workers	Socio-economic monitoring and adaptive management	Risk to public safety	Direction: Adverse Magnitude: Moderate Geographic Extent: Small Duration: Short to Medium-term
TRAVEL, ACCESS AND SAFETY			
Changes to travel on and access to Nelson River; restricted access near construction site	Implementation of the Reservoir Clearing Plan, the Waterways Management Plan (WMP) Phase I and the Access Management Plan. Existing waterways management programs under the Comprehensive Implementation Agreement with TCN and YFFN	Changes to travel and access	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term
Increased traffic volumes on PR 280 and PR 391 with potential for increased accidents	Improvements to PR 280 undertaken by MIT prior to Project Construction Access Management Plan	Increased traffic	Direction: Adverse Magnitude: Moderate Geographic Extent: Medium Duration: Short-term

Table 5-29: Summary of Construction Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Mitigation measures, monitoring and follow-up	Residual socio-economic effect	Assessment characteristics[1]
CULTURE AND SPIRITUALITY			
Loss of cultural landscape and the rapids	Offsetting Programs in AEAs are key to addressing effects on culture and spirituality Ceremonies and rituals at key Project milestones Counselling services as part of Employee and Retention Support DNC	Loss of cultural landscape and rapids	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term
THE WAY THE LANDSCAPE LOOKS (AESTHETICS)			
Changes in physical landscape and scenic views	Implementation of Reservoir Clearing Plan Ceremonies and rituals at key Project milestones; vigil at river closing Nature trails within north camp area Rehabilitation of construction site as per Sch. 7-1 of JKDA	Ongoing changes to physical landscape and views	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term

Notes:
Direction: Positive, Neutral or Adverse
Magnitude: Small, Moderate, or Large
Geographic Extent: Small, Medium, Large
Duration: Short-term, Medium-term or Long-term

5.5.2 Operation Phase

Table 5-30 provides a summary of expected Project operation effects, high-level mitigation and monitoring identified to address those effects, assessment characteristics used (*e.g.*, magnitude, geographic extent and duration) and the residual effects (after mitigation) pertaining to the Local Study Area. Effects beyond the local study area are not anticipated.

Table 5-30: Summary of Operation Phase Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Mitigation measures, monitoring and follow-up	Residual socio-economic effect	Assessment characteristics
GOVERNANCE, GOALS AND PLANS			
KCNs: Ongoing role in oversight of the Project, including on the KHLP board and committees. Demand on KCN leadership regarding the use of equity income.	Measures already in place through JKDA and AEAs	Ongoing demands related to planning and decision making regarding the use of equity income	Direction: Positive Magnitude: Small to Moderate Geographic Extent: Medium Duration: Long-term
Gillam: Ongoing demand for leadership in community planning	Continued involvement in Gillam Land Use Planning Process already underway	Same as effect	Direction: Neutral
COMMUNITY HEALTH			
Increased demand for health and social services in the KCNs communities and Gillam	Offsetting Programs noted in each of the KCNs AEAs Continue existing dialogue with health and social services providers in Gillam (e.g., NNADAP, Awasis, RCMP, BRHA) Continued involvement in the Gillam Land Use Planning process already underway	Increased demand for health and social services	Direction: Positive Magnitude: Small Geographic Extent: Medium Duration: Long-term

Table 5-31: Summary of Operation Phase Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect
MERCURY AND HUMAN HEALTH			
Elevated levels of methylmercury will result in consumption restrictions on Gull and Stephens lakes	Monitor mercury concentrations in fish (see AE SV) Voluntary sampling of wild game, waterfowl, plants and gull eggs for mercury analysis (see TE SV) Encourage use of fish from unaffected lakes (via AEA programs) Employment of a risk communication strategy and communication products for post-impoundment conditions; encourage use of country foods generally, and use of fish with low mercury concentrations Prior to impoundment prepare and distribute communication products (e.g., poster, placemat, fish yardstick, maps and video) to KCNs communities and Gillam about increases in mercury concentrations post-impoundment, and implementation of monitoring Employment of a risk communication protocol for residents of Gillam (including signage) Communicate monitoring results Liaison (through MAC) with federal and provincial health authorities/Water	Restricted consumption of pickerel and jackfish (all groups) and lake sturgeon (for toddlers and women of child-bearing age only) in Gull and Stephens lakes Restricted consumption of walleye and northern pike	Direction: Adverse Magnitude: Moderate Geographic Extent: Medium Duration: Medium-term

Table 5-31: Summary of Operation Phase Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect
	Stewardship re: consumption restrictions HHRA redone until pre-Project levels are achieved Socio-economic monitoring plan (see Chapter 8 of the EIS)		
PUBLIC SAFETY			
Some risk to public safety related to community growth from operation workers in Gillam	If needed, extension of the coordinated approach to addressing worker interaction issues identified under the construction phase	Risk to public safety	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term
TRAVEL, ACCESS AND SAFETY			
Improved travel conditions on and access to Nelson River; use of new trails and portage routes to navigate around facilities	Implementation of the WMP Phase II safety features (*e.g.*, fencing) Safety features associated with generating facility (*e.g.*, siren and fencing) Existing waterway management programs under the Comprehensive Implementation Agreements with TCN and YFFN	Changes to travel and access	Direction: Positive Magnitude: Small Geographic Extent: Medium Duration: Long-term
Shorter travel distance between Thompson and Gillam	None required	Same as effect	Direction: Positive Magnitude: Small Geographic Extent: Medium Duration: Long-term
CULTURE AND SPIRITUALITY			
Loss of cultural landscape and the rapids	• Offsetting Programs in AEAs are key to addressing effects on	Loss of cultural landscape and rapids	Direction: Adverse Magnitude: Small

Table 5-31: Summary of Operation Phase Effects on Valued Environmental Components for Personal, Family and Community Life

Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect	Potential socio-economic effect
	culture and spirituality • Video of Gull Rapids and stretch of the Nelson River between Birthday Rapids and Stephens Lake prior to construction • Interpretative display in visitor room of generating station • Cultural training for operation staff		Geographic Extent: Medium Duration: Long-term
THE WAY THE LANDSCAPE LOOKS (AESTHETICS)			
Gull Lake changed from riverine to lake environment; loss of rapids	• Park/rest area with boat launch • Commemorative plaque or memorial • Video of Gull Rapids and stretch of the Nelson River between Birthday Rapids and Stephens Lake prior to construction Interpretative display in visitor room of generating station	Ongoing changes to Gull Lake and loss of rapids	Direction: Adverse Magnitude: Moderate Geographic Extent: Medium Duration: Long-term

Notes:
Direction: Positive, Neutral or Adverse
Magnitude: Small, Moderate, or Large
Geographic Extent: Small, Medium. Large
Duration: Short-term, Medium-term or Long-term

5.5.3 Summary of Residual Effects for the Construction and Operation Phases

In summary, residual effects on KCNs governance, goals and plans during construction are expected to be positive (due to experience gained in negotiations and planning and implementation of the Project) of moderate magnitude and short-term. During the operation phase, residual effects are expected to be positive (due to opportunity to use equity income for community goals and plans), medium in geographic extent, of small to moderate magnitude, and long-term.

Residual effects on governance related to Gillam are expected to be neutral due to ongoing planning in place now and into the future to prepare for future Project changes. Residual effects on governance related to Thompson are limited to the construction phase and are neutral.

Residual effects related to community health in the construction phase (KCNs, Gillam and Thompson) are adverse (due to increased demand for health and social services), of medium geographic extent, medium-term and medium in magnitude; and in the operation phase (KCNs, Gillam and Thompson) are positive (due to employment and equity income providing the opportunity for a higher standard of living), of medium geographic extent, of long-term duration and small to moderate in magnitude.

There are no residual effects related to methylmercury and human health in the construction phase. During the operation phase, there will be elevated levels of methylmercury, particularly in pickerel and jackfish from Gull Lake (and to a lesser extent Stephens Lake). Residual effects after mitigation are expected to be adverse, of moderate magnitude, medium in geographic extent, and medium-term and continuous for several decades, with declining trends over time. Undertaking further human health risk assessments will provide the necessary information to reduce the consumption restrictions as the methylmercury levels decline.

Residual effects, after mitigation, related to public safety and worker interaction for the KCNs and residents of Gillam and Thompson during the construction phase are expected to be adverse, moderate in magnitude and short to medium term in duration. A key mitigation measure is the development of a coordinated approach across all Manitoba Hydro projects in vicinity of Gillam among Manitoba Hydro, the Town, TCN (where appropriate) and FLCN (where appropriate). Residual effects during the operation phase are expected to be adverse, medium in geographic extent, small in magnitude and long-term in duration.

Residual effects, after mitigation, related to water and ice-based travel access and safety during the construction phase are expected to be adverse due to change in travel patterns and restricted access, small in magnitude, of long-term duration and of medium geographic extent. During the operation phase, residual effects are expected to be positive (due to provisions in the Waterways Management Program, including new trails, boat launches and a portage and safe landing sites), of small magnitude, medium in geographic extent and long-term in duration.

Residual effects, after mitigation, related to road-based travel access and safety during construction are expected to be adverse (due to increased traffic), of medium geographic extent, moderate in magnitude and short-term. Residual effects during the operation phase are expected to be positive (due to shorter travel distance between Thompson and Gillam), medium in geographic extent, small in magnitude and long-term.

Effects on culture and spirituality are moderated by the KCNs' involvement in shaping the Project, the AEA Offsetting Programs that are focused on culture and the DNC that includes cross-cultural training and provision for ceremonies at key milestones. Residual effects of both construction and operation, after mitigation, on culture and spirituality are adverse, medium in geographic extent, small in magnitude and long-term.

Residual effects after mitigation related to the way the landscape looks during the construction phase are expected to be adverse (due to the physical alteration of the landscape), small in magnitude, medium in geographic extent and long-term. During the operation phase, residual effects are expected to be adverse (due to a change from riverine to a reservoir environment and the loss of the rapids), moderate in magnitude, medium in geographic extent, and long-term.

APPENDIX 5A
HEALTH INDICATOR DATA

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5A.0 HEALTH INDICATOR DATA SOURCES

Three main sources of data for KCNs were used to compile information on the selected sets of indicators.

There are some discrepancies in the way in which data are collected and reported by these agencies. FNIH data can include both on- and off-reserve data for residents using the health center on-reserve for the Chronic Conditions by Diagnosis List. In addition, because WLFN residents obtain primary services at the Ilford Health Centre (under BRHA), there is no Chronic Condition List for these community Members.

Data for First Nation residents living on reserve for the province of Manitoba overall and for the entire BRHA area were only available from Manitoba Health for selected indicators. Therefore, provincial First Nation and regional rates are not provided for every indicator in this report.

There are discrepancies in population counts between INAC, FNIH and Manitoba Health. Usually, the population figures from Manitoba Health are much lower than those from the federal agencies. This is partly because Manitoba Health data are based strictly on geography and refer only to those residents actually living on-reserve. However, even the on-reserve population figures are different. This means that any health data with a source of Manitoba Health refers only to the smaller number of residents and this smaller population has been used as the denominator in calculation of rates.

It is also important to note that administrative health data are collected specifically by geographic location and not ethnicity. This means, for example, that we cannot compare KCNs residents with all Aboriginal residents living in BRHA. Comparison can only be made to BRHA residents living on-reserve or off-reserve or all residents. Because over three quarters of residents of the region self-identify as Aboriginal, we have chosen to compare to the entire region. For Manitoba overall, we can compare health data to all First Nation residents living on-reserve but not to all Aboriginal residents in Manitoba.

5A.1 LIMITATIONS OF THE DATA

One of the major challenges of determining whether there are impacts on the health of small populations from environmental change is that of sensitivity. Many environmental factors known to have an impact on community health can have relatively small effects, which can be lost amongst the multitude of influences on the health of a community. Over the past several decades there have been marked changes in the health, environmental, economic and social circumstances of northern First Nation peoples. There have been changes in diet, housing, income, employment, tobacco and alcohol misuse, transportation, education, physical activity, and exposures to a wide variety of environmental factors within the home, school and workplace. Trying to tease out the impact of an individual environmental change can be a challenge for many conditions. This is particularly true for chronic conditions and cancer, though more easily determined for more acute events such as infectious diseases like diarrhea from factors influenced by water quality.

With individual communities, the size of the population can also be a limitation in picking-up potential impacts because of the wide confidence intervals that result during the analysis. A change or impact needs to be fairly large in order to confidently say that there is a significant difference.

Many of the data sources use health service use as the measure for health status. An example of this is using hospitalization rates as an indicator for health. Hospitalization rates are influenced by health status but they are also influenced by general policy on hospitalization use, the availability of hospital beds, the practice patterns by various physicians, and the use and availability of ambulatory care services. Thus changes that occur between populations or within the same population over many years can be influenced by other factors over and above changes in health.

The Chronic Condition by Diagnosis List was used to assess a number of non-cancer chronic conditions. This type of data source has significant limitations because it does not capture all of the chronic conditions and there may be variations in the criteria for the diagnosis. These limitations need to be considered in the interpretation of various results.

Table 5A-1: International Classification of Disease and Cause of Death Classifications

Classification	Brief Description
I. Certain Infectious and Parasitic Disease	These are diseases that are generally recognized as communicable or transmissible. This includes tuberculosis, bacterial diseases, hepatitis and sexually transmitted infections.
II. Neoplasms (Cancer)	A group of diseases in which cells grow unusually and uncontrolled. Common forms of cancer include lung cancer, breast cancer, prostate cancer, colorectal cancer and skin cancer.
III. Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	Diseases that are caused by not having enough blood cells. Iron deficiency anemia is a common disease in this category (person does not have enough iron in the diet).
IV. Endocrine, nutritional and metabolic diseases	Diseases as a result of not eating properly, by glands that do not work properly or substances in the body that are toxic. Some conditions under this category include diabetes, malnutrition, obesity, and thyroid disease.
V. Mental and behavioural disorders	Disorders that affect people's mood or thinking over time. Some common disorders include depression, disorders caused by drugs or alcohol, and schizophrenia. Also included are mental retardation and childhood and adolescent behavioural and emotional disorders.
VI. Diseases of the nervous system	Those diseases that affect the ability to sense, feel and use reflexes. Some common nervous system diseases include Multiple Sclerosis, Alzheimer's disease and Parkinson's Disease.

Table 5A-1: International Classification of Disease and Cause of Death Classifications

Classification	Brief Description
VII. Diseases of the eye and adnexa; VII Diseases of the ear and mastoid process	Diseases of the Eye and Ear are those that affect a person's ability to see and hear. The most common eye diseases include blindness, nearsightedness, farsightedness, and astigmatism. A number of ear conditions can affect hearing or balance. Ear infections are the most common among children, tinnitus (roaring in one's ears) and Meniere's disease (inner ear disease affecting balance).
IX. Diseases of the circulatory system	Diseases that affect the movement of blood in heart and blood vessels. These diseases can cause problems for the lungs, the brain, kidneys or other parts of the body. The most common circulatory diseases are heart diseases and stroke.
X. Diseases of the respiratory system	Diseases that affect breathing. Examples of respiratory diseases include the common cold, asthma, lung cancer, pneumonia, tuberculosis, Chronic Obstructive Pulmonary Disease (COPD) and cystic fibrosis.
XI. Diseases of the digestive system	Conditions that affect the digestive tract in the body. Diseases included are appendicitis, Crohn's disease, colitis, ulcers, disorders of the gallbladder and liver disease.
XII. Diseases of the skin and subcutaneous tissue	Diseases that affect the layers of skin. Acne, blisters and rashes are common conditions in this category. Many of these diseases may be related to quality and availability of clean water as well as personal hygiene practices.
XIII. Diseases of the musculoskeletal system and connective tissue	This classification includes muscles disorders, arthritis, and osteopathies (disorders of bone density).
XIV. Diseases of the genitourinary system	Diseases affecting the reproductive system of men and women. Some common examples include kidney and gall bladder stones, urinary tract infections, kidney failure, and prostate cancer.
XV. Pregnancy, childbirth and the puerperium	Conditions related to, or aggravated by, the pregnancy, childbirth or by the puerperium (the six week period following childbirth). These can be due to maternal causes or obstetric causes. Some examples include pregnancy with abortive outcome, complications of labour and delivery and hypertension in pregnancy.
XVI. Certain conditions originating in the perinatal period	These are conditions that originated perinatal period (the time period from about 20 weeks gestation until about 4 weeks after birth) even though death or illness occurs later. This includes birth trauma, disorders related to length of gestation and fetal growth

Table 5A-1: International Classification of Disease and Cause of Death Classifications

Classification	Brief Description
	and infections that occurred during the perinatal period.
XVII. Congenital malformations, deformations and chromosomal abnormalities	Birth defects that develop before birth. Example include infants are born with heart defects, cleft lip or palate, Down syndrome, spina bifida, and limb defects.
XVIII. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	The conditions and signs or symptoms included consist of: Cases for which no more specific diagnosis can be made even after all the facts bearing on the case have been investigated; Signs or symptoms existing at the time of initial encounter that proved to be transient and whose causes could not be determined; Provisional diagnoses in a patient who failed to return for further investigation or care; Cases referred elsewhere for investigation or treatment before the diagnosis was made; Cases in which a more precise diagnosis was not available for any other reason; and Certain symptoms, for which supplementary information is provided, that represent important problems in medical care in their own right.
XIX. Injury, poisoning and certain other consequences of external causes	This classification involves the specific injury type and site. For example injuries to the head, the neck etc with details. Burns and frostbite are also included in the category.
XX. External causes of morbidity and mortality	This is the cause of the injury. For example, the external cause of a "head injury" may be motor vehicle accident. This classification would note the nature of the external cause (such as car accident) that lead to injury.
XXI. Factors influencing health status and contact with health services	This classification is used for reasons other than disease or injury: When a person donates an organ or tissue, receives vaccination or discusses a problem that is in itself not a disease or injury. When some circumstance or problem is present that influences the person's health status but is not in itself a current illness or injury. They can be recorded as an additional factor to be considered when the person does receive care for an illness or injury.

Source: WHO 2010.

APPENDIX 5B
MERCURY AND HEALTH
TECHNICAL WORKING GROUP

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5B.0 PURPOSE

The Keeyask Mercury and Human Health Technical Working Group (the Working Group) was formed in June 2007 to address concerns expressed by the Keeyask Cree Nations (KCNs) respecting an increase in methylmercury (mercury) resulting from the flooding of land in the forebay of the proposed Keeyask Generation Project. Two key questions were raised:

- Would flooding increase mercury levels in fish and other animals eaten by people so that mercury levels in people would also increase?
- If there was an increase, would this pose a health risk to people?

The Working Group was struck by the EIS Coordination Team[1], which recognized that the topic of mercury and human health is highly complex in both technical analysis and language. The level of technical complexity presents a challenge when trying to discuss study results with communities in ways that are clear and helpful. As discussed at the first workshop in June 2007, the purposes of the Working Group were as follows:

- To answer the KCNs communities' and Manitoba Hydro's questions about mercury and human health today;
- To answer the KCNs communities' and Manitoba Hydro's questions about future mercury effects on human health if the Keeyask Generation Project is developed and ways to reduce those effects; and
- To develop ways to effectively communicate with communities about what has been learned.

The Working Group undertook its work between June 2007 and June 2011. A record of all meetings and presentations has been maintained.

5B.1 BACKGROUND: THE MERCURY CONCERN

The effect of mercury on human health was an issue of concern to each of the KCNs and to Manitoba Hydro. Manitoba Hydro and some members of the KCNs communities are aware of mercury as a health issue due to past hydroelectric development. In northern Manitoba, the Churchill River Diversion, Lake Winnipeg Regulation and generating station projects along the Nelson River (*e.g.,* Kettle Generating Station) in the 1970s led, unexpectedly, to raised levels of mercury in fish from affected waterways. For example, mercury levels in lake whitefish, jackfish and pickerel rose in differing amounts within three to seven years after flooding. These elevated levels then declined over time so that, 20 to 30 or more years after flooding, they had returned to near-original concentrations or levels that are similar to those found in fish from lakes in the area that were not affected by flooding.

Country food is an important part of the diet in KCNs communities. In the period after flooding, many communities in northern Manitoba became aware they should not eat fish from affected waterways because

[1] The EIS Coordination Team was established under the Joint Keeyask Development Agreement to coordinate the Environmental Assessment of the Keeyask Generation Project. It includes representation from the KCNs and Manitoba Hydro and is supported by the environmental assessment study team (EA Study Team).

of mercury contamination. This caused alarm and led many people to reduce the amount of local fish in their diet.

The prospect of development of the Keeyask Generation Project renewed questions about the safety of fish today and about the effects of flooding and mercury elevation in fish and people with development of the Project.

5B.2 PARTICIPANTS

The Working Group included representatives from each of the KCNs, Manitoba Hydro and the environmental assessment study team (EA Study Team). An independent toxicologist, Mr. Ross Wilson of Vancouver, BC was hired to do the human health risk assessment (HHRA). An independent specialist, Dr. Laurie Chan of the University of Ottawa (formerly of the University of Northern BC), was hired to assist the Working Group; he provided information about mercury and human health at the outset of the process, undertook the peer review of the HHRA results and reviewed the draft communication products. In addition, for a portion of the process, the Medical Health Officer of the Burntwood Regional Health Authority participated in the process (Dr. Lisa Richards and Dr. Randy Gesell each participated).

5B.3 ACTIVITIES OF THE WORKING GROUP

The Working Group held 14 workshops between June 2007 and June 2011. See Table 5B-1 for details on the workshops.

At the initial workshops, the Working Group gathered facts about mercury to enable everyone to gain a better understanding of the concern and to answer the KCNs communities' and Manitoba Hydro's questions about mercury.

Through presentations and discussion, the Working Group covered topics such as the following:

- What is methylmercury and where does it come from;
- Mercury in freshwater environments in northern Manitoba (including lakes unaffected by hydroelectric projects);
- Mercury in fish;
- Mercury in furbearers;
- Mercury in birds;
- Mercury and people;
- Guidelines for mercury in fish and for people eating the fish; and
- Changes in mercury levels at previously constructed generation stations in northern Manitoba.

Secondly, the Working Group commissioned the HHRA that was undertaken by Ross Wilson. The study examined ways in which mercury could reach human receptors in the areas that will be affected by the Project – through use of country foods from the area, through drinking of surface water and from skin contact with surface water. The study examined both the present-day conditions without the Project and future conditions with the Project. The Working Group reviewed and discussed interim and then final results of the HHRA. In addition, the details of interim pathways from the environment to country foods – through mercury in fish, mammals, plants and water – were discussed with specialists from the EA Study Team who prepared these analyses. The HHRA included recommendations to reduce the risk associated with mercury in country food. The HHRA confirmed the importance of the programs included in each of the KCNs' Adverse Effects Agreement to enable Members to harvest country food in locations unaffected by the Project. The recommendations also recognized the health benefits of eating fish and encouraged the KCNs to focus on fish with low mercury content, especially for the vulnerable groups, such as women of child-bearing age and children. Monitoring of mercury content in country foods (primarily in fish, but also in mammals and plants to confirm their low mercury content) was included.

The draft HHRA was peer reviewed by Dr. Laurie Chan.

The third major focus of the Working Group was to consider effective ways to communicate the results of this work to the KCNs communities. The topic of mercury is highly technical and very complex, in particular because the health benefits of fish are important to confirm as well as the risks of mercury. The Working Group wanted to ensure that communication was clear and well understood.

Communication products were developed, based on experience elsewhere (*e.g.,* northern Québec), the knowledge of Working Group Members from the KCNs and the specific results to be communicated about the present-day and future conditions. Draft products included placemats, maps, a poster, a fish "yardstick" for measuring fish length in the field and a PowerPoint presentation for local health care providers. A two-phased communication strategy was developed for delivery of the products, including an initial phase to communicate present-day conditions and a second phase that would be undertaken prior to impoundment to communicate the risks that are expected in the period three to seven years after impoundment in Gull Lake and Stephens Lake. The communication products were tested by some of the KCNs communities for effectiveness. In addition, the HHRA background, results and communication products were presented to federal and provincial health staff.

Table 5B-1: Technical Working Group Workshops

Workshop One	
Date:	June 13, 2007
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda Working Group Members Identified So Far Memo on candidate profiles of technical experts
Summary:	This workshop discussed the purpose of the Mercury and Human Health Technical Working Group, goals, schedule, hiring a health expert and next steps.
Workshop Two	
Date:	July 30, 2007
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda Working Group Members Background and Guidelines for Consumption (J. Whitaker) Mercury in Freshwater Environments in Northern Manitoba (F. Schneider-Vieira Memo on Effects of Mercury Loading on Piscivourous Birds; Memo on Effects of Mercury on Bald Eagles; Article – Effects of Environmental Methylmercury on the Health of Wild Birds, Mammals, and Fish (L. Wyenberg) Mercury in Furbearers (R. Berger) Mercury and Human Health in Northern Manitoba – Initial Comments (J. Kinley)
Summary:	This workshop focused on gathering facts about mercury – the big picture, mercury in the environment in northern Manitoba, mercury in water and fish, mercury in birds, mercury in furbearers, mercury and human health in northern Manitoba – mercury and health in KCNs communities, questions about mercury and health that remain to be answered and next steps.

Table 5B-1: Technical Working Group Workshops

Workshop Three	
Date:	September 27, 2007
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members Specialist Presentation -- Dr. Laurie Chan
Handouts:	Draft Meeting Agenda Members @ 31 August 2007 A Brief Introduction to Mercury Toxicology (presentation slides prepared by Dr. Laurie Chan)
Summary:	This workshop included a presentation by Dr. Laurie Chan on mercury and human health followed by discussion of specific questions and answers, outstanding questions yet to be answered and next steps.
Workshop Four	
Date:	November 23, 2007
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda What We've Covered to Date Additional Questions from the Last Meeting Predicting Fish Mercury Concentrations for the Keeyask Project – Approach and Preliminary Results (presentation) Estimating Effects of Mercury on People
Summary:	This workshop addressed what was learned at the last meeting, the status of predictive modeling to estimate effects of the Keeyask Generation Project on mercury, communicating with the communities about what we've learned and next steps.

Table 5B-1: Technical Working Group Workshops

Workshop Five	
Date:	January 31, 2008
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members Specialist Dr. Laurie Chan (via speaker phone)
Handouts:	Draft Meeting Agenda Fish Mercury Concentrations for the Keeyask Project – Projects Lakes and Offset Lakes (presentation) Approach to Assessing the Effects of Mercury on Birds (presentation) Predicting Furbearer Mercury concentrations for the Keeyask Project – Preliminary Approach (presentation) Health Risk Assessment – correspondence, CVs and Comparison of Specialists and Approaches table Updated draft “Good for You and Good to Eat” placemat DVD of videotapes explaining the Federal Ecological Monitoring Plan (FEMP) mercury testing from Member E. Morris of Tataskweyak Cree Nation
Summary:	This workshop included clarity on guidelines (Dr. Chan on speaker phone), reporting on action items from the last meeting, mercury levels in other lakes being fished, status of predictive modeling for birds, communication results with the communities and next steps.
Workshop Six	
Date:	March 27, 2008
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members

Table 5B-1: Technical Working Group Workshops

Handouts:	Draft Meeting Agenda Mercury in Fish and Guidelines for the Consumption of Recreationally Angled fish in Manitoba (Manitoba Water Stewardship) Article: Mercury Connections: The extent and effects of mercury pollution in northeastern North America Article: Maternal Fish Intake during Pregnancy, Blood Mercury Levels, and Child Cognition at Age 3 Years in a US Cohort October 2006 Fact Sheet: Balancing Choices: Supporting Consumer Seafood Consumption Decisions (Institute of Medicine of the National Academies) Initial Draft Mercury and Health Question and Answer Summary for Input to Communication Products for Communities Graph of mercury levels in fish in Sipiwesk Lake Updated draft “Good for You and Good to Eat” placemat
Summary:	This workshop included reporting on selected items, factual questions, communication results regarding current mercury levels with communities, and next steps.
Workshop Seven	
Date:	May 22, 2008
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda Keeyask Mercury and Human Health Technical Working Group Interim Summary Report (draft May 14, 2008) Summary PowerPoint presentations for communities to use (long and short version) Hydro Quebec’s Nutrition Guide and map
Summary:	This workshop included reporting on selected action items, a review of interim summary report and PowerPoint presentations, communication of results regarding current mercury levels with communities, health risk assessment (Ross Wilson) and next steps.
Consumption Workshop	
Purpose:	Workshop to set assumptions about country food use for the HHRA
Date:	October 7, 2009

Table 5B-1: Technical Working Group Workshops

In Attendance:	Each of the KCNs was asked to bring community representatives who were familiar with country food use in their community; representatives were from: Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Also attending: Wilson Scientific Manitoba Hydro InterGroup Consultants
Handouts:	Draft Meeting Agenda
Summary:	This workshop included a review of the agenda and background on the Mercury and Human Health Technical Working Group. Questions were posed to participants regarding the types of country foods eaten by communities and the quantities eaten by adults and children. The intent was to establish assumptions for the HHRA.
Workshop Eight	
Date:	November 24, 2009
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda Members of the Mercury and Health TWG as of Nov. 24, 2009 Mercury and Human Health in Northern Manitoba – A Status Report Predicting Fish Mercury concentrations for the Keeyask Project – Update of Estimates (November 2009) Birds: Estimated Levels of Mercury in Water Birds – Pre and Post Impoundment Human Health Risk Assessment of Country Foods: Update Keeyask Country Foods consumption Assumptions
Summary:	This workshop included an updated status report, a review of the HHRA and an update on some preliminary draft results and next steps.

Table 5B-1: Technical Working Group Workshops

Workshop Nine	
Date:	March 23, 2010
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members
Handouts:	Draft Meeting Agenda Nov. 24, 2009 Draft Meeting notes of the Mercury and Health TWG PowerPoint presentation: Estimated Levels of Mercury in Mammals Pre and Post Impoundment (R. Berger) PowerPoint presentation: Human Health Risk Assessment of Country Foods: March 2010 Update (R. Wilson)
Summary:	This workshop included a presentation about mercury in mammals as well as the HHRA. In addition, a communications strategy was discussed along with next steps.
Workshop Ten	
Date:	May 20, 2010
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members Dr. Lisa Richards, Medical Officer of Health
Handouts:	Draft Meeting Agenda March 23, 2010 Draft Meeting notes of the Mercury and Health TWG PowerPoint presentation: Estimated Levels of Mercury in Mammals Pre and Post Impoundment (R. Berger) PowerPoint presentation: Human Health Risk Assessment of Country Foods: May 2010 Update (R. Wilson) Communication Strategy – Methylmercury and Human Health Today and After the Keeyask Generation Project

Table 5B-1: Technical Working Group Workshops	
Summary:	This workshop included a review of the agenda, the moose and caribou monitoring program, HHRA, communications strategy and next steps.
Workshop Eleven	
Date:	September 9, 2010
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members Dr. Lisa Richards, Medical Officer of Health Dr. Susan Roberecki, Environmental Health Lead (via teleconference)
Handouts:	Draft Meeting Agenda May 20, 2010 Draft Meeting notes of the Mercury and Health TWG PowerPoint presentation: Human Health Risk Assessment: Sept 2010 Update (R. Wilson) PowerPoint presentation: Communicating Mercury and Human Health (J. Kinley) Revised draft placemat Draft "Yardstick": Mercury in Fish: Guide to Fish Size for Healthy Eating in Gull Lake and Stephens Lake (for use by resource harvesters in boats) Draft Map: Fish Consumption Guide for Keeyask Project Waterbodies Draft Wild Game Monitoring Program: Recommended Procedures for Obtaining and Submitting Tissue Samples Draft Lake Sturgeon Mercury Monitoring Program and Sample Collection Protocol
Summary:	This workshop included a review of the agenda, a presentation concerning HHRA (updated from the May 20^{th} presentation), a presentation concerning communicating mercury and human health (including a discussion of the placemat update, sample map with consumption guidelines, and fish "yardstick"), a plan for discussion with health representatives in communities about mercury, the country food monitoring programs and next steps.

Table 5B-1: Technical Working Group Workshops

Workshop Twelve	
Date:	November 3, 2010
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members Dr. Randy Gesell, Medical Officer of Health
Handouts:	Draft Meeting Agenda September 9, 2010 Draft Meeting notes of the Mercury and Health TWG PowerPoint presentation: Human Health Risk Assessment: Nov 2010 Update (R. Wilson) PowerPoint presentation: Communicating Mercury and Human Health (J. Kinley) Revised draft Placemats Revised draft "Yardstick" Revised draft Maps: Fish Consumption Guide for Split, Gull & Stephens Lakes, and for Keeyask Project Offset Lakes Draft Poster: Mercury, Fish and People
Summary:	This workshop included a review of the agenda, a presentation concerning the HHRA (updated from September 9, 2010 workshop), a presentation concerning communicating mercury and human health (including a discussion of revised placemat, maps, and yardstick and the poster), discussion with health representatives in communities, a presentation on the environmental contaminant monitoring program organized and managed by the First Nations University of Canada, AFM and Health Canada, a discussion of the country food monitoring program and next steps.
Workshop Thirteen	
Date:	February 2, 2011
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members Dr. Randy Gesell, Medical Officer of Health

Table 5B-1: Technical Working Group Workshops

Handouts:	Draft Meeting Agenda November 3, 2010 draft meeting notes of the Mercury and Health TWG Finalizing the Work of the Mercury and Human Health TWG, Draft @ Jan 27, 2011 PowerPoint presentation: Status and Draft Plan to Complete the Original Tasks (Draft @ Feb 2, 2011; J. Kinley) PowerPoint presentation: Mercury and Human Health: Presentation to Health Care Providers – revised with TWG suggestions Revised draft placemats Revised draft yardstick Revised draft maps: Fish Consumption Guide for Split, Gull and Stephens Lakes, and for Keeyask Project Offset Lakes Draft poster: Mercury, Fish and People
Summary:	This workshop included a review of the agenda, the status and plan for completion of the work of the Mercury and Human Health Technical Working Group, discussion of the plain language version of the HHRA for communities, finalizing the communications strategy, discussion of communication strategy products (placemat, maps, yardstick, poster, report with health care professionals), discussion of country food monitoring programs and next steps.
Workshop Fourteen	
Date:	June 15, 2011
In Attendance:	Cree Nation Partners (Tataskweyak Cree Nation and War Lake First Nation) Representatives York Factory First Nation Representatives Fox Lake Cree Nation Representatives Wilson Scientific Manitoba Hydro EA Study Team Members Dr. Randy Gesell, Medical Officer of Health
Handouts:	Draft Meeting Agenda PowerPoint Presentation: Finalizing The Work Of the Mercury and Human Health Technical Working Group (J. Kinley) Communication products
Summary:	This workshop included a review of the agenda, a review of the summary of the Mercury and Human Health Technical Working Group work, finalizing the communications products, finalizing the HHRA, including the full technical report and plain language summary, and review of country food monitoring programs.

APPENDIX 5C

HUMAN HEALTH RISK ASSESSMENT

Hydropower Limited Partnership

APPENDIX 5C

Human Health Risk Assessment of the Mercury from the Proposed Keeyask Generation Project

DRAFT REPORT

Prepared for:

InterGroup Consultants Ltd.
Suite 500 – 280 Smith Street
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R3C 1K2

Prepared by:

____
Ross Wilson, M.Sc., DABT
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JUNE, 2012

EXECUTIVE SUMMARY

The Mercury and Human Health Technical Working Group, participating in the environmental assessment (EA) for the Keeyask Generation Project requested Wilson Scientific Consulting Inc. (Wilson Scientific) to complete a human health risk assessment (HHRA) to address current and potential increased mercury in the environment that may result if the proposed Keeyask Generation Project proceeds. The HHRA was to consider the traditional uses of the land by the various First Nation communities in the study area. In addition, the most recent scientific evidence on health effects from mercury was to be part of the assessment.

The methods used to estimate human health risks were based on risk assessment procedures cited by Health Canada, the World Health Organization (WHO) and the US Environmental Protection Agency (US EPA).

The items of main concern were:

- Consumption of country foods (*i.e.*, fish, wild game, waterfowl and wild plants); and
- Ingestion and direct contact with surface water.

The water bodies of primary interest for this assessment were Gull and Stephens lakes. The HHRA was greatly assisted by local First Nations' representatives who shared their knowledge regarding types and locations of country foods and food consumption patterns. In addition, it should be noted that the HHRA did not measure mercury concentrations in food or people but instead relied upon present and estimated post-impoundment concentrations in water and foods that have been provided by other experts (*i.e.*, fish and surface water mercury concentrations provided by North/South Consultants Inc.; wild game mercury concentrations by Wildlife Resource Consulting Services MB Inc.; and waterfowl concentrations of mercury estimated by TetrES Consultants Inc. [now known as Stantec]).

It is considered to be extremely important that persons follow the fish consumption recommendations provided in this HHRA (especially under the post-impoundment scenario). Individuals could be in the "at risk" range of exposures if consumption recommendations are not followed. The information provided in this evaluation should be used to make informed choices about fish consumption with special emphasis on the consumption of fish from lakes unaffected by the Project during the post-impoundment elevation in fish mercury concentrations. There could also be very real health risks if persons choose to reduce overall fish consumption (rather than supplementing their fish intake from the unaffected lakes). Thus, every reasonable effort should be made to encourage people to continue eating fish that are low in mercury concentrations under both present and post-impoundment conditions. The key conclusions of the HHRA are as follows:

1. Consumption recommendations (*i.e.,* recommendations for consumption restriction) may be required for certain fish under both the present conditions and the predicted post-impoundment conditions. Under post-impoundment conditions, it would still be possible to consume fish (just not as much as before). The fish with the predicted highest increase in mercury concentrations are from Gull Lake and include northern pike (0.22 µg/g to just over 1 µg) and walleye (0.23 µg/g to just over 1 µg/g) while the increase in lake whitefish would be less (0.07 µg/g to just below 0.2 µg/g). The same species from Stephens Lake would be impacted less than fish from Gull Lake.

2. Consumption recommendations are not currently required for wild game or waterfowl and would not likely be required following impoundment. Muskrat is the only mammal that was predicted to have increased tissue concentrations of mercury following impoundment; however, the increases are considered to be very minor (*i.e.*, 0.02 µg/g under baseline conditions versus 0.04 µg/g under post-impoundment conditions). No measurable change in mercury tissue concentrations under post-impoundment conditions in moose, beaver and snowshoe hare was predicted by Wildlife Resource Consultants.

3. Mercury concentrations in surface water would not pose unacceptable risks from contact or drinking under present or post-impoundment conditions (*i.e.,* risks are considered to be negligible). Typical total mercury surface water concentrations are predicted to remain less than the currently used analytical method detection limit (*i.e.,* less than 0.05 µg/L as compared to the Canadian Drinking Water Guideline of 1 µg/L).

4. No conclusions can be provided on consumption of wild plants or gull eggs since discipline experts have not been able to estimate mercury concentrations either presently or under post-impoundment conditions.

The key recommendations of the HHRA are as follows:

1. The fish consumption recommendations based on the current quality of fish and the predicted post-impoundment quality should be communicated to local First Nations and communities through appropriate means (*e.g.,* via community health practitioners). Fish species and size-specific consumption recommendations should be emphasized so that people may make the most informed decisions regarding their consumption of specific species (*i.e.,* smaller and non-predatory fish tend to have lower concentrations of mercury). Mercury concentrations in fish should continue to be monitored throughout the project life.

2. Options for collection of fish from lakes unaffected by the Project should be offered to the local First Nation communities under the post-impoundment scenario (as is planned in programs included in the First Nations' Adverse Effects Agreements); however, even from pristine offset lakes, it will be necessary to consider size and species of fish for persons desiring to reduce their mercury exposures (*i.e.,* certain fish from these natural, unimpacted lakes may have mercury concentrations that warrant consumption recommendations).

3. No unacceptable risks were estimated from consumption of wild game or waterfowl. Nevertheless, there could remain a perception among certain people that wild game or waterfowl is not safe to consume. To help address those concerns, it is recommended that samples, voluntarily submitted by hunters, are analyzed for mercury in order to confirm that wild game and/or waterfowl concentrations remain acceptable to consume. This should be coupled with appropriate education (*e.g.*, community presentations, posters, etc.) that clearly states that wildlife is currently safe to eat and that mercury concentrations in tissues of these animals are expected to remain acceptable due to project activities.

4. No recommendations are provided on consumption of wild plants or gull eggs. To help address local First Nations' concerns regarding consumption of those foods, it is recommended that wild plant samples are voluntarily submitted by gatherers and analyzed for mercury concentrations in order to confirm that wild plants are acceptable to consume. Also, the community should be educated about the findings of this work, so that wild plants can continue to be used by the community. In the case of gull eggs, it appears that collection of this food from the study area is not a common activity but nevertheless, if this were to occur in the future, sampling of this food group could be considered.

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HUMAN HEALTH RISK ASSESSMENT OF THE MERCURY FROM THE PROPOSED KEEYASK GENERATION PROJECT

DRAFT

1.0 INTRODUCTION

The Mercury and Human Health Technical Working Group (the Technical Working Group) for the Keeyask Generation Project requested that Wilson Scientific Consulting Inc. (Wilson Scientific) complete a human health risk assessment (HHRA) to address current and potential increased methylmercury (mercury) concentrations in the environment that may result if the proposed Keeyask Generation Project is approved. The specific questions that the HHRA needed to address were:

1. Is it safe to eat fish under present conditions?

2. If the proposed project is approved, what are the risks to persons consuming:
    a. Fish?
    b. Wild game?
    c. Waterfowl?
    d. Wild plants?
    e. Water?

The HHRA also needed to consider the domestic uses of the land by the various local First Nation communities. In addition, the most recent scientific evidence on health effects from mercury was required to be part of the assessment.

It is important to note that through a formal agreement with the Keeyask Cree Nations (KCNs), they participated in the environmental assessment (EA) for the Keeyask Generation Project; as part of the EA, a Mercury and Human Health Technical Working Group was established with representatives from the KCNs and Manitoba Hydro and their respective consultants. The First Nations consisted of representatives from:

- Tataskweyak Cree Nation
- War Lake First Nation
- Fox Lake Cree Nation
- York Factory First Nation

The Mercury and Human Health Technical Working Group played an important role in providing guidance and knowledge on traditional use of the land that has been incorporated into this HHRA.

This report outlines the methods, results, conclusions and recommendations of the HHRA and is organized as follows:

- Section 2 of the report introduces mercury as a chemical of potential concern, and the concept of HHRA;
- Section 3 summarizes the site setting and relevant documents that provide information cited in the HHRA;
- Section 4 provides methods used to complete the HHRA;
- Section 5 provides the results;
- Section 6 provides a discussion of the results including an uncertainty analysis;
- Section 7 provides the overall conclusions of the HHRA; and
- Appendix 5C-1 provides detailed technical information, worked example calculations and detailed risk estimates.

2.0 MERCURY AND HUMAN HEALTH RISK ASSESSMENT

2.1 WHAT IS MERCURY?

Mercury is a metal that naturally occurs in very small quantities in the soil, water, plants, animals, etc. in the Keeyask Project area as well as many other parts of Canada. Mercury can be found in various forms categorized as follows:

- Elemental mercury (a shiny silver-coloured liquid that slowly evaporates at room temperature and more rapidly when heated to moderate temperatures);
- Inorganic mercury (a form of mercury that results when elemental mercury combines with sulphur, chlorine or oxygen to form “mercury salts”); and
- Methyl mercury (a form of mercury that results when elemental mercury combines with carbon to form “organic mercury” and is naturally present in very small quantities in all foods, but almost always highest in carnivorous fish).

2.2 WHAT ARE TYPICAL SOURCES OF MERCURY?

Mercury is used by humans in a wide-variety of industrial processes and commercial products. Metallic mercury is used to produce chlorine gas and caustic soda. In consumer products, metallic mercury can be found in thermometers, dental fillings, batteries and fluorescent lights. Inorganic mercury salts can sometimes be found in various anti-septic creams and ointments. In terms of exposure to people, the vast majority of exposure is in the form of methyl mercury through the consumption of fish.

Although mercury occurs naturally in the environment, human activities may result in increased exposures. Human-contributed sources of mercury exposures include:

- Releases of mercury into the air from combustion processes such as coal-fired power generation, metal mining, metal smelting operations and waste incineration;
- Disposal of mercury containing products (*e.g.*, fluorescent lights, batteries, thermostats, barometers, switches and relays) into landfill sites and subsequent leaching into the environment; and
- Flooding of soils for new dam sites (this can result in mercury from flooded soils releasing mercury into the aquatic food chain).

2.3 HOW ARE CANADIANS EXPOSED TO MERCURY?

Canadians may be exposed to mercury from activities that include:

- Eating fish flesh of any kind. Fish consumption typically represents the greatest source of exposure to most Canadians. Fish with the highest muscle mercury concentrations tend to be the large and long-lived predatory fish; however, essentially all fish contain some levels of mercury. Fish in some lakes in Canada have naturally high concentrations of mercury and it is not an issue that is totally restricted to impoundments. Also, some marine fish often contain elevated concentrations of mercury. A list of fish with relatively high mercury concentrations includes the following:
    - Fresh and frozen tuna;
    - Canned albacore tuna (other canned tuna do not typically contain as much mercury);
    - Lake trout;
    - Burbot;
    - Walleye (or pickerel);
    - Jackfish (or pike);
    - Shark;

  - Swordfish;
  - Marlin;
  - Orange roughy; and
  - Escolar (a type of mackerel that is commonly used in sushi);

- Eating fish from localized areas impacted by mercury releases (concentrations also tends to be greatest in the larger, long-lived predatory fishes);

- Breathing vapours in air from spills, incinerators and industrial operations that release mercury into the air;

- Breathing mercury vapours that are released into a person's mouth during dental treatments (mercury amalgams used as fillings for cavities); and

- Use of medical treatments which contain mercury (various topical ointments and creams).

2.4 WHAT ARE THE HEALTH EFFECTS ASSOCIATED WITH MERCURY?

The health effects of concern depend on the form of mercury and the duration and magnitude of exposures. If the exposure is of elevated concentrations for a long duration, all forms of mercury may cause health effects to the nervous system. Methyl mercury (primarily from fish consumption) and elemental mercury (primarily from inhalation of vapours) tend to have greater ability to cause health effects than inorganic mercury due to an increased ability of these forms to cross body tissues and enter the nervous system. Important aspects of mercury toxicology include the following:

- Health effects primarily associated with methyl mercury have included damage to the brain (*e.g.*, motor skills, irritability, shyness, tremors, changes in vision/hearing, memory problems, decreased IQ);

- Health effects primarily associated with inorganic mercury have been associated with the kidneys, gastrointestinal damage and autoimmune effects. Mercury salts can cause blisters and ulcers on the lips and tongue. Rashes, excessive sweating, irritability, tremors, muscle weakness and high blood pressure have also been noted in persons exposed to elevated concentrations of inorganic mercury;

- Health effects primarily associated with elemental mercury, as vapours, have included hand tremors and memory problems;

- Short-term exposures to high levels of metallic mercury (primarily as vapours) may be associated with effects that include lung damage, nausea, vomiting, diarrhea, blood pressure, heart rate and skin rashes, and eye irritation; and

- Although there is some evidence of mercury causing cancer in animals at elevated exposures, there is not considered to be adequate evidence to conclude that mercury is a human carcinogen and most health agencies do not consider it necessary to consider the cancer endpoint in establishing safe levels of exposure.

Fortunately, mercury in most foods, consumer products, and the environment are at concentrations not great enough to cause the health effects listed above.

It is also noted that in order for mercury to cause toxicity, it must be absorbed. For example, if a child accidentally swallowed liquid mercury from a broken thermometer, it is unlikely that much of the ingested mercury would be absorbed into the body; however, mercury could enter the body via inhalation of vapours from the spill.

2.5 WHO IS MOST SENSITIVE TO MERCURY EXPOSURES?

Generally speaking, young children and pregnant women (or women of child-bearing age) (due to the potential harmful effects on the developing fetus) are of primary concern to health agencies with respect to mercury exposure; however, persons of any age may experience health effects if the exposures are great enough. Consequently, there can be different recommendations for minimizing exposures depending upon the segment of the population a person may represent. For example, many health agencies recommend that pregnant or breastfeeding women and young children restrict their consumption of certain types of fish containing high concentrations of mercury; however, most health agencies also agree that consumption of fish is an important part of the diet and these agencies stress that consumption of fish containing low concentrations of mercury represent a healthy part of the diet for pregnant and breastfeeding women (as well as for young children).

2.6 If Mercury is Toxic, How is Any Exposure Safe?

Although mercury exposure is associated with some serious health effects, there are certain exposures considered to be "safe" and without appreciable health risks to the general public. Because mercury is ubiquitous in the global environment, health agencies around the world have dedicated considerable effort in determining mercury exposure rates considered to be acceptable. This process has allowed health agencies to recommend that people continue to consume fish because the benefits outweigh the risks.

Using a risk assessment approach, it is possible that no unacceptable health risks may exist from mercury even when concentrations in the environment are considered to be elevated above normal levels. This conclusion is most common when persons are not receiving elevated exposures to the mercury (despite its presence at elevated concentrations in the environment). Situations that can result in a conclusion of "no appreciable risk" from elevated mercury concentrations in the environment include:

- The mercury is found in environmental media with which people do not often come into contact (*e.g.,* located in subsurface soils that do not leach into groundwater and are not releasing appreciable mercury vapours);

- The mercury is found in a food (or foods) that people are not consuming or are consuming infrequently;

- The mercury is found in a form in the environment that is not very soluble and, therefore, cannot readily be absorbed into the body even when it is consumed (*i.e.,* it is in a form that is not very bioavailable); and

- The mercury is found in environmental media at concentrations that people regularly contact; however, the concentrations are low enough that exposures are still below levels considered to be acceptable by agencies such as the World Health Organization and Health Canada.

In such cases, it may be possible to arrive at conclusions that indicate acceptable risks from mercury even though elevated concentrations are present in the environment. Nevertheless, in all cases, conclusions must be based on a careful analysis supported by the available science (*e.g.,* risk assessment).

2.7 WHAT ARE ACCEPTABLE CONCENTRATIONS OF MERCURY IN FOOD?

For mercury occurring in commercial fish sold at the retail level, Health Canada (2007) provides a guideline of 0.5 µg/g (wet weight). Similarly, the European Community (2006) provides a maximum permissible mercury concentration of 0.5 µg/g (wet weight) for most fish but then allows up to 1.0 µg/g (wet weight) for a list of specific fish that includes northern pike (*Esox lucius*). It needs to be stressed that these maximum permissible concentrations are specific to commercial fish.

In the case of fish consumed for subsistence purposes, there is no official recommendation available from either Health Canada or WHO. Part of the difficulty in establishing acceptable concentrations of mercury is that fish (*i.e.,* often the major source of mercury exposure) has tremendous nutritional benefits.

Health Canada (2007) has noted the following:

> *"It is considered essential that any communications to the public include information on the health benefits of fish consumption alongside information on the risks of methylmercury exposure so that citizens can consider both the benefits and risks in reaching their own decisions about appropriate fish consumption. Studies on the nutritional benefits of fish are supportive of efforts to influence consumers' behaviour by modifying the types of fish regularly chosen rather than by decreasing overall fish consumption."*

In the case of other foods (*i.e.*, wild game, waterfowl and plants), no health agency recommendations were identified for allowable mercury content.

2.8 WHAT IS HUMAN HEALTH RISK ASSESSMENT?

Human health risk assessment is a process that is accepted by Canadian and international health agencies for evaluating the potential for chemical, biological and physical agents to cause adverse health effects in people. Although it is desirable to minimize exposures to some environmental chemicals, exposures to chemicals and physical agents cannot be avoided in many circumstances. Potentially harmful chemicals and physical agents can exist naturally, and there were exposures prior to modern civilization. This is also true for mercury. Regulatory agencies across Canada and around the world have adopted risk assessment as a scientifically-defensible tool for the evaluation of potential health risks to chemicals and physical agents. Examples of regulatory agencies that currently use risk assessment to assist in making health-based decisions include the World Health Organization, US Environmental Protection Agency and Health Canada.

Risks from environmental chemicals and physical agents are normally evaluated using the same principles and fundamentals that regulatory agencies use to develop standards to protect the general public from unacceptable risks for soil, water, air and food. It is stressed that there are uncertainties in risk assessment and it is virtually impossible to prove complete safety in almost anything that is evaluated. Consequently, risk assessment normally comments on the reasonable likelihood of adverse health effects in people exposed to various environmental chemicals or physical agents rather than providing absolute certainties of no adverse health effects.

It should also be noted that most health agencies and scientists contend that risk assessment is much more likely to overestimate than underestimate risks. Due to the various uncertainties in risk assessment, health agencies tend to use large safety factors and default assumptions that result in overestimation of health risks. Further details on the HHRA methods are provided in Sections 4 and 5 of this report while some of the particularly important concepts are discussed below.

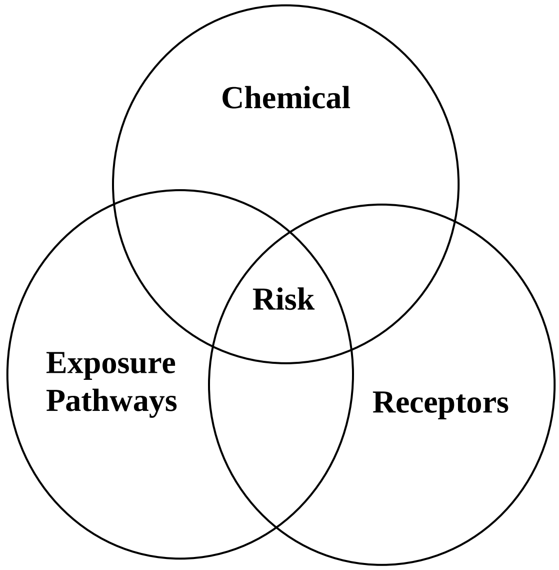
Basic Elements Required for Risk to Exist

One of the basic tenets of risk assessment is that in order for human health risks to exist the following elements must be present:

- A person (or receptor) is present in the area of concern;
- A chemical is present in the area of concern; and
- An exposure pathway must exist that allows a person (or persons) to be exposed.

For example, if a non-volatile chemical (such as lead) was present in subsurface soil and not leaching into groundwater, there would be virtually no risk from this chemical (as long as persons were not digging in the soil) as exposure pathways would not exist. However, as soon as persons dig in the subsurface soil, an exposure pathway would be open and exposures could then potentially exist. The need for all three of these elements to be present is illustrated below in Figure 2-1.

Figure 2-1: Required Elements for Potential Risks to Exist



Dose-Response Relationships

A second important fundamental of risk assessment is that the magnitude of risk is proportional to both the magnitude of exposure and the inherent potency of the chemical. Most health agencies agree that there are acceptable or “safe” levels of exposures unlikely to cause adverse health effects for even the most potent chemicals (*e.g.*, there are acceptable levels of exposure to chlorinated dioxins from pulp and paper effluent, benzo[a]pyrene from car exhaust, aflatoxin in peanut butter and various chemicals in a cup of coffee). Likewise, some seemingly innocuous chemicals may pose unacceptable risks if consumed in excess quantities (*e.g.,* although quite rare, people have become ill or even died from consumption of excessive amounts of water [due to electrolyte imbalance] or over consumption of Vitamin A from polar bear livers and carrot juice). In other words, there can be acceptable levels of the most hazardous substances and unacceptable levels of the most innocuous substances. Thus, for virtually all chemicals and physical agents that may be harmful to people, the principle of dose-response relationships apply.

According to the dose-response principle, as the level of exposure increases, the probability and/or magnitude of adverse health effects also increase. An important exception to this theory, however, is for exposure rates that are so low that adverse health effects are not expected to be observed until dose rates increase above a certain threshold of exposure. For example, certain minerals such as iron and zinc are required in our diet and are not expected to cause adverse health effects at levels at or below our recommended daily allowances for proper health and fitness. It is only when these levels are exceeded that the adverse health effects begin to increase with increasing levels of exposure.

The principle that the magnitude of risk is in proportion to the level of exposure and the potency of the chemical can be summarized as follows:

Risk = Magnitude of Exposure x Toxicity of the Chemical

Human health risks were estimated using the concept of dose-response relationships to the maximum extent possible in this report.

Important Terms Used in Human Health Risk Assessment

Scientific terminology is commonly used to describe human health risks from chemicals and physical agents. Some of the more important terms in the context of the human health risk assessment are provided below.

> *Tolerable Daily Intake (TDI):* The daily amount of exposure that is considered unlikely to cause adverse health effects in the general population (including sensitive individuals). Tolerable Daily Intakes are usually provided as daily dose rates in units of mass of chemical per kilogram of body weight of a person per day (*e.g.,* the Tolerable Daily Intake for methyl mercury exposure to pregnant women is 0.2 μg of methyl mercury/kg body weight/day such that a 60 kilogram pregnant woman should not exceed 12 μg of methyl mercury per day). Other terms that are similar in meaning are the Acceptable Daily Intake (used by the World Health Organization) and Reference Dose (used by the US Environmental Protection

Agency). Health Canada-derived Tolerable Daily Intakes are meant to protect all members of the general public including First Nation individuals.

Hazard Quotient: Used to estimate risks for non-carcinogens, Hazard Quotient values can be estimated according to the following formula:

$$\textit{Hazard Quotient} = \frac{\textit{Estimated Exposure } (\mu g/kg \textit{ body weight/day})}{\textit{Tolerable Daily Intake } (\mu g/kg \textit{ body weight/day})}$$

A Hazard Quotient value that is less than 1 indicates that exposures are less than the Tolerable Daily Intake and, thus, adverse health effects are unlikely. A Hazard Quotient value that is greater than 1 indicates a situation where chemical exposure rates may exceed the acceptable rate and, thus, may indicate excessive or unacceptable risks. In all cases, however, Hazard Quotients require careful consideration of the underlying assumptions and uncertainties before final conclusions are made.

Incremental Lifetime Cancer Risk: An estimate of the increased level of cancer risk posed by exposure to a carcinogen at a site. Incremental Lifetime Cancer Risks can be estimated according to the following formula:

$$\textit{ILCR} = \textit{Lifetime Daily Exposure } (\mu g/kg/day) \times \textit{Potency Factor } (\mu g/kg/day)^{-1}$$

In many parts of Canada, an Incremental Lifetime Cancer Risk estimate that is less than or equal to one in one hundred thousand (1×10^{-5}) is normally considered to be acceptable while an Incremental Lifetime Cancer Risk greater than this value generally indicates that clean-up or some other form of risk reduction/management is required. In all cases, however, interpretation of Incremental Lifetime Cancer Risk estimates requires consideration of the overall risk assessment process and assumptions to ensure conclusions on risks are not misrepresented.

It is noted that neither Health Canada nor the World Health Organization consider mercury to be a carcinogenic substance. Consequently, it was not necessary to estimate Incremental Lifetime Cancer Risks due to mercury exposures.

Some Limitations to Human Health Risk Assessment

With the above principles in mind, there are some important limitations to the HHRA process that need to be considered. Firstly, HHRA is completed as a science-based toxicological evaluation of the possibility for risks posed by chemicals. As a result, this toxicological evaluation does not cover all elements of health that local First Nations may be concerned about. To evaluate non-toxicological indicators of health, a different approach would be required that may involve other expertise (*e.g.*, sociologists, social scientists, spiritual leaders, etc.). Although the proposed Keeyask Project may affect health indicators not related to toxicological outcomes, only the toxicological evaluation of the potential for physical disease was the focus of the HHRA. No conclusions have been made about mental, emotional or spiritual health in this document.

Finally, risk assessment carries with it uncertainties and it is never possible to ensure absolute safety. Daily events may present exposures to chemicals and physical agents including: eating burned food (exposure to polycyclic aromatic hydrocarbons), consuming chlorinated drinking water (exposure to chlorinated organic chemicals), using environmentally friendly compact fluorescent lights (exposure to mercury), breathing indoor air of homes with carpeting (exposure to volatile organic compounds) and using electrical appliances that release electromagnetic fields. These exposures are associated with similar uncertainties. Although it is possible to estimate risks that may be associated with each of these individual activities, there is a level of uncertainty that exists despite our best efforts.

Overall, risk assessment is recognized as a scientifically-defensible tool that provides a methodology for evaluating potential risks from chemicals and physical agents; however, uncertainty is an element of risk assessment that cannot be avoided. Due to the existence of these uncertainties, a conservative approach is typically applied in risk assessment and this approach tends to overestimate risks and, thus, minimize the potential for adverse health effects.

3.0 SUMMARY OF ENVIRONMENTAL CONCENTRATIONS USED IN THE HHRA

The focus of the HHRA was on local First Nation communities since these people would have the greatest amount of exposure from country foods under both present and post-impoundment conditions. Nevertheless, similar methods and results would be expected for members of the general public who fish and hunt at similar rates as the First Nations within the Project area. Local First Nations were assumed to be exposed to mercury from consumption of various local foods including fish, wild game, waterfowl and wild plants. Two scenarios were considered:

- Present conditions (*i.e.,* based on fish mercury data collected from 2001-2009).
- Post-impoundment conditions point in time when mercury concentration is predicted to reach peak concentrations in fish (it has been estimated in Keeyask Hydropower Limited Partnership [2011a,b] that this could occur approximately 3-7 years after impoundment).

The water bodies of primary interest were Gull and Stephens lakes. The HHRA did not measure mercury concentrations in food or people but relied on measured present and estimated post-impoundment concentrations in water and foods provided by other experts (*i.e.,* fish and surface water mercury concentrations by North/South Consultants Inc.; wild game mercury concentrations by Wildlife Resource Consulting Services MB Inc.; and waterfowl concentrations of mercury estimated by TetrES Consultants Inc. (now known as Stantec). Results of the various studies on mercury concentrations in fish, wild game, plants and water are critical input parameters used to assess human health risks. The reader is referred to Keeyask Hydropower Limited Partnership (2011a,b) for specific discussion on these concentrations and potential variability with time.

3.1 CONCENTRATION OF MERCURY IN FISH

The Aquatic Environment Supporting Volume (AE SV), Section 7.2) provides the present (up to year 2006) and predicted future concentrations of mercury in fish muscle and the reader is referred to that section for full details of historic, current, and potential future fish mercury concentrations in the Keeyask study area. To increase the sample size of fish mercury concentrations for the HHRA, particularly to strengthen the power of analysis for fish length-class specific exposure levels, available data from Stephens Lake for 2007 and 2009 were included.

For consideration in the HHRA, members of the Mercury and Human Health Technical Working Group arranged for a workshop in October 2009 with Members of local First Nations (known as the Keeyask Cree Nations). In this workshop, persons in the communities discussed how often and how much of each food type was consumed. The detailed results of this workshop are provided in the October 2009 memo provided by InterGroup Consultants. Although numerous fish species are available for consumption in the Keeyask area, the key fish species that are most frequently consumed by resource users and that will mainly contribute to human mercury exposure are:

- Lake whitefish;
- Northern pike (also known as jackfish);
- Walleye (also known as pickerel);
- Lake sturgeon.

Table 3-1 provides a summary of the total mercury concentrations in fish muscle tissue that were used in the HHRA and referred to as present concentrations (AE SV Section 7.2). It is noted that NSC has indicated that present mercury concentrations in lake sturgeon are based on only 13 fish from one location (Gull Lake).

Total mercury in fish was assumed to exist as methylmercury as recommended by Health Canada (2007). It is noted that there is considerable variability in the portion of total mercury that will exist as methylmercury (Health Canada [2007] cites a range of 30 to 95% as methylmercury). Nevertheless, Health Canada (2007) recommends that HHRA consider the mercury in fish to be present only as methylmercury.

Table 3-1 Total Mercury in the Muscle Tissue of Length-Standardized* Fish from Gull and Stephens Lakes: Present (2001-2006 for Gull Lake, 2001-2005 for Stephens Lake) Concentrations

Fish species	Mercury Concentration in Fish Muscle (for Standardized Size)* (µg/g; wet weight)	
	Gull Lake	**Stephens Lake**
Lake whitefish	0.07	0.09
Northern pike	0.22	0.26
Walleye	0.23	0.29
Lake sturgeon	0.20	No measurements currently available

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm, lake sturgeon 1,300 mm. Individual mercury concentrations will be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.

To estimate maximum mercury concentrations in whitefish, pike, and walleye following impoundment, NSC have used various modeling approaches (AE SV, Section 7.2.2). Based on the modeling results and taking into account the strength and weaknesses of the different models used, NSC considered the best estimates of maximum post-impoundment concentrations would be equal to the values provided in Table 3-2. No model is available to predict maximum post-impoundment mercury concentrations in lake sturgeon, and the values included in Table 3-2 are “best guess” estimates by the author of the Fish Quality section of the Aquatics Environment SV (North South Consultants, *pers. comm*. 2010).

Based on this evaluation, it is evident that the mercury concentrations of certain fish may increase markedly following impoundment while other fish would be much less affected. Northern pike and walleye from Gull Lake would be the most affected fish species while the whitefish from Stephens Lake is predicted to have the lowest increase in mercury concentration following impoundment.

Table 3-2 Total Mercury in the Muscle Tissue of Length-Standardized* Fish from Gull and Stephens Lakes: Predicted Maximum Post-Impoundment Concentrations

Fish Type	Average Estimated Mercury Concentration in Fish Muscle (for Standardized Size)* (μg/g; wet weight)	
	Gull Lake	Stephens Lake
Whitefish	0.19	0.15
Northern pike	1.0	0.50
Walleye	1.0	0.50
Sturgeon	0.30	0.25

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm, lake sturgeon 1,300 mm. Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.

3.2 CONCENTRATION OF MERCURY IN WILD GAME

Terrestrial Environment Supporting Volume (TE SV) (Section 8) provides the present and future concentrations of mercury in wild game tissue compiled by Wildlife Resource Consulting Services MB Inc. (WRCS) and the reader is referred to that section for full details of the measured and predicted concentrations.

As discussed earlier, members of the Mercury and Human Health Technical Working Group arranged for a workshop in October 2009 with members of local First Nations communities. In this workshop, persons in the communities discussed how often and how much of each food type was consumed. Although numerous wild game species can be consumed, the key species of concern (based on frequency of consumption and likelihood to accumulate mercury) are as follows:

- Beaver;
- Muskrat;
- Moose; and
- Snowshoe hare.

Table 3-3 provides a summary of the mercury concentrations in muscle tissue of wild game that were used in the HHRA for present concentrations. Mercury in wild game was estimated as total mercury concentrations (*i.e.*, present in both inorganic and methylmercury forms).

Table 3-3 Total Mercury in the Muscle Tissue of Wild Game Collected from the Project Area: Present Concentrations

Species	Total Mercury as an Average Concentration in Muscle (μg/g; wet weight)	Range of Total Mercury Concentration in Muscle (μg/g; wet weight)
Beaver	0.01	<0.01 – 0.05
Muskrat	0.02	<0.01 – 0.06
Moose	0.07*	<0.01–0.17
Snowshoe Hare	0.05*	<0.01–0.12

* Mercury concentration in moose and snowshoe hare was only a literature estimate and may have greater uncertainty than other species for which measured values were obtained from the study area.

In the case of the mercury concentrations in wild game following impoundment, Wildlife Resource Consulting Services considered the best estimate of concentrations during the maximum year post-impoundment would be equal to the values provided in Table 3-4. Mercury in wild game was estimated as total mercury concentrations.

Table 3-4 Total Mercury in the Muscle Tissue of Wild Game from the Project Area: Predicted Maximum Post-Impoundment Concentrations

Species	Total Mercury Concentration in Muscle (μg/g; wet weight)	Most Likely Range in Total Mercury Concentration in Muscle (μg/g; wet weight)
Beaver	0.01	<0.01 – 0.05
Muskrat	0.04	<0.01 – 0.12
Moose	0.07*	<0.01–0.17
Snowshoe Hare	0.05*	<0.01–0.12

* Mercury concentration in moose and snowshoe hare was a literature based estimate and likely has greater uncertainty than other species for which measured concentrations were obtained from the study area

Based on this evaluation, it is evident that wild game would not be expected to be greatly impacted by the proposed impoundment. Beaver, moose and snowshoe hare would not be predicted to have any measurable change in mercury tissue concentrations while muskrat would be only expected have an increased concentration of 0.04 µg/g (although this is a doubling of concentrations, it is still an increase of only 0.02 µg/g).

3.3 CONCENTRATION OF MERCURY IN WATERFOWL

The TE SV (Section 8 and Appendix 8A) provide the present and future concentrations of mercury in waterfowl tissue compiled by Stantec and the reader is referred to that section for full details of the measured and predicted concentrations. Although various species of waterfowl can be consumed, the waterfowl assessed were (based on frequency of consumption and likelihood to accumulate mercury):

- Ducks (*e.g.*, mallard, ring-necked duck, teal, golden eye);
- Gull eggs.

Table 3-5 provides a summary of the mercury concentrations in muscle tissue of ducks that were used in the HHRA of present concentrations. As described in TE SV (Section 8), Stantec has estimated that concentrations of mercury in ducks would be similar to or less than concentrations measured in local whitefish. Stantec has indicated that there is no information on mercury concentrations that may result in gull eggs and, as a result, could not provide an estimate of present concentrations for use in the HHRA. All mercury in ducks was assumed to exist as methylmercury (*i.e.*, mirrored lake whitefish concentrations).

Table 3-5 Total Mercury in Waterfowl from the Project Area: Present Concentrations

Taxon	Mean Mercury Concentration (µg/g; wet weight)	
	Gull Lake	Stephens Lake
Duck	≤0.07	≤0.09
Gull eggs	No measurements currently available	No measurements currently available

* Mercury concentration in ducks was an estimate where concentrations were assumed to be similar to or less than concentrations found in whitefish.

In the case of the mercury concentrations in waterfowl following impoundment, Stantec considered the best estimate of concentrations during the maximum year post-impoundment to equal the values provided in Table 3-6. Once again, Stantec has estimated that concentrations of mercury in ducks would be similar to or less than concentrations in whitefish and, consequently, the mercury levels provided in Table 3-6 for ducks are those previously provided for whitefish.

Based on this evaluation, it is evident that the increases in mercury concentrations in ducks are expected to be relatively modest following impoundment. No estimates are provided for gull eggs and, consequently, these would need to be directly measured in the field if further information is required.

Table 3-6 Total Mercury in Waterfowl in the Project Area: Predicted Maximum Post-Impoundment Concentrations

Taxon	Mean Mercury Concentration (µg/g; wet weight)	
	Gull Lake	Stephens Lake
Duck	≤0.19	≤0.15
Gull eggs	No estimates available	No estimates available

* Mercury concentration in ducks was an estimate where concentrations were assumed to be similar to or less than concentrations found in whitefish.

3.4 Concentration of Mercury in Wild Plants

Although many types of wild plants can be consumed from the project area, the key plants that were identified from discussions with local First Nations community Members are:

- Northern tea (also known as Labrador tea);
- Blueberries; and
- Seneca root.

There was no information available on present mercury concentrations in these plants. Nor were future concentrations estimates provided for post-impoundment conditions. Consequently, these would need to be directly measured in the field if further information was required.

3.5 Concentration of Mercury in Surface Water

The AE SV (Section 2) provides a description of the present concentrations of mercury in surface water as well as an assessment of effects of the Project on concentrations in surface water in the study area and the reader is referred to that section for additional detail. The following provides a summary of this information presented in the AE SV.

Mean total mercury concentrations measured in Gull and Stephens lakes were less than the current analytical method detection limit of 0.05 µg/L. The maximum measured total mercury concentration for the entire study area (Split Lake to the Nelson River estuary) was 0.32 µg/L (site NR-5 August 2003). Mercury has been detected across the study area and at three sites (GT1, NR5, and NR6) concentrations have occasionally exceeded the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOG) for freshwater aquatic life of 0.1 µg/L; however, all samples were within the Manitoba drinking water guideline of 1 µg/L.

Table 3-7 provides a summary of the measured total mercury concentrations in surface water that were used in the HHRA of present concentrations.

Table 3-7 Total Mercury Measured in the Surface Water from the Project Area: Present Concentrations

Mean Total Mercury Concentration in Surface Water (µg/L)	
Gull Lake	**Stephens Lake**
Less than 0.05	Less than 0.05

Project-related increases in mercury in surface water are not expected to exceed 0.05 µg/L or to cause or contribute to exceedences of the drinking water quality guideline in, or downstream of, the Keeyask reservoir (see Table 3-8). Based on modeling results and literature regarding measured concentrations of mercury in Manitoba and Ontario reservoirs, it is expected that total mercury concentrations would not exceed 0.05 µg/L; this value was therefore used as a conservative value in the HHRA. Concentrations of mercury are expected to remain below the Manitoba PAL water quality guideline and below the analytical detection limits employed in this study from the combined effects of peatland disintegration and flooding. Mercury was not detected in the Nelson River between Clark and Stephens lakes and the predicted average increases due to peatland disintegration and flooding are expected to be too small to exceed the analytical detection limit. However, during periods where organic particulate materials are notably elevated as a result of resuspension or peatland disintegration (*i.e.*, stochastic events), total mercury concentrations may be higher than existing conditions. Effects on Stephens Lake are also not expected to exceed total mercury concentrations of 0.05 µg/L.

Table 3-8 Total Mercury in Surface Water from the Project Area: Predicted Mean Post-Impoundment Concentrations

Mean Total Mercury Concentration in Surface Water (µg/L)	
Gull Lake	**Stephens Lake**
Less than 0.05	Less than 0.05

4.0 HHRA METHODOLOGY

4.1 INTRODUCTION

As mentioned earlier, the focus of the HHRA was on local First Nations communities but similar findings would be expected for members of the general public who frequently fish and hunt. These First Nations were assumed to be exposed to mercury from consumption of various local foods including fish, wild game, waterfowl and wild plants. Two scenarios were considered:

- Present conditions;
- Post-impoundment conditions at the point in time when mercury concentration is predicted to reach peak concentrations in fish.

The methods used to estimate human health risks were primarily based on risk assessment provided by Health Canada, World Health Organization (WHO) and the United States Environmental Protection Agency (US EPA). Important documents that have been used to estimate risks include the following:

- Health Canada. 2010a. (draft) Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment of Chemicals ($DQRA_{CHEM}$). Contaminated Sites Division, Safe Environments Programme, Health Canada, Ottawa, ON.
- Health Canada. 2010b. Toxicological Reference Values, Estimated Daily Intakes, or Dietary Reference Values for Trace Elements.
- Health Canada. 2009a. (draft) Federal Contaminated Site Risk Assessment in Canada – Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA).

- Health Canada. 2009b. Federal Contaminated Site Risk Assessment in Canada – Part IV: Spreadsheet Tool for Human Health Preliminary Quantitative Risk Assessment (PQRA).

- Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption.

- Health Canada. 2004. Canadian Handbook on Health Impact Assessment.

Briefly, exposures to mercury were estimated based on a variety of assumptions relating to the use of areas and the possible dietary habits (*i.e.,* consumption of animals and plants) of people in the vicinity of the site. The toxicological literature was then reviewed to identify exposure rates for mercury that have been determined by international health agencies to be acceptable or "safe" (or more specifically, exposure rates without appreciable risks of adverse effects). The next step in the risk assessment was a comparison of the estimated exposure rates to the dose rates considered acceptable or "safe" for humans for the various consumption scenarios considered in the assessment. Finally, the recommended maximum weekly intakes of the various foods were estimated.

Risks from historic exposures that may have occurred in previous decades were not evaluated in the assessment of off-site receptors. Instead, the focus of the exposure assessment was on exposures that may possibly occur under present and post-impoundment use.

In addition, it should be noted that health agencies have undertaken blood and hair analysis for mercury in local First Nation communities in the Keeyask study area in the 1990s. These data are confidential and were not available to Wilson Scientific for inclusion in this HHRA. As discussed by the Mercury and Human Health Technical Working Group, community specific data were available, in summary form at the community level (*i.e.,* no individual results), to each community by request directly to Health Canada.

The methods used to complete the risk assessment are described in detail in the following sections.

4.2 PROBLEM FORMULATION

4.2.1 Chemicals of Potential Concern

The HHRA focused on mercury as the main chemical of potential concern. Mercury was evaluated since it has appreciable potential to accumulate in the environment at concentrations that could affect food and other sources. Mercury can enter the aquatic food chain and prompt fish consumption advisories following reservoir creation. It should be emphasized that mercury occurs naturally in many foods, particularly predatory fish at the top of the food chain. Nevertheless, it is clear that some fish concentrations of mercury are expected to increase appreciably following impoundment.

4.2.2 Receptors of Concern

The Keeyask study area is used for a variety of purposes including the traditional collection of foods by local First Nations community Members. Persons participating in such activities could be of any age. Consistent with Health Canada (2009a; 2010a) guidance, the most sensitive toddler (ages 0.5 to four years) was the key receptor used to evaluate risks to mercury in the Keeyask area. Other receptors included women of childbearing age and adult males.

4.2.3 Assumed Receptor Characteristics

To the extent possible, receptor characteristics were based on data specific to the Canadian population. Values used in the risk assessment were based primarily on recommendations provided by Health Canada (2009a; 2010a). Other sources such as CCME (2006), Richardson (1997) and other published scientific literature were also considered.

Body Weight

For body weight, the values recommended in Health Canada (2009a; 2010a) were considered for the assessment of child and adult receptors.

Accordingly, the following values were selected as receptor characteristics in the assessment:

Younger Child (ages 0.5-4 yrs):	16.5 kg (Health Canada 2009a; 2010a);
Women of Child-bearing Age:	60 kg (Health Canada 2009a; 2010a);
Adults:	70.7 kg (Health Canada 2009a; 2010a).

Water Consumption Rate

Water consumption rates for the various human receptor types recommended by Health Canada (2009a; 2010a) were used in the exposure assessment.

Accordingly, the following values were selected as receptor characteristics in this assessment as the drinking water consumption estimates:

Younger Child (ages 0.5-4 yrs):	0.6 L/day (Health Canada 2009a; 2010a);
Adults:	1.5 L/day (Health Canada 2009a; 2010a).

Skin Surface Area

In the case of skin surface area available for contact with surface water, Health Canada (2009a; 2010a) has adopted values recommended by Richardson (1997) for the whole body surface area.

The following values were selected as receptor characteristics in the assessment:

Younger Child (ages 0.5-4 yrs):	0.60 m^2 (whole body) (Health Canada 2009a; 2010a)

Adults:	1.8 m^2 (whole body) (Health Canada 2009a; 2010a).

Time Spent at the Site

For traditional land use, it was assumed that these persons would spend seven days per week, 52 weeks per year for their entire life at the site. These estimates are not from literature sources but instead are based input from local First Nations, professional judgment and acceptable practice in HHRA (*i.e.,* use of conservative estimates).

The following values were selected as receptor characteristics in the assessment:

Traditional Land Use:	7 days per week, 52 weeks per year for 80 years (professional judgment)
Country Foods Consumer:	Various rates of consumption for an entire lifetime (see below).

Country Foods Consumption

The term "country foods" refers to foods that are not bought in stores or grown in home gardens or farms but instead are collected from the environment. Country foods include fish, wild game, waterfowl and wild plants.

The scientific literature contains an appreciable amount of information on the rate of country food consumption by First Nation communities in Canada. Although this information provides excellent sources for consideration, use of such data has limitations since rates of country food consumption vary from locale to locale. As a result, it is preferable to have site-specific information on the rates of consumption when such estimates are available.

For consideration in the HHRA, members of the Mercury and Human Health Technical Working Group arranged for a workshop in October 2009 with members of local First

Nations communities. In this workshop, persons in the communities discussed how often and how much of each food type was consumed. The detailed results of this workshop are provided in the October 2009 memo provided from InterGroup Consultants. According to this memorandum, the most common food types and rate of consumption are provided below.

It is recognized that the fish serving sizes provided in Table 4-1 represent quite large serving sizes compared to those typical, as identified by Health Canada. These serving sizes were determined through consultations with local First Nations representatives at the October 2009 workshop. It is possible that many persons would consume smaller portion sizes or may eat foods at a lower frequency. For such persons, the HHRA has provided risk estimates as Recommended Maximum Weekly Intakes in units of grams per week (*i.e.,* independent of serving size).

Table 4-1 Assumed Consumption Rates of Various Country Foods Consumed by Local First Nations Communities

Food Type	Serving Size for Young Child	Serving Size for Adult	Frequency of Consumption
Fish			
Whitefish	100 g (or 3.5 ounces)*	400 g (or 14 ounces)	Three times per week
Northern pike	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Walleye	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Sturgeon	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Three times per week
Wild Game			
Beaver	57 g (or 2 ounces)	200 g (or 7 ounces)	Three times per week
Muskrat	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week
Moose	100 g (or 3.5 ounces)	400 g (or 14 ounces)	Five times per week
Snowshoe hare	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week
Waterfowl			
Duck	57 g (or 2 ounces)	200 g (or 7 ounces)	One time per week

* One ounce = 28.4 grams

The above information was used to estimate exposures to mercury that persons may receive from the consumption of various country foods. Using the period of exposure that may result in the greatest daily exposure over a period of one week, the daily intake rate was estimated for each of the food groups. For example, in the case of sturgeon which is consumed only in spring and fall, risk estimates are based on the period that it is consumed three times per week. This is considered to be a conservative assumption because it does not distinguish risks from foods consumed on a seasonal basis versus those consumed all year round. Nevertheless, no health agencies provide recommendations for addressing short-term exposures to methylmercury and, thus, this approach was conservatively adopted.

It is noted that local First Nation communities also identified the following country foods as a concern:

- Gull eggs;
- Wild plants:
  - Northern tea;
  - Blueberries; and
  - Seneca roots

However, as noted in Section 3, there are no estimates of mercury concentrations in these animals or plants either presently or that would occur following impoundment. Consequently, these foods were not further evaluated in the quantitative HHRA. It is recommended that these foods be part of future monitoring if information on risks from consumption is desired.

4.2.4 Exposure Pathways of Concern

The exposure pathways for the off-site receptors are receptor-dependent. In the case of traditional land use, the exposure pathways evaluated included:

- Ingestion of surface water from Gull Lake or Stephens Lake; and

- Dermal contact with surface water from Gull Lake or Stephens Lake.

In the case of the country foods consumers, risks from consumption of the following food groups were estimated:

- Fish:
  - Whitefish;
  - Northern pike;
  - Walleye;
  - Sturgeon.
- Wild Game:
  - Beaver;
  - Muskrat;
  - Moose;
  - Snowshoe hare;
- Waterfowl:
  - Ducks.

4.2.5 Conceptual Model

Based on the information provided in the previous section and following the guidance from Health Canada and various other international health agencies, conceptual models were developed to illustrate the receptors and exposure pathways identified for evaluation of risks to off-site receptors.

As discussed earlier, it is usually not possible to evaluate every individual and/or exposure pathway present; however, if the most sensitive receptors and most important pathways are evaluated, it can safely be concluded that other receptors and exposure pathways not considered would be adequately addressed by the result and conclusions of the HHRA. Consequently, the conceptual models summarized here have been developed with this objective in mind.

For the persons using the area for traditional land uses, the receptors and exposure pathways are provided in Table 4-2. Once again, the consumption of country foods was addressed as a separate pathway (see below).

Table 4-2 Conceptual Model for Traditional Land Use

Critical receptor		Exposure pathways	
	Infant		Soil Ingestion
X	Toddler		Soil dermal absorption
	Child		Particulate inhalation
	Teen		Vapour inhalation
X	Adult	X	Water dermal exposure
		X	Water ingestion
		X	Wild plant ingestion
		X	Fish ingestion
		X	Wild game ingestion

X – Requires evaluation in the human health risk assessment

4.3 EXPOSURE ASSESSMENT

4.3.1 Environmental Concentrations

As discussed earlier, receptors were assumed to consume country foods that include wild game, fish and plants. In addition, receptors were assumed to be exposed to surface water. The assumed concentrations of mercury in the various country foods and surface water are discussed in sections below.

Assumed Concentrations of Mercury in Fish

As identified by the Mercury and Human Health Technical Working Group, consumption of the following fish species was the primary concern to human health:

- Lake whitefish;
- Northern pike;
- Walleye; and
- Lake sturgeon.

Section 3.1 provides the measured and predicted concentrations of mercury in fish tissue that were used in the HHRA. The HHRA was based on the mean concentrations of mercury in fish tissue (current concentrations were measured while future concentrations were predicted).

The mercury concentrations reported in section 3.1 are specific to a standardized length of the various fish species. Because mercury concentrations are generally positively related to fish length, fish that are larger than the specified standard length usually have greater concentrations while smaller fish have lower concentrations. The standard lengths used here are based on the approximate size of fish that would typically be caught and eaten. Therefore, using mercury concentrations from fish of this size provides the best average estimate of mercury exposure to people over the long-term.

Assumed Concentrations of Mercury in Wild Game

As identified by the Mercury and Human Health Technical Working Group, consumption of the following wild game species were the primary concern to human health:

- Beaver;
- Muskrat;
- Moose; and
- Snowshoe hare.

Section 3.2 provides the measured and estimated concentrations of mercury in wild game tissue that were used in the HHRA. Similar to that discussed for fish, the HHRA of wild game consumption was based on the mean concentrations of mercury.

It is noted that other wild game species may be consumed by First Nations that were not directly evaluated in the HHRA. In most cases, these species would likely have similar or lower concentrations of mercury than those assumed in the HHRA. For example, caribou are consumed from the area but caribou would be expected to have lower concentrations of mercury than moose because they spend less time in the area (*i.e.*, larger home range) and less time in contact with aquatic habitat. Consequently, it is likely that risks from such foods would be even lower than from the wild game evaluated in the HHRA. Nevertheless, it will be recommended that a program is established whereby hunters may submit tissue samples of any species of wild game that they have hunted in the area for mercury analysis. In this manner, the mercury content of other country foods can be monitored.

Assumed Concentrations of Mercury in Waterfowl

As identified by the Mercury and Human Health Technical Working Group, consumption of the following waterfowl species was the primary concern to human health:

- Ducks; and
- Gull eggs.

Section 3.3 provides the assumed concentrations of mercury in ducks. As discussed earlier, no estimate of mercury concentrations in gull eggs was possible for either present or future scenarios. Consequently, gull eggs would need to be monitored if risk estimates from this food group are required.

It is noted that other waterfowl may be consumed by local First Nations that were not directly evaluated in the HHRA (*e.g.,* geese). In the case of geese, they would likely have similar or lower concentrations of mercury than those assumed in the HHRA (due to their mainly plant-based diet, geese have a lower ability to accumulate mercury than ducks). Consequently, it is likely that risks from geese would be lower than from the ducks evaluated in the HHRA. Nevertheless, it will be recommended that a program is established whereby hunters may submit tissue samples of any species of waterfowl that they have hunted in the area for mercury analysis. In this manner, the mercury content of other country foods can be monitored.

Assumed Concentrations of Mercury in Wild Plants

As identified by the Mercury and Human Health Technical Working Group, consumption of the following wild plant species was the primary concern to human health:

- Northern tea;
- Blueberries; and
- Seneca root.

As discussed earlier, no estimates of mercury concentrations in wild plants were available for either present or post-impoundment scenarios. Consequently, wild plants would need to be monitored if risk estimates from this food group is required and it will be recommended that a program is established whereby food gatherers may submit tissue samples of species of edible plants that have been gathered for mercury analysis. In this manner, the mercury content of wild plants can be monitored.

Assumed Concentrations of Mercury in Surface Water

The approach for estimating potential human exposure to off-site receptors was based on measured water concentrations at the current time and estimated water concentrations that would occur at the maximum time following impoundment. As discussed previously in Section 3.5, the surface water concentrations were largely compiled from data presented in the AE SV, Section x. Briefly, North/South Consultants have indicated that both present and post-impoundment concentrations of mercury in surface water would be expected to be less than the method detection limit of 0.05 µg/L. For the purposes of the HHRA, it was assumed that mercury would be found in surface water at a concentration equal to the method detection limit of 0.05 µg/L.

4.3.2 Mathematical Equations Used to Estimated Exposures

As discussed earlier, the exposures that off-site receptors may receive were estimated for the following pathways:

- Ingestion of surface water;
- Dermal contact with surface water (bathing or swimming); and
- Consumption of country foods (wild game, fish and plants).

The mathematical equations used to estimate exposures from these pathways are discussed in Appendix 5C-1. Some of the other important concepts applied in the exposure assessment approach are discussed below.

4.3.2.1 Exposure Amortization

As noted earlier, the number of weeks assumed for the exposure duration of concern was important to the outcome of the risk assessment. Essentially, it is important that the exposure data match as closely as possible the toxicological data (*i.e.*, toxicity reference values [TRVs]) in terms of exposure duration.

For assessment of risks from mercury, no lifetime exposure amortization was completed for less than lifetime exposures. Although it was previously stated that persons spend 80 years of their lifetime at the site, this timeframe does not play a role in estimation of risks to the non-carcinogens. According to Health Canada guidance, any exposure that lasts more than three months is considered to be chronic in duration and lifetime exposure amortization is typically appropriate for exposures that last longer than this duration. With the above in mind, it was considered appropriate and consistent with Health Canada guidance to amortize exposures that occur two times per week over the entire week. Although it is likely that receptors will have lower exposures in the winter than in the summer (due to snow cover and potentially reduced use of off-site areas in some cases), the HHRA did not consider this in the quantitative evaluation. As a result, the HHRA has been completed for exposures that occur during the season where the exposure took place (*i.e.,* exposures that occur over a one or two month period were not spread out over the entire year).

4.3.2.2 Bioavailability Assessment

As shown in the Appendix 5C-1 calculations, bioavailability was used to estimate the fraction of exposure that may actually enter a person's body. Bioavailability is an important factor that allows for the comparison of exposures via multiple routes. For example, bioavailability allows the risk assessment to compare health risks from dermal exposures to TRVs established for oral exposure routes. For the purposes of the HHRA, the bioavailability of mercury in food was assumed to be 100%. For dermal absorption from surface water, mercury was assumed to have a permeability constant of 1×10^{-5} m/hr as recommended by Health Canada (2009b).

4.4 TOXICITY ASSESSMENT

Toxicological data were available from regulatory agencies such as Health Canada, US EPA and the World Health Organization. In the case of mercury, the following TRVs were used:

- Tolerable Daily Intake (TDI) for methyl mercury = 0.2 µg/kg bw/day (for children, women of child bearing age) and 0.47 µg/kg bw/day (for other members of the general population) (Health Canada, 2010b).

- TDI for total mercury = 0.57 µg/kg bw/day for all persons (based on WHO [2010] provisional tolerable weekly intake of 4 µg/kg/week).

For mercury in fish and waterfowl, all mercury was assumed to be present as methylmercury since most experts would agree that the vast majority of mercury would be present in this form. For mercury in wild game and wild plants, mercury was assumed to be present as total mercury since information is not readily available on the mercury form in muscle tissue and, thus, was compared to the WHO/Health Canada total mercury toxicity reference value. Appendix 5C-1 provides additional details regarding these TRVs.

4.5 RISK CHARACTERIZATION

Risks were estimated as Hazard Quotient values according to the following formula:

$$\textit{Hazard Quotient} = \frac{\textit{Estimated Exposure } (\mu g/kg \textit{ body weight/day})}{\textit{Tolerable Daily Intake } (\mu g/kg \textit{ body weight/day})}$$

With respect to Health Canada guidance for foods, a Hazard Quotient value of 1 is typically considered to be the maximum acceptable exposure that will not be associated with unacceptable risks (Health Canada 2004). Although a Hazard Quotient value of 0.2 is considered to be acceptable for contaminated soils (when environmental concentrations represented by the arithmetic means are considered) (Health Canada 2009a, 2010a), this value is not typically used for evaluation of foods. Indeed, there are numerous precedents where Health Canada has considered Hazard Quotient values of 1 to be acceptable (especially when food sources are considered). Consequently, a Hazard Quotient value of 1 was used as the acceptable risk for mercury.

Since mercury is not evaluated as a carcinogen by most health agencies (*e.g.*, Health Canada, World Health Organization and US Environmental Protection Agency), it was not necessary to estimate cancer risks.

In addition to estimation of risks as Hazard Quotients, the Recommended Maximum Weekly Intakes (RMWIs) for the various country foods were estimated. The RMWI represents the amount of food that, if consumed on a weekly basis, would result in an exposure that is equal to the Tolerable Daily Intake (and thus result in a Hazard Quotient value equal to 1).

RMWIs were estimated as:

$$RMWI = \frac{TDI \times BW \times 7\ days}{CF}$$

where:

RMWI	=	Recommended Maximum Weekly Intake (g/week)
TDI	=	Tolerable Daily Intake (µg/kg body weight/day)
BW	=	Body weight of person (kg)
CF	=	Concentration in food of concern (µg/g, wet weight)

In this manner, RMWIs were estimated for the country foods under present conditions and also that would result under the post-impoundment scenario (peak year).

5.0 RESULTS

The results of the risk assessment for receptors exposed to mercury are provided in the sections below. Worked examples of the risk calculations are provided in Appendix 5C-1.

5.1 RISKS FROM CONSUMPTION OF FISH

Risks from consumption of fish were estimated for the present conditions and for the possible post-impoundment scenario. Based on information provided by local First Nation communities, all fish were assumed to be consumed at a frequency of three meals per week with a serving size of 100 g (3.5 ounces) per meal for toddlers and 400 g (14 ounces) per meal for adults. These rates of consumption were used at the request of local First Nation communities and are considered to represent upper bound exposures (especially in regard to serving size). Nevertheless, the HHRA considered these values in order to ensure a conservative assessment and address all concerns of the local First Nation communities.

It is recognized that certain fish are only consumed at certain times of the year (*e.g.*, sturgeon are only consumed in the spring and the fall). Nevertheless, this less than continuous exposure is not quantitatively considered in the HHRA because the key concern regarding methylmercury is developmental toxicity. Developmental toxicants sometimes only require a couple of weeks of exposure to illicit adverse effects and the fact that a pregnant woman only consumed a certain country food for a few weeks during pregnancy would not necessarily be a mitigating factor that would diminish the potential developmental toxicity.

5.1.1 Present Conditions

Table 5-1 provides the risk estimates for consumption of fish under present conditions. Using the methods discussed previously, the key results of the risk analysis of present conditions include the following:

- In evaluation of the results of the HHRA, it is important to consider that relatively high rates of fish consumption were assumed.

- Toddlers and women of childbearing age had risks that were two to three times higher than adult males and Elders consuming the same fish species. This is mainly because the TDI for methylmercury is approximately 2.5 times lower for toddlers/women of child bearing age than for adults.

- The greatest risks were estimated from consumption of northern pike and walleye due to their higher tissue mercury concentrations relative to other fish species. These two predatory fish species have mean mercury concentrations that are greater than 0.2 µg/g but less than 0.5 µg/g and various health agencies have recommended that young children and women of childbearing age may want to restrict consumption of fish to a meal or so per week when mercury concentrations are in this range.

- Risks from consumption of lake whitefish were the lowest due to their low mercury concentrations; however, consumption of three large meals per week could still result in Hazard Quotient values that exceed the acceptable value. Nevertheless, whitefish at the present mercury concentrations represent an excellent source of nutrition and we are not aware of any international health agencies that would take issue with persons consuming fish with mercury concentrations less than 0.2 µg/g (fish from both lakes were substantially lower than this value).

- In the case of lake sturgeon in Gull Lake, these fish presently contain arithmetic mean mercury concentrations equal to 0.2 µg/g (the relationship between mercury concentration and fish length was not significant and standardized means should not be used; see AE SV (Section x). As noted above, we are not aware of any international health agencies that would take issue with persons consuming fish with mercury concentrations less than 0.2 µg/g. Nevertheless, consumption of three large meals per week could still result in Hazard Quotient values that exceed the acceptable value.

Based on the results, frequent consumption of large meals of certain types of fish may exceed the acceptable Hazard Quotient. It should be noted that the adult Hazard Quotient values would have been lower in Table 5-1 if a more common serving size of 150 grams per meal was used (*i.e.*, 150 grams is the serving size commonly assumed by Health Canada). Indeed, the Hazard Quotient values for adults (both women of childbearing age and adult males and all Elders) would have been about 2.5 times lower than provided in Table 5-1; however, for toddlers, Health Canada policy uses a serving size of 106 g/meal and a body weight of 14 kilograms such that Hazard Quotient values would have been about 20% higher than provided in Table 5-1. Nevertheless, the information on serving sizes obtained directly from the communities is considered to supersede the Health Canada recommendations.

Table 5-1 Risk Estimates from Consumption of Fish: Present Conditions

Fish Species	Standardized Concentration* (µg/g, wet weight)	Hazard Quotient from Consumption of Three Large Meals per Week (Acceptable Value = 1)***		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Lake Whitefish	0.07	0.9	1.0	0.4
Northern Pike	0.22	2.8	3.1	1.1
Walleye	0.23	3.0	3.3	1.2
Lake Sturgeon**	0.20	2.6	2.8	1.0
Stephens Lake				
Lake Whitefish	0.09	1.3	1.4	0.5
Northern Pike	0.26	3.5	3.8	1.4
Walleye	0.29	4.2	4.7	1.7
Lake Sturgeon	No measurements currently available	No estimates currently available	No estimates currently available	No estimates currently available

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm,
Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.
** Arithmetic mean concentration.
*** Based on information provided by local First Nation communities, all fish were assumed to be consumed at a frequency of three meals per week with a serving size of 100 g for toddlers and 400 g for adults.

In addition to estimation of risks as Hazard Quotient values, the Recommended Maximum Weekly Intake (RMWI) was estimated for fish under present conditions. Table 5-2 provides the RMWI that would result in a Hazard Quotient value of 1. The valuable aspect of this RMWI information is that it provides consumption recommendations that are independent of serving size. For example, if a RMWI of 1,200 g/week is acceptable for consumption of lake whitefish by women of childbearing age, it can be reasoned that a woman could have three meals per week if serving size is 400 g (14 ounces) or 6 meals per week if the serving size is 200 g (seven ounces) or eight meals per week if the serving size in 150 g (5.3 ounces). All three scenarios would still result in a woman consuming 1,200 g of lake whitefish which would equate to an exposure equal to a Hazard Quotient value of 1 (assuming consumption of lake whitefish of standard length).

Table 5-2 Recommend Maximum Weekly Intake of Fish for a Hazard Quotient Value =1: Present Conditions

Fish Species	**Standardized Concentration (µg/g, wet weight)***	**Recommended Maximum Weekly Intake (g/week) for a HQ =1 (All for Fish of Standard Length)**		
		Toddlers	**Women of Childbearing Age**	**Adult Males and All Seniors**
Gull Lake				
Lake Whitefish	0.07	330	1,200	3,400
Northern Pike	0.22	100	380	1,100
Walleye	0.23	100	370	1,000
Lake Sturgeon**	0.20	120	420	1,200
Stephens Lake				
Lake Whitefish	0.09	260	940	2,600
Northern Pike	0.26	89	320	900
Walleye	0.29	80	290	810
Lake Sturgeon	No measurements currently available	No estimates currently available	No estimates currently available	No estimates currently available

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm,
Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.
** Arithmetic mean concentration.

The amount that can be consumed on a weekly basis and result in an exposure equal to the Tolerable Daily Intake was also estimated for various sizes of fish. Using the mean mercury concentrations for each of three size classes for the three main fish species (North South Consultants Inc., unpubl. data), recommendations for consumption of various fish sizes were developed. Table 5-3 provides the size recommendations for consumption of fish. These recommendations are for present day conditions as they are based on actual size distributions that currently exist. If size recommendations were sought under post-impoundment conditions, fish would need to be caught and analyzed under such conditions.

Table 5-3 Recommendations for Consumption Based on Fish Size Class for a Hazard Quotient Value = 1: Present Conditions (based on Mean Mercury Concentrations)

Species	Fish Size Class								
	Lake Whitefish			Northern Pike			Walleye		
	<300 mm	300-450 mm	>450 mm	<400 mm	400-800 mm	>800 mm	400-550 mm	400-550 mm	>550 mm
Gull Lake									
Mean concentration of mercury in tissue (µg/g; wet weight)	0.042	0.071	0.149	0.129	0.270	0.789	0.117	0.394	0.688
Consumption Recommendation for Toddlers (g/week)	550	330	160	180	86	29	200	59	34
Consumption Recommendation for Women of Child Bearing Age (g/week)	2,000	1,200	570	650	310	110	720	210	120
Consumption Recommendation for Adult Males/ All Seniors (g/week)	5,600	3,300	1,600	1,800	870	300	2,000	600	340
Stephens Lake									
Mean concentration of mercury in tissue (µg/g; wet weight)	0.070	0.094	0.154	0.096	0.318	1.07	0.183	0.422	0.716
Consumption Recommendation for Toddlers (g/week)	331	250	150	240	73	22	130	55	32
Consumption Recommendation for Women of Child Bearing Age (g/week)	1,200	900	550	880	260	79	460	200	120
Consumption Recommendation for Adult Males/ All Seniors (g/week)	3,300	2,500	1,500	2,400	740	220	1,300	560	330

Although it is possible to estimate Hazard Quotient values greater than associated with very high rates consumption of fish (see below),it would seem unnecessary to recommend that consumption needs to be reduced for fish with mercury concentrations less than 0.2 µg/g. There is no known federal policy that strictly indicates that no risk management is required when fish concentrations are less than 0.2 µg/g. Nevertheless, it would seem that most agencies and experts would agree that such concentrations can be considered to be low and the nutritional benefits of such fish may outweigh any risk factors. Indeed, we are aware of no major health agency that has expressed concerns at such low concentrations. In addition, experience with Health Canada's Health Products and Food Branch and the First Nations and Inuit Health Branch have indicated that when the First Nation communities are encouraged to undergo routine blood and hair analysis this should provide further emphasis that it may be unnecessary to recommend restricting consumption of fish when mercury concentrations are less than 0.2 µg/g[1].

It is recognized that using an approach where no consumption restrictions are recommended for persons consuming fish less than 0.2 µg/g will result in Hazard Quotient values greater than 1 and this may seem to contradict the results of the HHRA. For example, if a woman of childbearing age consumed fish with a mercury concentration of 0.2 µg/g at a rate of five meals per week (400 g/serving), a Hazard Quotient of 4.8 would be predicted. However, as noted above, there is no health agency precedent to suggest that persons should reduce current frequencies of fish consumption. Nevertheless, in all cases it would seem prudent to communicate to communities that smaller, younger or non-predatory fish species will typically have lower mercury concentrations so that persons can make informed decisions for themselves and their families.

Consequently, the following approach was used to derive overall consumption recommendations:

[1] Health Canada has not as of yet reviewed the site-specific information nor do they have an official policy that mercury concentrations less than 0.2 µg/g do not require further assessment or restrictions. Instead, Health Canada would address such issues on a case-by-case basis and in all cases would encourage dissemination of information that emphasize which fish have the lowest mercury concentrations (*i.e.*, smaller, younger or non-predatory fish species that typically have lower mercury concentrations).

- A Hazard Quotient value of 1 was assumed to be acceptable; however, all fish less than 0.2 µg/g were classified as acceptably low and no consumption restrictions were recommended.
- Serving sizes are 100 g for toddlers and 400 g for adults.
- The following consumption categories were used:
    - Unrestricted eating;
    - Eat up to 1 meal per week;
    - Avoid consumption.

Using the above, Table 5-4 provides the overall consumption recommendations based on present conditions. Regardless of any decisions of proceeding with impoundment (*i.e.*, these risks are independent of impoundment), fish consumption recommendations for fish should be communicated to local First Nations people through community health practitioners. In the case of lake sturgeon for which only data for 13 fish from Gull Lake were available and for which the length-mercury concentration relationship was not significant (*i.e.*, length standardization was not meaningful), it is recommended that sturgeon of less than 1,220 mm fork length can be consumed on an unrestricted basis. This length represents the mean fork length of the 13 sturgeon which had an arithmetic mean mercury concentration of 0.18 µg/g (North South Consultants *pers. comm.* 2010).

Table 5-4 Overall Recommendations for Consumption Based on Fish Size Class: Present Conditions (based on Mean Mercury Concentrations)

Receptor Group of Concern	Lake Whitefish			Northern Pike			Walleye		
	<300 mm	300-450 mm	>450 mm	<400 mm	400-800 mm	>800 mm	<400 mm	400-550 mm	>550 mm
Gull Lake									
Women of childbearing age and toddlers	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 meal per week	Avoid eating	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 meal per week	Avoid eating	Unrestricted eating	Eat up to 1 meal per week	Avoid eating
Stephens Lake									
Women of childbearing age and toddlers	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Avoid eating	Avoid eating	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Unrestricted eating	Unrestricted eating	Unrestricted eating	Eat up to 1 meal per week	Avoid eating	Unrestricted eating	Eat up to 1 meal per week	Avoid eating

Notes:
Based on serving sizes of 400 grams per serving for men and women and 100 grams per serving for toddlers.
A Hazard Quotient value of 1 was assumed to be acceptable; however, all fish less than 0.2 µg/g were classified as acceptable mercury concentrations and no consumption restrictions from current frequencies were recommended.

5.1.2 Post-Impoundment Scenario

Table 5-5 provides the risk estimates for consumption of fish that would occur under post-impoundment conditions. These risk estimates are based on the peak concentrations that would occur following impoundment and assuming consumption of fish of standard size (*i.e.*, lake whitefish = 350 mm; northern pike = 550 mm; walleye = 400 mm; and, lake sturgeon = 1,300 mm). Key results of the risk analysis include the following:

- The greatest risks were estimated from consumption of northern pike and walleye from Gull Lake due to tissue concentrations of mercury predicted to reach or slightly exceed 1.0 µg/g (Keeyask Hydropower Limited Partnership, 2012a). In order to maintain a desirable margin of safety, it is generally not advisable for young children and women of childbearing age to consume fish with such concentrations of mercury.

- In the case of northern pike and walleye from Stephens Lake and lake sturgeon from either Stephens Lake or Gull Lake, these fish are predicted to have mercury concentrations that are greater than 0.2 µg/g but less than or equal to 0.5 µg/g. Nevertheless, in order to maintain a desirable margin of safety, it is generally not advisable for young children and women of childbearing age to consume fish with such concentrations of mercury when mercury concentrations are in this range.

- Risks from lake whitefish from Gull Lake and Stephens Lake were the lowest of the fish evaluated; however, consumption of three large meals per week could still result in Hazard Quotient values that exceed the acceptable value. Nevertheless, it has been estimated that mercury concentrations of lake whitefish will remain less than 0.2 µg/g and, as noted earlier. Wilson Scientific is not aware of any health agency that has recommended that consumption of such fish should be restricted.

Based on the results, some fish from Gull and Stephens Lakes would still be acceptable to consume at current frequencies under the post-impoundment scenario while for other fish it would be advisable that consumption should be restricted and, in some cases, avoided. Although concentrations of lake whitefish are predicted to increase under post-impoundment conditions (particularly in Gull Lake), the concentrations of mercury should still permit unrestricted consumption of lake whitefish that are standard size or smaller (*i.e.*, 350 mm) from either lake (*i.e.*, concentrations of such fish would be less than 0.2 µg/g). On the other hand, standard-sized northern pike (550 mm), walleye (400 mm) and lake sturgeon (1,300 mm) from either lake would contain mercury concentrations that would not be advisable for young children and women of childbearing age to consume. Northern pike, walleye and lake sturgeon from Stephens Lake and lake sturgeon from Gull Lake would fall into the category that consumption should be restricted to a meal per week for adult men and women past childbearing age. Finally, it would be recommended that the standard-sized northern pike and walleye from Gull Lake should be avoided by all ages under post-impoundment conditions.

It is noted that the above recommendations are for standard-sized fish as estimated by NSC. If, as planned, monitoring of fish mercury levels will occur in key water bodies should the Project be implemented, it may be possible to develop size-specific recommendations for the different fish species in the future. Under such an approach, the consumption recommendations could be refined and it may be possible that certain fish consumption recommendations may be less strict for smaller sizes of fish.

Another alternative to reduce post-impoundment mercury exposures would be to encourage consumption of fish from lakes unaffected by the Project, which are part of programs to provide for replacement country foods included in Adverse Effects Agreements established between Manitoba Hydro and the KCNs. It is stressed that it would still be necessary to consider the size and the species of fish for persons desiring to reduce their mercury exposures even from lakes unaffected by the Project. More specifically, NSC have measured mercury concentrations in fish from so-called offset lakes (specifically identified by one of the KCNs) and have indicated that certain fish from the various background lakes in the study area may have mercury concentrations that warrant consumption recommendations (tissue concentrations of mercury above 0.2

μg/g [Keeyask Hydropower Limited Partnership, 2012a]). As is the case in Stephens and Gull lakes, the mercury concentrations in fish from the offset lakes are variable but are generally highest in northern pike and walleye. Nevertheless, there are numerous fish with concentrations that are less than 0.2 μg/g in these lakes and, thus, would offer lower exposures than those expected at post-impoundment conditions that would be expected at either Gull Lake or Stephens Lake.

Table 5-5 Risk Estimates from Consumption of Fish: Post-Impoundment Conditions

Fish Species	Assumed Concentration* (μg/g, wet weight)	Hazard Quotient from Consumption of Three Large Meals per Week (Acceptable Value = 1)***		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Lake Whitefish	0.19	2.4	2.7	1.0
Northern Pike	1.0	12.9	14.2	5.1
Walleye	1.0	12.9	14.2	5.1
Lake Sturgeon**	0.30	3.9	4.2	1.5
Stephens Lake				
Lake Whitefish	0.15	1.9	2.1	0.8
Northern Pike	0.50	6.4	7.1	2.5
Walleye	0.50	6.4	7.1	2.5
Lake Sturgeon	0.25	3.2	3.5	1.3

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm,
Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.
** Arithmetic mean concentration.
*** Based on information provided by local First Nation communities, all fish were assumed to be consumed at a frequency of three meals per week with a serving size of 100 g for toddlers and 400 g for adults.

Table 5-6 provides the post-impoundment RMWIs for the average-sized fish that would result in a Hazard Quotient value of 1. For some fish species, it should be clear that the RMWIs under post-impoundment are appreciably lower than under present day conditions. For example, the RMWI for northern pike and walleye are approximately four times lower under post-impoundment as compared to present conditions. For other fish species, such as lake whitefish from Stephens Lake, the RMWI is lowered only slightly. In addition, it should be noted that these RMWIs are specific to fish of standard length and it would be possible to consume smaller fish at a greater rate than specified in Table 5-4. Finally, it should be noted that these RMWIs are specific to maximum mercury concentrations that are expected to occur a few (3-7) years after reservoir creation (Keeyask Hydropower Limited Partnership, 2012a). After that time, fish concentrations are expected to decline and it may be possible to gradually increase the RMWIs.

Table 5-6 Recommend Maximum Weekly Intakes of Fish for a Hazard Quotient Value = 1: Post-Impoundment Conditions

Fish Species	**Assumed Concentration (µg/g, wet weight)***	**Recommended Maximum Weekly Intake (g/week) for a HQ =1 (All for Fish of Standard Length)**		
		Toddlers	**Women of Childbearing Age**	**Adult Males and All Seniors**
Gull Lake				
Lake Whitefish	0.19	120	440	1,200
Northern Pike	1.0	23	84	230
Walleye	1.0	23	84	230
Lake Sturgeon**	0.30	77	280	780
Stephens Lake				
Lake Whitefish	0.15	160	560	1,600
Northern Pike	0.50	46	170	470
Walleye	0.50	46	170	470
Lake Sturgeon**	0.25	93	340	940

* Standard lengths: lake whitefish 350 mm; northern pike 550 mm; walleye 400 mm,
Individual mercury concentrations would be dependent upon the size of the fish with the smaller fish having generally lower concentrations than bigger fish.
** Arithmetic mean concentration.

The important aspect of this RMWI information is that it provides consumption recommendations that are independent of serving size. For example, a RMWI of 440 g/week for women of childbearing age consuming lake whitefish from Gull Lake means that a woman could have about 1 meal per week if serving size is 400 g (14 ounces) or two meals per week if the serving size is 200 g (seven ounces) or three meals per week if the serving size in 150 g (5.3 ounces). All three scenarios would still result in a woman consuming about 400 to 450 g of lake whitefish which would equate to an exposure approximately equal to a Hazard Quotient value of 1 (assuming consumption of lake whitefish of standard length). Thus, if a person does not consume 400 g of fish in a single serving, they can use these RMWIs to estimate the amount of fish that can be consumed.

The concentration of mercury will be directly dependent upon the size of the fish. In all cases, smaller fish will have lower concentrations. Nevertheless, NSC (North South Consultants *pers. comm*. 2010) concluded that there was not sufficient information to do a length-class specific analysis of mercury concentrations for the post-impoundment scenario. Consequently, in contrast to the present-day scenario, specific fish size recommendations for consumption are not provided for the post-impoundment scenario.

Consequently, the following approach was used to derive overall consumption recommendations:

- A Hazard Quotient value of 1 was assumed to be acceptable; however, all fish less than 0.2 µg/g were classified as acceptably low and no consumption restrictions were recommended;
- Serving sizes are 100 g for toddlers and 400 g for adults;
- The following consumption categories were used:
    - Unrestricted eating;
    - Eat up to 1 meal per week;
    - Avoid consumption.

Using the above approach, Table 5-7 provides the overall consumption recommendations based on predicted post-impoundment conditions. If impoundment were to proceed in the future, it may be possible to develop size-specific recommendations for the various fish. Under such an approach, the consumption recommendations could be refined and it may be possible that certain fish consumption recommendations may be less strict for smaller sizes of fish.

Table 5-7 Overall Recommendations for Consumption Based on Fish Size Class: Post-Impoundment Conditions (based on Predicted Mean Mercury Concentrations and Standard Lengths)

Receptor Group of Concern	Lake Whitefish of Standard Length (i.e., 350 mm)	Northern Pike of Standard Length (i.e., 550 mm)	Walleye of Standard Length (i.e., 400 mm)
Gull Lake			
Women of childbearing age and toddlers	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Avoid eating	Avoid eating
Stephens Lake			
Women of childbearing age and toddlers	Unrestricted eating	Avoid eating	Avoid eating
Adult men and women past child-bearing age	Unrestricted eating	Eat up to 1 meal per week	Eat up to 1 meal per week

Notes:
Based on serving sizes of 400 grams per serving for men and women and 100 grams per serving for toddlers.
A Hazard Quotient value of 1 was assumed to be acceptable; however, all fish with mercury concentrations less than 0.2 µg/g were classified as acceptable mercury concentrations and no consumption restrictions from current frequencies were recommended.

If impoundment occurred, it would be important that fish consumption recommendations for fish be communicated to local First Nations people through community health practitioners.

5.1.3 Health Effects from Consuming Fish at Rates Greater than the RMWI

This section addresses the potential health effects that could be associated with persons who consume fish at rates greater than the RMWIs or have Hazard Quotient values greater than . Both the present and post-impoundment scenarios have estimated fish consumption rates (RMWIs) that may be exceeded.

5.1.3.1 Present Conditions

Under present conditions, it is apparent that persons should take and avoid excessive consumption of certain northern pike and walleye. The key concern is consumption of larger northern pike and walleye by women of childbearing age and young children. Nevertheless, potential unacceptable risks could affect persons of any age if unrestricted consumption of the larger fish occurred on a frequent basis.

Blood and hair measurements are a well known and accurate method for estimating of both exposure and risks from methylmercury in fish. To evaluate potential health risks, the Health Canada approach has been employed whereby mercury hair concentrations less than 5 ppm (or 20 µg/L in blood) are considered to be in the "normal range" while concentrations between 5 and 25 ppm (25 to 100 µg/L in blood) are in the "increasing risk" range and concentrations above 25 ppm (or 100 µg/L in blood) are considered to be "at risk" levels (INAC 2009). In addition, to these broad classifications, the following tissue concentrations would be close to known effects levels from the literature:

- Health Canada (1998) and US EPA (2011) have indicated that maternal mercury concentrations of 10 ppm in hair and/or 58 µg/L in blood are generally equal to the threshold for a 5% increased risk of developmentally delayed children. Although there have been no clearcut clinical abnormalities in children born to mothers with mercury concentrations above 10 ppm in hair or 58 µg/L, there have been effects on language, attention and memory that have been reported to be mercury-related.
- US EPA (2011) has developed a Benchmark Dose Level ($BMDL_{05}$) (the lower 95% confidence limit of the BMD_{05}) of 59 µg/L in maternal blood for neurological effects in children. This blood concentration would result in a doubling of the number of children with a neurological response at the fifth percentile of the population.
- Axelrad *et al.* (2007) has estimated that mercury concentrations of 1 ppm in maternal hair may be associated with a 0.18 IQ point decrement in children (*i.e.,* 10 ppm may be associated with a 1.8 IQ point decrement); however, it is unclear if Axelrad *et al.* (2007) appropriately controlled for other factors and this relationship has not yet been used by any major health agency. It is stressed there can be a great number of everyday factors that can affect IQ at rates much greater than 1.8 IQ (as summarized in Wilson *et al.* [2005][2] a person's

[2] As summarized in Wilson *et al.* (2005), example of factors that may each cause an IQ decrement of three points or more include: socio-economic status (SES); parent's education, family size and child's position in family; enriched pre-school and breast feeding. Furthermore, it is noted that the standard deviation on an IQ test is three points.

environment may affect their IQ by 20 to 25 points) and, thus, the proper context should be provided to a potential 1.8 IQ decrement at 10 ppm.

- In addition to the comparison of these literature-effect levels, it is possible that to compare the exposure to the Inuit in the Canadian Arctic. INAC (2009) data indicate that only 2% of Nunavut/Inuit women sampled between 2005 and 2007 had blood levels of mercury greater than 20 µg/L.

It is beyond the scope of this analysis to attempt to predict the blood and hair levels of mercury that may be currently be present in the communities due to fish consumption. We understand that local First Nation communities have a dialogue with health agency officials regarding such testing but this information is considered to be private medical information that is not to be used in this HHRA. With the above noted, the greatest Hazard Quotient under present conditions was estimated to be 4.7 under present conditions (as shown in Table 5-1). It is not clear that actual adverse health effects would occur at such exposures and, instead, it is only clear that a desired margin of safety would be intruded upon. Nevertheless, it is stressed that Hazard Quotient values of 4.7 are not desirable and would place women and their developing babies in the “increasing risk” that has been defined by Health Canada. Consequently, there is importance to making good decisions regarding fish consumption under the present scenario since there would be much lower risks for women consuming lake whitefish or smaller northern pike and walleye (*i.e.,* fish with mercury concentrations less than 0.2 µg/g).

In addition to the effects on development, there have been concerns regarding cardiovascular effects of mercury. Clinical effects in adults have included increased blood pressure. Roman *et al.* (2011) have indicated that a dose-response relationship could be developed for methylmercury exposure and acute myocardial infarction; however, at the current time, we are not aware of any recognized relationship that can be quantified and applied to the results of this risk assessment. Moreover, in two very large US cohorts, Mozaffarian *et al.* (2011) found no evidence of any clinically relevant adverse effects of mercury exposure on coronary heart disease, stroke, or total cardiovascular disease. Consequently, at the current time, the effect of mercury on cardiovascular risk remains unclear.

Overall, for persons with Hazard Quotient values up to 4.7, there is a recognized risk of children being born who later do not perform as well as in various mental tasks. In addition, there is the potential for other health effects that may include cardiovascular effects. Ideally, it would be prudent for persons to attempt to lower exposures through good choices of fish consumption (*i.e.*, people should try to consume fish with mercury concentrations less than 0.2 µg/g). On the other hand, there could also be risks from persons not consuming fish (since fish can be such an important source of nutrients and the health effects of not eating fish is not an issue that has been quantified in this report). As a result, it is stressed that this information should be used to make informed choices about fish consumption.

5.1.3.2 Post-Impoundment Conditions

There is potential for unacceptable health risks for persons who decide to frequently consume fish from Gull and Stephens lakes. There would be greater risks associated with the consumption of northern pike and walleye in Gull Lake but consumption recommendations are also recommended for such fish from Stephens Lake to a lesser extent and lake sturgeon from both lakes. On the other hand, there could also be health risks if persons choose to consume fish and instead substitute less healthy foods in their diet. Thus, it is important that persons should be encouraged to use, to the maximum extent possible, the programs that enable use of lakes unaffected by the Project.
Similar to that discussed for present-day conditions, it is beyond the scope of this analysis to attempt to predict the blood and hair levels of mercury that may be present in the communities following impoundment with maximum Hazard Quotient values of 14.2. Future hair and blood concentrations would be expected to follow fish mercury concentrations (for which we have estimated levels) but would also be dependent on how many and which people choose to use the lakes unaffected by the Project versus Gull Lake versus Stephens Lake (all unknown variables). Nevertheless, it should be apparent that for persons frequently consuming fish at mercury concentrations of 1 µg/g (*i.e.*,

Hazard Quotient values up to 14.2), exposures would be classified in the Health Canada "at risk" range. For women who continues to consume Gull Lake northern pike or walleye from Gull Lake at 1.2 kilograms of northern pike or walleye (1.0 ppm for standardized size) per week, it could be expected that hair and blood concentrations exceed the previously described known effects levels from the literature (main concerns would be development effects in children and potential cardiovascular effects in adults). Such populations would be considered to be in the Health Canada "at risk" range. In addition, such concentrations would be greater than the majority of Nunavut/Inuit women sampled between 2005 and 2007 by INAC (2009) (*i.e.,* only two percent had blood levels of mercury greater than 20 µg/L).

It is noted that this Hazard Quotient was estimated by assuming that a 60 kg women consumes 1.2 kg of northern pike or walleye per week on a consistent basis. If a woman consumed less fish, the exposure and risk values would accordingly decrease. For example, if a woman consumed serving sizes of seven ounces rather than 14 ounces (but still at a rate of three meals of northern pike or walleye per week), the Hazard Quotient values would be halved (*i.e.,* Hazard Quotient values of 7.1). Such halving would place women in the "increasing risk" range of exposure (rather than in the "at risk" range).

Although these levels of exposures are of concern, it is important to recognize that these are not estimates of blood and hair concentrations that will occur in the community as a whole. First of all, there are programs in the Adverse Effects Agreements to enable the KCNs to access lakes unaffected by the Project that will provide an alternate source of fish and, thus, if the people use these programs, it should not be a health concern. In addition, these estimates apply to consumption of a 1.2 kg of northern pike or walleye from Gull Lake per week on a consistent basis. Appreciably lower hair and blood levels would be associated with less frequent consumption of the same fish and it is also noted that accumulation of such levels takes several weeks of such consumption such that lower blood and hair concentrations would be associated with lower frequencies of consumption of fish from Gull Lake. As discussed earlier, the rate of compliance with following the fish consumption recommendations and the use of these programs will be key factors relating to future concentrations of mercury in hair and blood.

Overall, it is considered to be important that persons follow the fish consumption recommendations and utilize the programs to access areas unaffected by the Project under post-impoundment conditions. As is also currently the case under present-day conditions, it will be important that persons do no frequently consume the fish that will have concentrations above 0.2 µg/g under post-impoundment conditions. If persons frequently consume northern pike and walleye from Gull and Stephens lakes following impoundment, individuals could be in the “at risk” range of tissue concentrations. On the other hand, under the programs in the Adverse Effects Agreements to enable the KCNs to access lakes unaffected by the Project, there would be no adverse effects or unacceptable risks if persons follow recommendations. This information should be used to make informed choices about fish consumption with special emphasis on the consumption of fish from unaffected lakes during the post-impoundment elevation in fish concentrations.

5.2 RISKS FROM CONSUMPTION OF WILD GAME

Risks from consumption of wild game (beaver, muskrat, moose and snowshoe hare) were estimated for the present conditions and for the post-impoundment scenario. Based on information provided by local First Nation communities, the following consumption rates of wild game were assumed:

- Moose was assumed to be consumed at a frequency of five meals per week with a serving size of 100 g (3.5 ounces) per meal for toddlers and 400 g (14 ounces) per meal for adults.

- Beaver was assumed to be consumed at a frequency of three meals per week with a serving size of 57 g (two ounces) per meal for toddlers and 200 g (seven ounces) per meal for adults.

- Muskrat and snowshoe hare were assumed to be consumed at a frequency of 1 meal per week with a serving size of 57 g (two ounces) per meal for toddlers and 200 g (seven ounces) per meal for adults.

These rates of consumption were used at the request of local First Nations and are considered to represent upper bound exposures. It is recognized that some wild game are only consumed at certain times of the year (*e.g.*, muskrat and beaver are mostly consumed in the colder months). Similar to that discussed for fish consumption, less than continuous exposure was not quantitatively considered in the HHRA because the key concern regarding mercury is developmental toxicity. In addition, although moose are mainly harvested in the fall, the meat is stored in a freezer and can be consumed all year. As a result, the risks from consumption of the various forms of wild game were not adjusted for less than all year round consumption patterns.

5.2.1 Present Conditions

Table 5-8 provides the risk estimates for consumption of wild game under present conditions. Key results of the risk analysis include the following:

- Consumption of wild game at present concentrations of total mercury is not associated with unacceptable risks. The greatest risks were estimated from consumption of moose; however, five times per week consumption of large serving sizes resulted in Hazard Quotient values approximately equal to 0.5.

- Even lower Hazard Quotient values were estimated from consumption of muskrat, beaver and snowshoe hare (due to a combination of lower total mercury concentrations, less consumption frequency and smaller serving sizes).

Based on the results, consumption of large meals of any wild game does not pose unacceptable health risks under present conditions. As noted in Section 3, there is some uncertainty in regard to the moose and snowshoe hare concentrations of mercury and it is recommended that monitoring of these species be completed to ascertain that the assumed mercury concentrations were reasonable.

Table 5-8 Risk Estimates from Consumption of Wild Game: Present Conditions

Wild Game Species	Assumed Concentration* (µg/g, wet weight)	Hazard Quotient (Acceptable Value = 1)**		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Beaver	0.01	0.03	0.02	0.02
Muskrat	0.02	0.02	0.02	0.01
Moose*	0.07	0.5	0.29	0.24
Snowshoe hare*	0.05	0.04	0.04	0.03

* Mercury concentration in moose and snowshoe hare was only a literature estimate and may have greater uncertainty than other species for which measured values were obtained from the study area
** Hazard Quotient estimated assuming either five meals per week for moose, three meals per week for beaver or 1 meal per week for snowshoe hare/muskrat

Table 5-9 provides the RMWIs that would result in a Hazard Quotient value of 1 for the various wild game species considered in the HHRA. Once again, this RMWI information provides consumption recommendations that are independent of serving size.

Table 5-9 Recommended Maximum Weekly Intakes of Wild Game: Present Conditions

Wild Game Species	Assumed Concentration (µg/g, wet weight)*	Recommended Maximum Weekly Intake (g/week)		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Beaver	0.01	6,600	24,000	28,000
Muskrat	0.02	3,300	12,000	14,000
Moose*	0.07	940	3,400	4,100
Snowshoe hare*	0.05	1,300	4,800	5,700

* Mercury concentration in moose and snowshoe hare were literature estimates and may have greater uncertainty than other species for which measured values were obtained from the study area

Using terminology where frequent consumption refers to three to five meals per week with serving sizes of 100 g for toddlers and 200 g for adults, the following recommendation can be made under the present conditions:

- Beaver, muskrat, moose and snowshoe hare can be frequently consumed by all members of the communities.

5.2.2 Post-Impoundment Scenario

Table 5-10 provides the risk estimates for consumption of wild game that would occur under post-impoundment conditions. In some cases, it is important to realize that these risk estimates are based on very high rates of wild game consumption (*i.e.*, moose was assumed to be consumed at a frequency of five meals per week with a serving size of 100 g per meal for toddlers and 400 g per meal for adults).

Key results of the risk analysis include the following:

- In the case of moose, beaver and snowshoe hare, the concentrations of total mercury in the tissue of these animals would not be expected to change post-impoundment. As a result, there is no change in risk from consumption of these animals and risks are estimated to remain acceptable.

- In the case of muskrat, the risks from consumption were estimated to be acceptable for the post-impoundment scenario (*i.e.*, Hazard Quotient less than 1) even though total mercury concentrations may increase from 0.02 µg/g to 0.04 µg/g.

It is noted that some aquatic mammals such as otter and mink may experience appreciably higher increases in total mercury concentrations than the mammals considered in the HHRA. However, consultation has indicated that these mammals are not consumed by the local First Nation communities. Nevertheless, it should be clear that risks from consumption of such aquatic mammals were not considered in the HHRA.

It is also noted that certain other wild game has not been considered in the HHRA. For example, the HHRA has not evaluated consumption of lynx, bear or caribou. These animals are not expected to have higher concentrations of mercury than the wild game considered in the HHRA (*i.e.*, the animals considered in the HHRA will have more direct contact with the aquatic ecosystem and/or more potential to accumulate mercury). In addition, these animals are not consumed as frequently as the animals considered in the HHRA. Since risks were acceptable from consumption of the wild game that was more likely to contribute risks from mercury, it can be conservatively concluded that risks would be even lower and, therefore, acceptable for these other animals not formally considered in the HHRA.

Overall, based on the results (see Table 5-10), consumption of large meals of any wild game does not pose unacceptable health risks under post-impoundment conditions. As noted in Section 3, there is some uncertainty in regard to the moose and snowshoe hare concentrations of mercury and it is recommended that monitoring of these species be completed to ascertain that the assumed mercury concentrations were reasonable.

Table 5-10 Risk Estimates from Consumption of Wild Game: Post-Impoundment Conditions

Wild Game Species	Assumed Concentration* (µg/g, wet weight)	Hazard Quotient (Acceptable Value = 1)**		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Beaver	0.01	0.03	0.02	0.02
Muskrat	0.04	0.03	0.03	0.03
Moose*	0.07	0.5	0.29	0.24
Snowshoe hare*	0.05	0.04	0.04	0.03

* Mercury concentration in moose and snowshoe hare were based on a literature estimate and may have greater uncertainty than other species for which measured values were obtained from the study area
** Hazard Quotient estimated assuming either five meals per week for moose, three meals per week for beaver or 1 meal per week for snowshoe hare/muskrat

Table 5-11 provides the post-impoundment RMWIs that would result in a Hazard Quotient value of 1. The RMWIs provided in Table 5-9 all appear to be greater than the typical amounts of country foods that the local First Nation communities have reported to consume. Consequently, it is unlikely that unacceptable risks from consumption of wild game would exist under post-impoundment conditions due to mercury.

Table 5-11 Recommend Maximum Weekly Intakes of Wild Game: Present Conditions

Wild Game Species	Assumed Concentration (µg/g, wet weight)*	Recommended Maximum Weekly Intake (g/week)		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Beaver	0.01	6,600	24,000	28,000
Muskrat	0.04	1,600	6,000	7,100
Moose*	0.07	940	3,400	4,100
Snowshoe hare*	0.05	1,300	4,800	5,700

* Mercury concentration in moose and snowshoe hare were a literature estimate and may have greater uncertainty than other species for which measured values were obtained from the study area

Using terminology where frequent consumption refers to three to five meals per week with serving sizes of 100 g for toddlers and 200 g for adults, the following recommendation can be made under post-impoundment conditions:

- Beaver, muskrat, moose and snowshoe hare can be frequently consumed by all members of the communities.

5.3 RISKS FROM CONSUMPTION OF WATERFOWL

Risks from consumption of waterfowl (*i.e.*, ducks) were estimated for the present conditions and for the post-impoundment scenario. Based on information provided by local First Nation communities, ducks were assumed to be consumed at a frequency of 1 meal per week with a serving size of 57 g (two ounces) per meal for toddlers and 200 g (seven ounces) per meal for adults. These rates of consumption were used at the request of local First Nation communities.

It is recognized that ducks are only consumed at certain times of the year (*i.e.*, mostly in the spring and fall). Similar to that discussed for fish consumption, less than continuous exposure was not quantitatively considered in the HHRA because the key concern regarding mercury is developmental toxicity. In addition, duck meat could be placed in a freezer and can be consumed all year. As a result, the risks from consumption of waterfowl were not adjusted for less than all year round consumption patterns.

Finally, it is noted that the mercury present in duck tissue was assumed to be methylmercury rather than total mercury. Consequently, the more conservative methylmercury TRV (i.e., 0.2 µg/kg bw/day for sensitive populations) was used rather than the 0.57 µg/kg bw/day that the WHO has recommended for use when mercury is not present in fish and shellfish. Although this is considered to be conservative, the avian experts have indicated that the mercury concentrations in waterfowl are expected to mirror the whitefish concentrations and that no further information on mercury speciation was available. If monitoring of waterfowl indicates that the mercury is not present as methylmercury, it would be possible to adjust these risk estimates (*i.e.*, even lower risks would be predicted).

5.3.1 Present Conditions

Table 5-12 provides the risk estimates for consumption of waterfowl under present conditions. Key results of the risk analysis include the following:

- Consumption of waterfowl at present concentrations of total mercury is not associated with unacceptable risks.

- Even lower Hazard Quotient values would be estimated from consumption of other waterfowl (such as geese) (due to a combination of lower total mercury concentrations and possibly less consumption frequency).

- No risk estimate was available for gull eggs since no estimate of the mercury concentration of these eggs was available. To provide an estimate of risks from eggs, monitoring of gull eggs would likely be required.

Based on the results, consumption of duck and other waterfowl does not pose unacceptable health risks under present conditions. No estimate can be provided on the risks from consumption of gull eggs. As noted in Section 3, there is some uncertainty in regard to the duck concentrations of mercury and it is recommended that monitoring of these species be completed to ascertain that the assumed mercury concentrations were reasonable.

Table 5-12 Risk Estimates from Consumption of Waterfowl: Present Conditions

Fish Species	Assumed Concentration* (µg/g, wet weight)	Hazard Quotient (Acceptable Value = 1)**		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Duck	0.07	0.17	0.17	0.06
Stephens Lake				
Duck	0.09	0.22	0.21	0.08

* Mercury concentration in duck was assumed to be similar to that estimated for lake whitefish
** Hazard Quotient estimated assuming 1 meal per week

Table 5-13 provides the RMWIs that would result in a Hazard Quotient value of 1. Once again, this RMWI information provides consumption recommendations that are independent of serving size. Since geese are expected to have even lower concentrations than ducks, no unacceptable risks would be predicted from goose consumption at these RMWIs for ducks.

Table 5-13 Recommend Maximum Weekly Intakes of Waterfowl: Present Conditions

Fish Species	Assumed Concentration (µg/g, wet weight)*	Recommended Maximum Weekly Intake (g/week)		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Duck	0.07	330	1,200	3,400
Stephens Lake				
Duck	0.09	260	940	2,600

* Mercury concentration in duck was assumed to be similar to that estimated for lake whitefish

Consumption recommendations for waterfowl should be communicated to local First Nations people through community health practitioners. Using terminology where frequent consumption refers to two to three meals per week with serving sizes of 100 g for toddlers and 200 g for adults, the following recommendation can be made under present conditions:

- Ducks can be consumed frequently by all members of the communities.

5.3.2 Post-Impoundment Scenario

Table 5-14 provides the risk estimates for consumption of waterfowl that would occur under post-impoundment conditions. Key results of the risk analysis include the following:

- In the case of ducks from Stephens Lake, a small increase in methylmercury concentration predicted. As a result, there is no or little change in risk from consumption of these animals and risks are estimated to remain acceptable.

- In the case of ducks from Gull Lake, the risks from consumption were estimated to be acceptable for the post-impoundment scenario (*i.e.*, Hazard Quotient less than 1) even though total mercury concentrations may increase from 0.07 µg/g to 0.19 µg/g.

It is also noted that certain other waterfowl has not been considered in the HHRA. For example, the HHRA has not evaluated consumption of geese. Geese are not expected to have higher concentrations of mercury than the ducks considered in the HHRA. Since risks were acceptable from consumption of ducks, it can be safely concluded that risks would be even lower and, therefore, acceptable for geese even though it was not formally considered in the HHRA.

Overall, based on the results, consumption of waterfowl would not pose unacceptable health risks under post-impoundment conditions. As noted in Section 3, there is some uncertainty in regard to duck concentrations of mercury and it is recommended that monitoring of these species should be completed to ascertain that the assumed mercury concentrations were reasonable.

Table 5-14 Risk Estimates from Consumption of Waterfowl: Post-Impoundment Conditions

Fish Species	Assumed Concentration* (µg/g, wet weight)	Hazard Quotient (Acceptable Value = 1)**		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Duck	0.19	0.47	0.45	0.16
Stephens Lake				
Duck	0.15	0.37	0.35	0.13

* Mercury concentration in duck was assumed to be similar to that predicted for lake whitefish
** Hazard Quotient estimated assuming 1 meal per week

Table 5-15 provides the post-impoundment RMWI that would result in a Hazard Quotient value of 1. The RMWIs provided in Table 5-13 all appear to be greater than the typical amounts of duck that the local First Nation communities have reported to consume. Consequently, it is unlikely that unacceptable risks from consumption of waterfowl would exist under post-impoundment conditions due to mercury.

Table 5-15 Recommend Maximum Weekly Intakes of Waterfowl: Post-Impoundment Conditions

Bird Species	Assumed Concentration (µg/g, wet weight)*	Recommended Maximum Weekly Intake (g/week) for Fish of Standard Length		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Gull Lake				
Duck	0.19	120	440	1,200
Stephens Lake				
Duck	0.15	160	560	1,600

* Mercury concentration in duck was assumed to be similar to that estimated for lake whitefish

Using terminology where frequent consumption refers to three to five meals per week with serving sizes of 100 g for toddlers and 200 g for adults, the following recommendation can be made under post-impoundment conditions:

- Ducks can be consumed frequently by all members of the communities.

Consumption recommendations for waterfowl should be communicated to local First Nations people through community health practitioners.

5.4 RISKS FROM CONSUMPTION OF WILD PLANTS

The local First Nation communities identified the following plants as primary concern:

- Northern tea;
- Blueberries; and
- Seneca root.

As discussed earlier in Section 3.4, no estimates of mercury concentrations in wild plants are available under either present or post-impoundment conditions. Consequently, no risk estimates are available from consumption of wild plants. If risk estimates are required, it will likely be necessary to collect samples from the study area.

5.5 RISK FROM CONTACT WITH SURFACE WATER

The final media of concern that was evaluated in the HHRA was surface water. For the purposes of the HHRA, it was assumed that local First Nation communities would consume surface water as their drinking water source. In addition, it was assumed that the communities would use the water for bathing/swimming. For both the present and post-impoundment scenarios, mercury was assumed to be present in surface water at a concentration equal to the method detection limit of 0.05 µg/L

5.5.1 Present Conditions

Table 5-16 provides the risk estimates from contact with surface water under present conditions. Key results of the risk analysis include the following:

- Present surface water concentrations (less than method detection limit of 0.05 µg/L) are appreciably lower than the Canadian Drinking Water Guideline of 1 µg/L for total mercury.
- Hazard Quotient from ingestion and dermal contact with surface water is not associated with unacceptable risks.

Based on the results, contact with surface water does not pose unacceptable health risks under present conditions.

Table 5-16 Risk Estimates from Contact with Surface Water: Present Conditions

Route of Concern	Assumed Concentration* (µg/L)	Hazard Quotient (Acceptable Value = 1)		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Drinking (direct ingestion)	0.05	0.0032	0.0022	0.0019
Bathing/swimming (dermal)	0.05	0.000032	0.000026	0.000022
Total		0.0032	0.0022	0.0019

* Mercury concentration in surface water was assumed to equal the method detection limit

5.5.2 Post-Impoundment Scenario

Table 5-17 provides the risk estimates from contact with surface water under post-impoundment conditions. Key results of the risk analysis include the following:

- No changes in surface water concentrations of mercury are expected under post-impoundment conditions (*i.e.*, surface water concentrations would be expected to remain less than method detection limit of 0.05 µg/L).
- Hazard Quotient from ingestion and dermal contact with surface water is not associated with unacceptable risks.

Based on the results, contact with surface water would not pose unacceptable health risks under post-impoundment conditions.

Table 5-17 Risk Estimates from Contact with Surface Water: Post-Impoundment Conditions

Route of Concern	Assumed Concentration* (µg/L)	Hazard Quotient (Acceptable Value = 1)		
		Toddlers	Women of Childbearing Age	Adult Males and All Seniors
Drinking (direct ingestion)	0.05	0.0032	0.0022	0.0019
Bathing/swimming (dermal)	0.05	0.000032	0.000026	0.000022
Total		0.0032	0.0022	0.0019

* Mercury concentration in surface water was assumed to equal the method detection limit

5.6 CHEMICAL INTERACTION ASSESSMENT OF VARIOUS FORMS OF MERCURY

A final consideration in the HHRA involves estimation of risks for persons who may be involved in multiple activities. For example, what are the health risks for a person who is exposed to surface water (mercury primarily as inorganic) and also consumes country foods? Or, what are the health risks for a person who consumes multiple types of country foods?

In the case of adding mercury-related risks from surface water exposures to consumption of country foods, the combination of these activities will not change the conclusions or recommendations. As illustrated previously in Tables 5-16 and 5-17, it is expected that risks from mercury due to contact with surface water would be associated with a Hazard Quotient value of 0.0032 for toddlers (and even less for other age groups). When this Hazard Quotient is added to the values associated with consumption of fish, wild game or waterfowl, the sum of the Hazard Quotient values remains essentially unchanged in all cases.

When the Hazard Quotient of 0.0032 from surface water is added to the values associated with consumption of certain fish, the sum of the Hazard Quotient values will remain above 1 for various consumption scenarios; however, there is no reason to recommend that persons consuming fish should avoid using the surface water (and vice versa). In past guidance from international health agencies (such as Health Canada and the World Health Organization), consumption advice to the general public has typically allowed for exposures from fish to contribute a Hazard Quotient value of 1 from methyl mercury, irrespective of other forms of mercury exposures.

In the case of interactive effects from consumption of multiple country foods, it is clear that fish consumption is the dominant contributor in terms of risks. Although moose consumption also theoretically contributes a Hazard Quotient of 0.5, this is based on a person consuming large amounts of moose on a daily basis and, thus, it is likely that their fish consumption would drop under such circumstances. In addition, it has not been confirmed that the mercury concentrations of 0.07 µg/g for moose muscle tissue would actually occur at the study area. Finally, mercury concentrations in moose tissues was predicted to be essentially unaffected by impoundment. Nevertheless, the possible implications of cumulative exposure is discussed in greater detail below.

There are too many possible combinations to fully evaluate all possible interactions that may occur. As an alternative, the percentage of the TDI that 1 meal per week of each food group would represent was estimated as shown below. In completing these calculations, the meal sizes provided earlier were used:

- Toddler fish and moose meal = 100 g;
- Toddler beaver/muskrat/snowshoe hare/duck meal = 57 g;
- Adult fish and moose meal = 400 g; and
- Adult beaver/muskrat/snowshoe hare/duck meal = 200 g.

Once again, it should be noted that these represent rather large portion sizes for adults and Health Canada often uses a fish serving size of 200 g in most of their evaluation of adults (while in the case of the toddler, the 100 g is similar to Health Canada policy).

5.6.1 Present Conditions

As discussed above, the percentage of the TDI that 1 meal per week of each food would represent was estimated for present conditions and is provided in Table 5-18. As shown in this table, some food combinations would likely result in exposures exceeding the TDI under present conditions and, indeed, some foods by themselves (*i.e.*, northern pike and walleye) could result in exposures exceeding the TDI if consumed on a once per week basis under present conditions. In other words, the recommended fish consumption for certain fish under present conditions is less than a meal per week if people or agencies want exposures less than the TDI for methyl mercury. Nevertheless, it is stressed that people should not be discouraged from consuming such a diet that is based on country foods under present conditions provided in the previous fish consumption recommendations. Rationale that supports the current country foods diet as not requiring further restrictions includes:

- Under present conditions, fish recommended for frequent consumption (*i.e.*, lake whitefish) typically have mercury tissue concentrations less than 0.1 µg/g. Wilson Scientific is not aware of any major health agency that advises against frequent consumption for fish with less than 0.2 µg/g of mercury (especially given the nutritional benefits that such fish also offer). With the above in mind, selecting lake whitefish less than 450 mm in length will ensure the lowest exposures.

- Under present conditions, fish recommended for occasional consumption (*i.e.*, northern pike, walleye and lake sturgeon) typically have mercury tissue concentrations less than 0.3 µg/g. Wilson Scientific is not aware of any major health agency that advises against occasional consumption for fish with less than or equal to 0.5 µg/g of mercury (especially given the nutritional benefits that such fish also offer). With the above in mind, selecting northern pike and walleye less than 400 mm in length will ensure the lowest exposures.

- Under present conditions, all wild game and waterfowl are expected to typically have mercury tissue concentrations less than 0.1 µg/g. We are aware of no major health agency that provides consumption advice for acceptable mercury concentrations in muscle tissue of meat but, nevertheless, wild game with concentrations less than 0.1 µg/g results in quite low exposures and consumption of these foods offers substantial nutritional benefits (especially when compared to many store bought conventional foods).

Consequently, despite numerous combinations where the exposure may exceed the TDI (*i.e.,* Hazard Quotient values greater than 1), the consumption recommendations for present conditions are considered to be appropriate for the study area. Notwithstanding the above, the communities should be aware that excessive consumption of certain fish under present conditions may be a concern and, where possible, steps should be taken to select foods lowest in mercury. In particular, toddlers and women of child-bearing age should not consume the larger predatory fish (northern pike, walleye) or long-lived fish (lake sturgeon) more than once per week due to the higher mercury concentrations. During the week that they consume the fish with higher mercury concentrations, it would be advisable to reduce exposure to other fish. In addition, it should also be clear for everyone that lower mercury exposure are associated with consumption of smaller sizes of any fish species (*e.g.,* northern pike less than 400 mm may have lower concentrations than lake whitefish longer than 450 mm – see Table 5-3).

Table 5-18 Risk Estimates from Mercury for Combined Sources: Present Conditions

Food	% of TDI Used Based on 1 Meal per Week		
	Toddlers	Women of Childbearing Age	Other Members of the General Population
Gull Lake			
Lake whitefish	30	33	12
Northern Pike	94	104	37
Walleye	99	108	39
Lake sturgeon	86	94	34
Duck	17	17	6
Beaver	3	<1	<1
Muskrat	<1	<1	<1
Moose	10	12	10
Snowshoe hare	4	4	3
Stephens Lake			
Lake whitefish	40	42	15
Northern Pike	110	123	44
Walleye	120	137	49
Lake sturgeon	No estimate available	No estimate available	No estimate available
Duck	17	17	6
Beaver	<1	<1	<1
Muskrat	2	2	1
Moose	10	12	10
Snowshoe hare	4	4	3

5.6.2 Post-Impoundment Conditions

Under post-impoundment conditions, the percentage of the TDI that 1 meal per week of each food would represent is provided in Table 5-19. As shown in this table, some food combinations will likely result in exposures exceeding the TDI under present conditions and, indeed, some foods by themselves (*i.e.*, northern pike and walleye) could result in exposures exceeding the TDI if consumed on a once per week basis from either Gull Lake or Stephens Lake under post-impoundment conditions. Nevertheless, it is stressed that people should not be discouraged from consuming such a diet that is based on certain country foods and follows the previously provided fish consumption recommendations. Rationale that supports the country foods diet as not requiring further restrictions includes:

- Under post-impoundment conditions, fish recommended for frequent consumption (*i.e.*, lake whitefish from either Gull Lake or Stephens Lake) would typically have mercury tissue concentrations less than 0.2 µg/g. Wilson Scientific is not aware of any major health agency that advises against frequent consumption for fish with less than 0.2 µg/g of mercury (especially given the nutritional benefits that such fish also offer). With the above in mind, selecting lake whitefish less than 450 mm in length would ensure the lowest exposures.

- Under post-impoundment conditions, fish recommended for occasional consumption (*i.e.*, northern pike and walleye from Stephens Lake and lake sturgeon from Stephens and Gull lakes) typically have mercury tissue concentrations less than or equal to 0.5 µg/g. Wilson Scientific is not aware of any major health agency that advises against occasional consumption for fish with less than 0.5 µg/g of mercury (especially given the nutritional benefits that such fish also offer). With the above in mind, selecting northern pike and walleye less than 400 mm in length will ensure the lowest exposures.

- Under post-impoundment conditions, ducks from either Gull Lake or Stephens Lake would typically have mercury tissue concentrations less than 0.2 µg/g. Wilson Scientific is not aware of any major health agency that advises against frequent consumption for duck with less than 0.2 µg/g of mercury.

- Under post-impound conditions, wild game would not be expected to be appreciably impacted. Aside from muskrat, no wild game consumed by people (*i.e.*, beaver, moose or snowshoe hare) would have increased concentrations of mercury. In the case of muskrat, the estimated increase would be very minor and still result in final typical concentrations of only 0.04 µg/g. Once again, no major health agency provides consumption advice for acceptable mercury concentrations in muscle tissue of meat but, nevertheless, wild game with concentrations less than 0.1 µg/g results in quite low exposures and consumption of these foods offers substantial nutritional benefits.

Consequently, despite numerous combinations where the exposure may exceed the TDI (*i.e.,* Hazard Quotient values greater than 1), the consumption recommendations for post-impoundment conditions would be considered to be appropriate for the study area. Notwithstanding the above, the communities should be aware that excessive consumption of certain fish under present conditions may be a concern and, where possible, steps should be taken to select foods lowest in mercury. In particular, toddlers and women of child-bearing age should not consume the larger predatory fish (northern pike, walleye) and longer-lived fish (lake sturgeon) from Stephens Lake more than once per week due to the higher mercury concentrations. In addition, consumption of northern pike and walleye from Gull Lake should be avoided by these receptors. During the week that a person consumes fish with higher mercury concentration, it would be advisable to reduce exposure to other fish. In addition, it should also be clear for everyone that lower mercury exposure will be associated with consumption of smaller sizes of any fish species (*e.g.,* northern pike less than 400 mm may have lower concentrations than lake whitefish longer than 450 mm – see Table 5-3).

Another alternative to reduce mercury exposures would be consumption of fish from appropriate lakes unaffected by the Project. However, even from pristine lakes unaffected by the Project, it will be necessary to consider size and species of fish for persons desiring to reduce their mercury exposures (*i.e.,* certain fish from these offset lakes may have mercury concentrations that warrant consumption recommendations).

Table 5-19 Risk Estimates from Mercury for Combined Sources: Post-Impoundment Conditions

Food	% of TDI Used Based on 1 Meal per Week		
	Toddlers	Women of Childbearing Age	Other Members of the General Population
Gull Lake			
Lake whitefish	80	90	32
Northern Pike	430	470	170
Walleye	430	470	170
Lake sturgeon	130	140	50
Duck	47	45	16
Beaver	<1	<1	<1
Muskrat	3	3	3
Moose	10	12	10
Snowshoe hare	4	4	3
Stephens Lake			
Lake whitefish	60	71	25
Northern Pike	210	240	85
Walleye	210	240	85
Lake sturgeon	110	118	42
Duck	37	35	13
Beaver	<1	<1	<1
Muskrat	3	3	3
Moose	10	12	10
Snowshoe hare	4	4	3

6.0 DISCUSSION AND UNCERTAINTY ANALYSIS

The HHRA was completed using a series of upper-bound assumptions that are intended to over-estimate actual health risks and thereby ensure a conservative assessment. Given the conservative assumptions used in this assessment, it is quite possible that actual risks may be substantially lower than estimated here. Nevertheless, certain assumptions were key determinants in the acceptability of risks. The following sensitivity analysis discusses some of the most important assumptions that had key influences on the risk assessment.

Mercury Concentrations in the Environment

One source of uncertainty is the concentrations of mercury in surface water and country foods that persons may be exposed to through their typical daily activities. The HHRA relied heavily on present and post-impoundment concentrations that have been measured or predicted by other disciplines. The prediction of the magnitude and extent of the changes in environmental concentrations was considered to be beyond the scope of the HHRA.

In the case of fish concentrations, the largest uncertainty with the most substantial impact on consumption recommendations is for mercury concentrations in pike and walleye (*i.e.*, the NSC modeled post-impoundment estimates range from 0.81-1.33 μg/g and 0.83-1.46 μg/g). In addition, it is noted that there was particular uncertainty reported by the other disciplines in the mercury concentrations in the tissues of the following animals:

- Moose;
- Lake sturgeon;
- Snowshoe hare; and
- Ducks and geese.

It is anticipated that continued monitoring of concentrations can be used as a direct measure of the impact that present conditions and impoundment would have on mercury concentrations. Nevertheless, there remain uncertainties and, in all cases, future environmental monitoring and risk management should be used to determine if environmental concentrations increase beyond those assumed in the HHRA.

Toxicity Reference Values

The approach that health agencies use to estimate acceptable or "safe" levels of exposure are typically very conservative and employ considerable safety factors to ensure protection of the general population. It is unlikely that such regulatory agency-derived exposure limits would underestimate health risks. Overall, the TRVs for the metals used in this assessment represent dose rates that are unlikely to present unacceptable health risks and may actually overestimate health risks.

Country Foods Consumption Rates

Highly conservative estimates of country foods consumption were assumed for the HHRA. The rate of country foods consumption was provided directly by members of First Nation communities as high-end estimates of food consumption. As a result, it is considered unlikely that these consumption rates underestimate exposures.

Overall Uncertainty in the Risk Assessment

Overall, it is unlikely that human health risks have been underestimated in the risk assessment and it is quite possible that already low risks have been overestimated. The potential combination of upper bound estimates of consumption patterns and conservative TRVs likely resulted in an overestimate of actual risks. Nevertheless, it is still possible (but not likely) that risks may have been underestimated for certain receptors in some cases. The two main conditions where risks may have been underestimated would include:

- Any situations where environmental sampling or modeling has underestimated mercury concentrations either currently or that would occur following impoundment; and

- Any situations where people are not accurately represented by the assumed receptor assumptions.

Risk management measures should be undertaken to ensure that neither of the conditions described above occur. If such conditions do occur, additional risk analysis would be recommended to address potential increases in human health risks.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The HHRA has indicated that under present conditions that most country foods can be consumed frequently (wild game, waterfowl and lake whitefish) except for northern pike, walleye and lake sturgeon which should only be occasionally consumed by young children and women of childbearing age. For fish from Gull and Stephens lakes, the present arithmetic mean mercury concentrations of lake whitefish are less than 0.1 µg/g while northern pike and walleye have an arithmetic mean concentration of approximately 0.3 µg/g. In the case of wild game, moose meat concentrations of mercury are largely unknown for the study area but have been estimated to perhaps be in the range of 0.07 µg/g while muskrat, beaver and snowshoe hare would have concentrations of mercury in muscle tissue in the range of 0.01 to 0.05 µg/g, depending on the species. The present concentrations suggest that lake whitefish and wild game can be frequently consumed. In the case of northern pike, walleye and lake sturgeon, it is considered to be acceptable that these fish can currently be consumed on an occasional basis by young children and women of childbearing age. In all cases, smaller-sized fish will have lower tissue concentrations of mercury.

Under the post-impoundment scenario, the mercury concentrations of fish in Gull Lake and Stephens Lake would increase such that it would be recommended that young children and women of childbearing age should only consume certain fish while avoiding other fish. Specifically, during years of maximum mercury concentrations in fish (perhaps 3 to 7 years post-impoundment; refer to Keeyask Hydropower Limited Partnership [2012a,b] for specific discussion on patterns of variation), the concentrations of mercury in fish and ducks from Gull Lake may increase by 0.5 to five times (smallest increase was in lake sturgeon and lake whitefish while greatest increase was in northern pike and walleye) while the concentrations of mercury from Stephens Lake would be more modest (perhaps 0.3 to 0.7 times increase). In the case of waterfowl, it is possible that fish eating ducks could experience an increase in mercury concentrations; however, the increase is not expected to result in the recommendation of consumption restrictions. The mercury concentrations of wild game tissues consumed by local First Nations (*i.e.*, beaver, muskrat, moose or snowshoe hare) would be expected to be essentially unaffected by the impoundment.

It is considered to be extremely important that persons follow the fish consumption recommendations provided in this HHRA (especially under the post-impoundment scenario). Individuals could be in the “at risk” range of exposures if consumption recommendations are not followed. The information provided in this evaluation should be used to make informed choices about fish consumption with special emphasis on the consumption of fish from off-set lakes during the post-impoundment elevation in fish concentrations. There could also be very real health risks if persons choose to reduce overall fish consumption (rather than supplementing their fish intake from lakes unaffected by the Project). Thus, every reasonable effort should be made to encourage people to continue eating fish that are low in mercury concentrations under both present and post-impoundment conditions. Table 7-1 provides a summary of the findings while the key conclusions of the HHRA are as follows:

1. Consumption recommendations (*i.e.*, recommendations for consumption restriction) may be required for certain fish under both the present conditions and the proposed post-impoundment conditions. Under post-impoundment conditions, it would still be possible to consume fish (just not as much as before). The fish with greatest predicted increase in mercury concentrations are from Gull Lake and include northern pike (0.22 µg/g to just over 1 µg/g) and walleye (0.23 µg/g to just over 1 µg/g) while the increase in lake whitefish would be less (0.07 µg/g to just below 0.2 µg/g). The same species from Stephens Lake would be impacted less than fish from Gull Lake.

2. Consumption recommendations are not currently required for wild game or waterfowl and would not likely be required following impoundment. Muskrat is the only mammal that was predicted to have increased tissue concentrations of mercury following impoundment; however, the increases are considered to be very minor (*i.e.*, 0.01 µg/g under existing conditions versus 0.02 µg/g

under post-impoundment conditions). No measurable change in mercury tissue concentrations under post-impoundment conditions in moose, beaver and snowshoe hare was predicted by Wildlife Resource Consultants.

3. Mercury concentrations in surface water would not pose unacceptable risks from contact or drinking under present or post-impoundment conditions (*i.e.*, risks are considered to be negligible). Typical surface water concentrations are predicted to remain less than the currently used analytical method detection limit (less than 0.05 µg/L as compared to the Canadian Drinking Water Guideline of 1 µg/L).

4. No conclusions can be provided on consumption of wild plants or gull eggs since discipline experts have not been able to estimate mercury concentrations either presently or under post-impoundment conditions.

The key recommendations of the HHRA are as follows:

1. The fish consumption recommendations based on the current quality of fish and the predicted post-impoundment quality should be communicated to local First Nations and communities through appropriate means (*e.g.*, via community health practitioners). Fish species and size-specific consumption recommendations should be emphasized so that people may make the most informed decisions regarding their consumption of specific species (*i.e.*, smaller and non-predatory fish tend to have lower concentrations of mercury). Mercury concentrations in fish should continue to be monitored throughout the Project life.

2. Options for collection of fish from lakes unaffected by the Project should be offered to the local First Nation communities under the post-impoundment scenario (as is planned in programs included in the KCNs' Adverse Effects Agreements); however, even from pristine lakes, it will be necessary to consider size and species of fish for persons desiring to reduce their mercury

exposures (*i.e.*, certain fish from these offset lakes that were tested may have mercury concentrations that warrant consumption recommendations).

3. No unacceptable risks were estimated from consumption of wild game or waterfowl. Nevertheless, there could remain a perception among certain people that wild game or waterfowl are not safe to consume. To help address those concerns, it is recommended that samples, voluntarily submitted by hunters, are analyzed for mercury in order to confirm that wild game and/or waterfowl concentrations remain acceptable to consume. This should be coupled with appropriate education (*e.g.*, community presentations, posters, etc.) that clearly states that wildlife is currently safe to eat and mercury concentrations in tissues of these animals are expected to remain acceptable with Project activities.

4. No recommendations are provided on consumption of wild plants or gull eggs. To help address local First Nation concerns regarding consumption of those foods, it is recommended that wild plant samples are voluntarily submitted by gatherers and analyzed for mercury concentrations in order to confirm that wild plants are acceptable to consume. Also, the community should be educated about the findings of this work, so that wild plants can continue to be used by the community. In the case of gull eggs, it appears that collection of this food from the study area is not a common activity but nevertheless, if this were to occur in the future, sampling of this food group could be considered.

Table 7-1 Summary of Risk-Based Conclusions and Recommendations

Exposure	Risk-based Conclusion		Recommendations for Further Action
	Present Conditions	Post-Impoundment Scenario	
Fish consumption from Gull Lake and Stephens Lake	Fish that can be consumed without restriction by the entire population from both lakes are lake whitefish (any size), northern pike less than 400 mm, walleye less than 400 mm. Average sized lake sturgeon from Gull Lake can be consumed without restriction by the entire population. No recommendations can currently be provided on lake sturgeon that are larger than average size or from Stephens Lake (due to lack of suitable data). For northern pike and walleye greater than 400 mm from both lakes various consumption recommendations are provided.	Average sized or smaller lake whitefish can be consumed without restriction by the entire population from both lakes. For northern pike, walleye and sturgeon various consumption recommendations are provided. No size-specific recommendations can currently be provided; however, smaller and less predatory fish will have lower concentrations. It is possible that size-specific recommendations will be possible if sampling was completed.	Consult findings and approach with communities, health agencies and stakeholders. Continued monitoring. Appropriate education (e.g., presentations in the community, newsletter, pamphlets, etc.) with emphasis on consumption recommendations for on a fish species and size-specific basis.
Wild game consumption	Beaver, muskrat, moose and snowshoe hare can be consumed at current frequencies by all members of the communities.	Beaver, muskrat, moose and snowshoe hare can be consumed at current frequencies by all members of the communities.	Consult findings and approach with communities, health agencies and stakeholders. Periodic volunteer sampling of wild game submitted by hunters. Appropriate education that clearly states that wildlife is safe to eat.
Waterfowl consumption	Ducks and geese can be consumed at current frequencies by all members of the communities.	Ducks and geese can be consumed at current frequencies by all members of the communities.	Consult findings and approach with communities, health agencies and stakeholders. Periodic volunteer sampling of wild game submitted by hunters. Appropriate education that clearly states that waterfowl is safe to eat.
Wild plant and gull egg consumption	No conclusions possible (no measurements of mercury have been collected).	No conclusions possible (no measurements of mercury have been collected)	Consult findings and approach with health agencies and stakeholders. Monitoring required if risk-based conclusions are desired.
Surface water ingestion and contact from Gull Lake and Stephens Lake.	Surface water can be used as a drinking water and recreational water source by all members of the communities.	Surface water can be used as a drinking water and recreational water source by all members of the communities.	Consult findings and approach with health agencies and stakeholders. Continued monitored and communication with communities.

STATEMENT OF LIMITATIONS

This report has been prepared by Wilson Scientific Consulting Inc. (Wilson Scientific) for the sole benefit of InterGroup Consultants Limited (InterGroup). Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Wilson Scientific accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional staff in accordance with generally accepted scientific practices current at the time the work was performed.

Any site-specific information provided by InterGroup or other parties has been assumed by Wilson Scientific to be accurate. Conclusions presented in this report should not be construed as legal advice.

This risk assessment was undertaken exclusively for the purpose outlined herein and was limited to those contaminants, exposure pathways, receptors, and related uncertainties specifically referenced in the report. This work was specific to the site conditions and land use considerations described in the report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations.

This report describes only the applicable risks associated with the identified environmental hazards, and is not intended to imply a risk-free site. Should any conditions at the site be observed or discovered that differ from those at the sample locations, or should the land use surrounding the identified hazards change significantly, Wilson Scientific requests that to be notified immediately to reassess the conclusions provided herein.

REFERENCES

Axelrad D.A., Bellinger D.C., Ryan L.M., Woodruff T.J. 2007. Dose-response relationship of prenatal mercury exposure and IQ: an integrative analysis of epidemiologic data. Environ Health Perspect. 115: 609-15.

CCME. 2006. Protocol for Development of Environmental and Human Health Soil Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg, MB.

European Community. 2006. Commission Regulation (EC) No 1881/2006 of 19 December 2006: Setting maximum levels for certain contaminants in foodstuffs. Official Journal of the European Union 364/5.

Health Canada. 2010a . Federal Contaminated Site Risk Assessment in Canada – Part V: Guidance on Human Health Detailed Quantitative Risk Assessment of Chemicals ($DQRA_{CHEM}$). Contaminated Sites Division, Safe Environments Programme, Health Canada, Ottawa, ON.

Health Canada. 2010b. Toxicological Reference Values, Estimated Daily Intakes or Dietary Reference Values for Trace Elements. Last Updated September 2010. Developed by the Chemical Health Hazard Assessment Division, Bureau of Chemical Safety, Food and Health Products Branch, Health Canada, Ottawa, Ontario.

Health Canada. 2009a (draft). Federal Contaminated Site Risk Assessment in Canada – Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Contaminated Sites Division, Safe Environments Programme, Health Canada, Ottawa, ON.

Health Canada. 2009b. Federal Contaminated Site Risk Assessment in Canada – Part IV: Spreadsheet Tool for Human Health Preliminary Quantitative Risk Assessment (PQRA).

Contaminated Sites Division, Safe Environments Programme, Health Canada, Ottawa, ON.

Health Canada. 2007. Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Chemical Health Hazard Assessment Division, Bureau of Chemical Safety, Food and Health Products Branch, Health Canada, Ottawa, Ontario

Health Canada, 2004. Canadian Handbook on Health Impact Assessment. Volume 3: The Multidisciplinary Team. Health Canada, Ottawa, Ontario.

Health Canada. 1998. Review of the Tolerable Daily Intake (TDI) for Methyl Mercury (MeHg). Bureau of Chemical Safety, Food Directorate, Health Canada, Ottawa Ontario. Dated: April 27, 1998.

INAC. 2009. Canadian Arctic Contaminants and Health Assessment Report: Human Health 2009. Indian and Northern Affairs Canada.

Keeyask Hydropower Limited Partnership, 2012a. Keeyask Generation Project Environmental Impact Statement, Response to EIS Guidelines, Aquatic Environment Supporting Volume, Winnipeg, MB.

Keeyask Hydropower Limited Partnership, 2012b. Keeyask Generation Project Environmental Impact Statement, Response to EIS Guidelines, Terrestrial Environment Supporting Volume, Winnipeg, MB.

Mozaffarian D., Shi P., Morris J.S., Spiegelman D., Grandjean P., Siscovick D.S., Willett W.C., Rimm E.B. 2011. Mercury exposure and risk of cardiovascular disease in two U.S. cohorts. New England Journal of Medicine. 364(12):1116-25.

North South Consultants. 2010. Jansen, Wolfgang. Personal Communications

Email correspondence with Ross Wilson, Wilson Scientific, Vancouver, B.C.

ORNL. 2010. Risk Assessment Information System (on-line database). Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Richardson G.M. 1997. Compendium of Canadian Human Exposure Factors for Risk Assessment.

Roman H.A., Walsh T.L., Coull B.A., Dewailly É., Guallar E., Hattis D., Mariën K., Schwartz J., Stern A.H., Virtanen J.K., Rice G. 2011. Evaluation of the cardiovascular effects of methylmercury exposures: current evidence supports development of a dose-response function for regulatory benefits analysis. Environ Health Perspect. 119:607-14.

US EPA. 1997a. Exposure Factors Source Book. U.S. Environmental Protection Agency, Washington, DC.

US EPA. 1997b . Mercury Study Report to Congress, Volume III: Fate and Transport of Mercury in the Environment. Office of Air Quality Planning and Standards and Office of Research and Development, US Environmental Protection Agency, Washington, DC.

US EPA. 2011. Integrated Risk Information System (IRIS) (on-line database). U.S. Environmental Protection Agency, Washington, DC.

WHO. 2010. Joint FAO/WHO Expert Committee on Food Additives: Seventy-Second Meeting Rome, 16–25 February 2010 – Summary and Conclusions, Issued 16th March 2010. World Health Organization, Geneva, Switzerland. JECFA/72/SC.

Wilson R., Healey N., Damman H. and Richardson G.M. 2005. Lead (Pb) Risk Assessment in Canada, Part I: Critical Review of Toxicity Reference Values. Report prepared for Health Canda, Healthy Environment and Consumer Safety Branch, Safe

Environments Programme by Fisheries and Oceans Canada, Real Property and Technical Support, Environmental Services, Pacific Region.

APPENDIX 5C-1-1: DETAILED TECHNICAL INFORMATION, WORKED EXAMPLE RISK CALCULATIONS AND DETAILED RISK ESTIMATES

APPENDIX 5C-1-1: DETAILED TECHNICAL INFORMATION, WORKED EXAMPLE RISK CALCULATIONS AND DETAILED RISK ESTIMATES

5C-1-1 Introduction

This appendix provides detailed technical information on the human health risk assessment (HHRA). The appendix includes the following:

- Section 5C-1-2 provides the mathematical equations used to estimate exposures.
- Section 5C-1-3 provides worked examples of the risk calculations for various scenarios.
- Section 5C-1-4 provides information on the toxicological reference values selected for the HHRA.
- Section 5C-1-5 provides the detailed results of the HHRA (results expressed on an exposure pathway basis)

5C-1-2 Mathematical Equations Used to Estimate Exposures

As discussed earlier, the exposures that receptors may receive were estimated for the following pathways:

- Ingestion of surface water.
- Dermal contact with surface water.
- Ingestion of country foods.

The mathematical equations used to estimate exposures from these pathways are discussed in greater detail below.

Estimation of Exposure from Ingestion of Surface Water

In order to estimate exposure from ingestion of surface water, the following Health Canada (2009a; 2010a) equation was applied:

$$EWG = \frac{C_W \times IR_W \times RAF_{Oral} \times D_2 \times D_3}{BW}$$

where:

EWG	=	exposure from the water ingestion pathway (µg/kg body weight/day)
C_W	=	water chemical concentration (µg/L)
IR_W	=	water ingestion rate of person (L/day)
RAF_{Oral}	=	relative bioavailability fraction via the ingestion route (chemical specific)
D_2	=	days per week exposed/7 days (unitless)
D_3	=	weeks per year exposed/52 weeks (unitless)
BW	=	body weight of person (kg)

Estimation of Exposure from Dermal Contact with Drinking Water

Dermal contact with surface water was another pathway of exposure that was quantitatively evaluated in the HHRA. Dermal exposure was estimated according to the following Health Canada (2009a; 2010a) equation:

$$EDW = \frac{C_w \times SA_B \times PC \times D_1 \times D_2 \times D_3}{BW}$$

where:

EDS	=	exposure from the dermal pathway for drinking water (µg/kg/day)
C_W	=	water chemical concentration (µg/L)
SA_B	=	surface area of the entire body (m^2)
PC	=	permeability constant (m/hr) (chemical specific)
D_1	=	hours per day exposed to water (hr/day)
D_2	=	days per week exposed/7 days (unitless)
D_3	=	weeks per year exposed/52 weeks (unitless)
BW	=	body weight of person (kg)
UCF	=	unit correction factor (1,000 L/m^3)

Estimation of Exposure from Ingestion of Country Food

In order to estimate exposure from consumption of country food, the following Health Canada (2009a; 2010a) equation was applied:

$$EFG = \frac{C_F \times IR_F \times RAF_{Oral} \times D_2 \times D_3}{BW}$$

where:

EFG	=	exposure from the country food ingestion pathway (µg/kg body weight/day)
C_F	=	food chemical concentration (µg/g)
IR_F	=	food ingestion rate of person (g/day)
RAF_{Oral}	=	relative bioavailability fraction via the ingestion route (chemical specific)
D_2	=	days per week exposed/7 days (unitless)
D_3	=	weeks per year exposed/52 weeks (unitless)
BW	=	body weight of person (kg)

5C-1-3 Worked Example Risk Calculations

5C-1-3.1 Worked Example #1: Risks Posed to a Person Using Surface Water

In this worked example, risks posed to a woman of child-bearing age using surface water from mercury are estimated. To estimate exposures and risks, a surface water concentration of 0.05 µg/L (equal to the method detection limit) was assumed.

<u>Estimation of Risks from Ingestion of Surface Water</u>

In order to estimate exposure from surface water, the following equation was applied:

$$EWG = \frac{C_W \times IR_W \times RAF_{Oral} \times D_2 \times D_3}{BW}$$

where:

EWG	=	exposure from the water ingestion pathway (µg/kg body weight/day)
C_W	=	water chemical concentration (0.05 µg/L)
IR_W	=	water ingestion rate of person (1.5 L/day)
RAF_{Oral}	=	relative bioavailability fraction via the ingestion route (1.0)
D_2	=	days per week exposed/7 days (1.0)
D_3	=	weeks per year exposed/52 weeks (1.0)
BW	=	body weight of person (60 kg)

Under this scenario, the estimated exposure to mercury from surface water ingestion was estimated to be 0.0012 µg/kg bw/day.

The Hazard Quotient from this route was then estimated as follows:

$$\text{Hazard Quotient} = \frac{\text{Estimated Exposure (0.0012 µg/kg bw/day)}}{\text{Tolerable Daily Intake (0.57 µg/kg bw/day)}}$$

Thus, the Hazard Quotient value from surface water ingestion was estimated to be 0.0021.

Estimation of Risks from Dermal Contact with Drinking Water

Dermal contact with drinking water was another pathway of exposure that was quantitatively evaluated in the HHRA. Dermal exposure was estimated according to the following Health Canada (2009a) equation:

$$EDW = \frac{C_w \times SA_B \times PC \times D_1 \times D_2 \times D_3}{BW}$$

where:

EDS	=	exposure from the dermal pathway for drinking water (µg/kg/day)
C_W	=	water chemical concentration (0.05 µg/L)
SA_B	=	surface area of the entire body (1.8 m^2)
PC	=	permeability constant (1 x 10^{-5} m/hr)
D_1	=	hours per day exposed to water (1 hr/day)
D_2	=	days per week exposed/7 days (1.0)
D_3	=	weeks per year exposed/52 weeks (1.0)
BW	=	body weight of person (60 kg)
UCF	=	unit correction factor (1000 L/m^3)

Under this scenario, the estimated exposure to mercury from dermal contact with surface/drinking water was estimated to be 0.000015 µg/kg bw/day.

The Hazard Quotient from this route was then estimated as follows:

$$\text{Hazard Quotient} = \frac{\text{Estimated Exposure } (0.000015\ \mu g/kg\ bw/day)}{\text{Tolerable Daily Intake } (0.57\ \mu g/kg\ bw/day)}$$

Thus, the Hazard Quotient value from dermal contact with drinking water was estimated to be 0.000026.

Estimation of Risks from All Surface Water Exposures

Summing the risks from all exposure routes, the following Hazard Quotient was estimated:

Hazard Quotient from ingestion of drinking water	0.0021
Hazard Quotient from dermal contact with drinking water	0.000026
Sum of all Hazard Quotients	0.0021

5C-1-3.2 Worked Example #2: Risks Posed from Consumption of Walleye

In this worked example, risks posed to the young child receptor from consumption of post-impoundment walleye from Gull Lake are estimated. It was assumed that the young toddler consumed walleye at a rate of one time per week (serving size = 100 g).

To estimate exposures and risks, the following environmental concentrations were assumed:

- Methylmercury concentration in walleye (peak year post-impoundment) = 1.0 µg/g

In order to estimate exposure from consumption of walleye, the following equation was applied:

$$EFG = \frac{C_F \times IR_F \times RAF_{Oral} \times D_2 \times D_3}{BW}$$

where:

EFG	=	exposure from the country food ingestion pathway (µg/kg body weight/day)
C_F	=	food chemical concentration (1.0 µg/g)
IR_F	=	food ingestion rate of person (100 g/week or 14.3 g/day)
RAF_{Oral}	=	relative bioavailability fraction via the ingestion route (1.0)
D_2	=	days per week exposed/7 days (1.0)
D_3	=	weeks per year exposed/52 weeks (1.0)
BW	=	body weight of person (16.5 kg)

Under this scenario, the estimated exposure to methylmercury from consumption of walleye was estimated to be 0.87 µg/kg bw/day.

The Hazard Quotient from this route was then estimated as follows:

$$\text{Hazard Quotient} = \frac{\text{Estimated Exposure } (0.87\ \mu g/kg\ bw/day)}{\text{Tolerable Daily Intake } (0.2\ \mu g/kg\ bw/day)}$$

Thus, the Hazard Quotient value from consumption of walleye at a rate of once per week during the peak year following impoundment was estimated to be 4.3 for the young toddler.

5C-1-4 Toxicological Reference Values Used in the HHRA

As discussed in the Main Report, toxicological reference values were selected using Health Canada guidance. The rationale for the selected TRVs is provided below.

Mercury, Methyl

Health Canada (2010b) recommends the following TDIs for methyl mercury:

- 0.2 µg/kg body weight/day for sensitive members of the general population (i.e., pregnant women, women of child-bearing age, infants and young children)

- 0.47 µg/kg body weight/day for non-sensitive member of the general population

Health Canada (1998; 2002) proposed an interim revised TDI of 0.2 µg/kg body weight/day for sensitive members of the population. The proposed interim revision of the TDI was based on a studies completed in human populations consuming fish in New Zealand, Republic of Seychelles and the Faroe Islands. The endpoint of primary concern was related to neurological development of children born to women consuming large amounts of fish with elevated methyl mercury concentrations. Based on these studies, Health Canada (1998) developed a benchmark dose of dietary intake equal to 1 µg/kg body weight/day that was felt to represent a dose where no adverse effects were observed. With the application of a 5-fold uncertainty factor to this benchmark dose, Health Canada then proposed an interim TDI for pregnant women, women of child-bearing age, and infants of 0.20 µg/kg body weight/day. Health Canada (1998; 2002) advised that this should be regarded as a temporary measure only and revised guidance may still be developed. For non-sensitive members of the general population, Health Canada (2010) cited a TDI of 0.47 µg/kg body weight per day. These TDIs were assumed to be protective of adverse health effects from methyl mercury.

Mercury, Inorganic

For evaluation of mercury when it is not present in fish, the human health risk assessment has relied on the recommendations of WHO (2010). WHO (2010) Committee established a provisional tolerable weekly intake (PTWI) for inorganic mercury of 4 µg/kg bw. WHO (2010) indicated that this PTWI for inorganic mercury was considered applicable to dietary exposure to total mercury from foods other than fish and shellfish. WHO (2010) also indicated that this was applicable to the whole population and did not indicate that risks would be additive with methylmercury exposures (i.e., WHO [2010] concluded that the upper limits of estimates of average dietary exposure to total mercury from foods other than fish and shellfish for adults (1 µg/kg bw per week) and for children (4 µg/kg bw per week) were at or below the PTWI for inorganic mercury and did not indicated a requirement to sum the methylmercury exposures). Consequently, this PTWI was used as the source of the TDI. To estimate a TDI, the PTWI was simply divided by 7 days. Consequently, a TDI of 0.57 µg/kg bw/day was estimated. This value was used to estimate risks from total mercury present in foods other than fish and shellfish and from mercury present in surface water.

In summary, the following Tolerable Daily Intakes were used to evaluate the neurological potential of inorganic of mercury:

- Total mercury TDI of 0.57 µg/kg bw/day for young children and women of child-bearing age;
- Total mercury TDI of 0.57 µg/kg bw/day for the rest of the population.

5C-1-5 Detailed Risk Estimates

The risk estimates for the various receptors and issues of concern are provided in Tables 5C-1-1 to 5C-1-7.

Table 5C-1-1 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Baseline Conditions at Gull Lak

Food Item	Assumed Concentration (ug/g wet weight)	Proposed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces)	Serving Size for Adult (ounces)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Fish							
Lake Whitefish	0.07	3	3.5	14	0.9	1.0	0.4
Jackfish (pike)	0.22	3	3.5	14	2.8	3.1	1.1
Pickerel (walleye)	0.23	3	3.5	14	3.0	3.3	1.2
Lake Sturgeon	0.2	3	3.5	14	2.6	2.8	1.0
Birds							
Duck	0.07	1	2	7	0.17	0.17	0.06

HQ = Hazard Quotient

Table 5C-1-2 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Baseline Conditions at Stephens Lake

Food Item	Assumed Concentration of Mercury (ug/g wet weight)	Assumed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces per meal)	Serving Size for Adult (ounces per meal)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Fish							
Lake Whitefish	0.09	3	3.5	14	1.2	1.3	0.5
Jackfish (pike)	0.26	3	3.5	14	3.3	3.7	1.3
Pickerel (walleye)	0.29	3	3.5	14	3.7	4.1	1.5
Birds							
Duck	0.09	1	2	7	0.22	0.21	0.08

HQ = Hazard Quotient

Table 5C-1-3 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Post-Impoundment Conditions at Gull Lake

Food Item	Assumed Concentration of Mercury (ug/g wet weight)	Assumed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces per meal)	Serving Size for Adult (ounces per meal)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Fish							
Lake Whitefish	0.19	3	3.5	14	2.4	2.7	1.0
Jackfish (pike)	1.0	3	3.5	14	12.9	14.2	5.1
Pickerel (walleye)	1.0	3	3.5	14	12.9	14.2	5.1
Lake Sturgeon	0.3	3	3.5	14	3.9	4.2	1.5
Birds							
Duck	0.19	1	2	7	0.47	0.45	0.16

HQ = Hazard Quotient

Table 5C-1-4 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Post-Impoundment Conditions at Stephens Lake

Food Item	Assumed Concentration of Mercury (ug/g wet weight)	Assumed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces per meal)	Serving Size for Adult (ounces per meal)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Fish							
Lake Whitefish	0.15	3	3.5	14	1.9	2.1	0.8
Jackfish (pike)	0.5	3	3.5	14	6.4	7.1	2.5
Pickerel (walleye)	0.5	3	3.5	14	6.4	7.1	2.5
Lake Sturgeon	0.25	3	3.5	14	3.2	3.5	1.3
Birds							
Duck	0.15	1	2	7	0.37	0.35	0.13

HQ = Hazard Quotient

Table 5C-1-5 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Baseline Conditions

Food Item	Assumed Concentration of Mercury (ug/g wet weight)	Assumed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces per meal)	Serving Size for Adult (ounces per meal)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Mammals							
Beaver	0.01	3	2	7	0.03	0.02	0.02
Muskrat	0.02	1	2	7	0.02	0.02	0.01
Moose	0.07	5	3.5	14	0.53	0.58	0.49
Rabbit*	0.05	1	2	7	0.04	0.04	0.03

* Concentrations of mercury in rabbit have only been evaluated semi-quantitatively at the current time

HQ = Hazard Quotient

Table 5C-1-6 Preliminary Risk Estimates from Mercury Due to Consumption of Country Foods: Future Conditions

Food Item	Assumed Concentration of Mercury (ug/g wet weight)	Assumed Consumption Frequency (meals per week)	Serving Size for Toddler (ounces per meal)	Serving Size for Adult (ounces per meal)	HQ for Toddlers	HQ for Women of Childbearing Age	HQ for Adult Males and All Seniors
Mammals							
Beaver	0.01	3	2	7	0.03	0.02	0.02
Muskrat	0.04	1	2	7	0.03	0.03	0.03
Moose	0.07	5	4	14	0.53	0.58	0.49
Rabbit*	0.05	1	2	7	0.04	0.04	0.03

* Concentrations of mercury in rabbit have only been evaluated semi-quantitatively at the current time

HQ = Hazard Quotient

Table 5C-1-7 Risk Estimates for Traditional Land Use - Based on Total Mercury Surface Water Concentrations (Present and Future Assumed to Equal 0. 05 ug/L)

Receptor of Concern	Assumed Surface Water Conc (ug/L)	HQ dermal - surface water	HQ - ingestion of drinking water	HQ all routes of surface water contact
Toddler	5.0E-02	0.000032	0.0032	0.0032
Woman of Childbearing Age	5.0E-02	0.000026	0.0022	0.0022
Adult Male	5.0E-02	0.000022	0.0019	0.0019

HQ = Hazard Quotient

APPENDIX 5D

CULTURE AND SPIRITUALITY DATA SOURCES

LIST OF FIGURES

5D.0 CULTURE AND SPIRITUALITY DATA SOURCES

5D.1 TATASKWEYAK CREE NATION DATA SOURCES

As part of a Project environmental review process (Article 2.8.3 (b), NFA Implementation Agreement 1992), TCN developed a volume of research called Analysis of Change: Split Lake Cree Post Project Environmental Review and designed the Mother Earth Ecosystem model to conduct research. The research conducted documents the community's perspective on past events and influences that affected environmental and cultural changes that touched the community. Discussions included a range of factors including hydroelectric development, trapping and fishing changes, the emergence of the wage economy, population movement and growth, community characteristics, diet/health, transportation, education, social issues, and other outside development pressures. Interviews were conducted using the Mother Earth Ecosystem Model with a total of 30 Split Lake Cree Elders and 15 other adult community members. A flexible, thematic approach was adopted for the interview process, contributing to the free flow of information while maintaining some structure. Indicator measures were not initially considered in the development of the research. As such, a qualitative content review of TCN's Analysis of Change and Overview of Water and Land (OWL) Summary Report (2002), was summarized and applied to the indicator measure discussion.

The Mother Earth Ecosystem Model represented in Figure 5D-1 below was designed by the TCN and its community researchers.

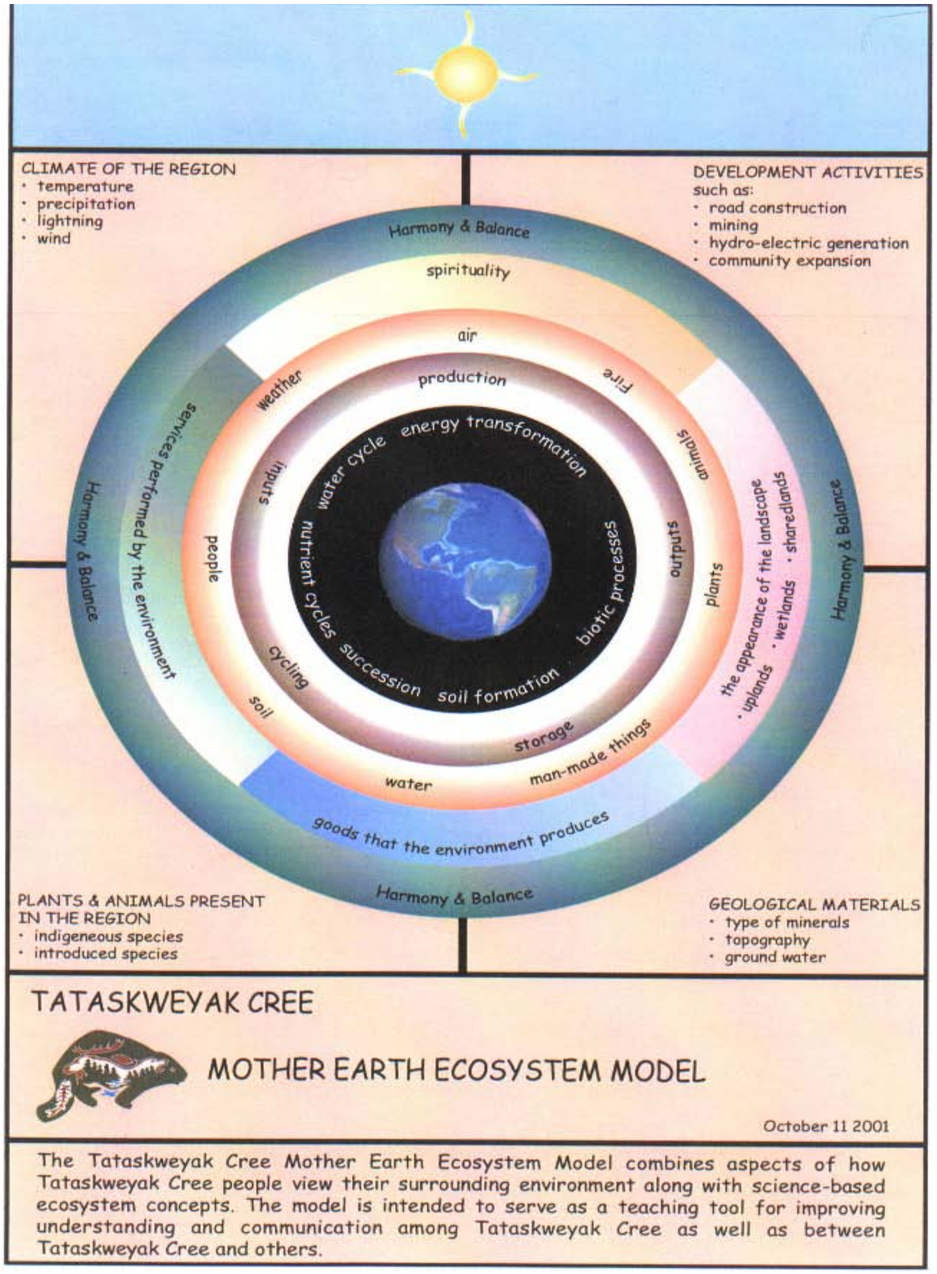


Figure 5D-1: Mother Earth Ecosystem Model (Copied from TCN OWL Document 2002)

5D.2 WAR LAKE FIRST NATION DATA SOURCES

A total of 44 interviews were conducted and categorized as 1) Elders 50 years of age or older, 2) adults 35-49 years old, 3) adults 21-34 years old, and 4) youth 16-20 years old. An additional 13 interviews with children from the band, ranging from grades one through four were conducted by WLFN and published for the Keeyask Generation Project as the War Lake OWL (Overview of Water and Land) Process

(2002). Prior to each interview, potential respondents were shown maps of the area to be affected by the project and were asked if they would consent to be interviewed. Each interview was approximately 30-60 minutes in length and consisted of 14 questions. In order to prepare the interviewees for the next phase of the OWL project, photographs of specific landscapes within the project area were shown and the various kinds of relationships were discussed.

The questions developed for this project allowed people to express their values, beliefs and aspirations regarding how the construction of a generating station at Keeyask Rapids would affect their way of life.

5D.3 FOX LAKE CREE NATION DATA SOURCES

The historic changes and impacts that have affected FLCN have been chronicled by community researchers in two documents called Forgotten Nation in the Shadow of the Dams and Ninan: Our Story (draft), in which 75 primary source interviews, conversations and workshops were compiled. A preliminary primary source document titled Fox Lake Cree Nation Preliminary Sturgeon TK Study (draft) discussing the cultural utilization of Sturgeon was also utilized. This research presented the current challenges the community faces. The research in the community history notes that:

> The losses that these Elders describe represent much more than an inability to obtain wild foods: and other products from the environment. They reflect fundamental changes in how the people provide for their families; making a living off the land; move and travel on the land to renew family and other relationships; obtain solace and emotional and spiritual well-being from the environment; live cohesively as a community without incidents of violence and racism; form trusting and respectful relationships with governments and corporate employers...; and most importantly, live empowered lives that in turn will nurture, support, and inspire the next generation (FLCN 2009a Draft).

For this component, indicator measures were not initially considered by FLCN community researchers in the development of the research and as such, a qualitative content review of the research was conducted, summarized and applied to the indicator measures.

In order to address gaps in primary source information of local women's perspectives, a Fox Lake Cree Nation (FLCN) Culture and Spirituality Workshop was held at the Gillam Recreation Centre on April 20, 2011 at which time four (4) female KPIs were conducted. This research was qualitatively and quantitatively reviewed, summarized and applied to the indicator measures.

5D.4 YORK FACTORY FIRST NATION DATA SOURCES

Twelve oral history interviews were conducted by York Factory First Nation (YFFN) community researchers at York Landing (*Kawechiwasik*), Thompson, Churchill and Nelson House for the book Voices from Hudson Bay; Cree Stories from York Factory (Beardy and Coutts 1996). These interviews were utilized for content analysis. Three additional culture and spirituality workshops for women, youth and families and one informal key person interview with an Elder were conducted in York Landing (*Kawechiwasik*) under the blanket of a Socio-Economic Impact Assessment in 2009. That work produced further shared knowledge that was similarly coded and analyzed. In 2010, YFFN provided Our Voices:

York Factory First Nation Speaks About the Keeyask Generating Station Project for additional consideration. Transcribed interviews were forwarded to Northern Lights Heritage Services Inc. for data management. The following is an account based on the methods that were employed to code, sort and measure the cultural record as described in the oral histories and other supplied documentation of YFFN.

The oral narratives provided by YFFN focused on the key elements which reflected worldviews, spiritual understandings, historical accounts and hopes for the future.

5D.5 YOUTH OBSERVATIONS FROM YORK LANDING

York Landing (*Kawechiwasik*) was generally described by the youth as being a small, safe community with Members sharing a synergy directed at the overall health and wellbeing of the community. The daily activities and cultural practices they are involved in are manifested as leisure and traditional components of their worldview. The leisure and traditional components discussed by the youth are intertwined and reflect the communities' efforts to maintain a balance of traditional and spiritual understanding.

Activities described by the youth illustrated this connection between leisure and tradition and focused on the natural environment and how it is shared as a group. These activities include skating, swimming and sledding, with traditional activities described as hunting, fishing and trapping. Other activities that featured prominently in their discussion were cultural practices that involved shared experiences with Elders of the community, sweat lodges, traditional craft making and cultural events. The youth descriptions were always in context of a shared experience with friends or a family kinship.

The youth who participated were also given the opportunity to provide insight into their perceptions and hopes for the future of York Landing (*Kawechiwasik*) with or without the proposed Keeyask Generation Project. The comments provided by youth participants were focused on the relationship between the natural and cultural environment, with community wellbeing as a central concept. The youth primarily discussed the need for more leisure and traditional activities. Environmental concerns were mentioned and a need to introduce activities like tree planting for the community and a concerted effort to keep the community clean and free of pollutants with the introduction of a recycling program. The youth also felt that the community would need an increase in housing, public facilities such as a new civic arena, and infrastructure development that could connect the community on a year round basis.

Youth concerns involving the presence of the Keeyask Generation Project focused on a perceived fear of flooding and pollution as an effect on the environment and the community. Another fear expressed was the perceived negative effects on animals and resources utilized by the community. The need for a community grocery store was discussed to offset diminished access to country food sources.

The positive perceptions discussed by the youth reflect the understanding that the Project presents an opportunity for the community to gain employment, education and the infrastructure needs that community will need in the future to flourish and maintain the balance of community well being.

APPENDIX 5E

POLICING INDICATORS IN THE LOCAL STUDY AREA

LIST OF TABLES

5E.0 POLICY INDICATORS IN THE LOCAL STUDY AREA

Policing statistics were gathered from the RCMP detachments in Thompson and Gillam, in addition to a policing report specific to the City of Thompson (prepared by the RCMP) for the five year period between 2005 and 2009. The data were aggregated based on each community's RCMP detachment and size, so as to ensure the confidentiality of the smaller communities. As such, the data is presented for the City of Thompson, Split Lake (TCN) and York Landing (YFFN) combined, and Gillam, Fox Lake (Bird) and Ilford (WLFN) combined.

Table 5E-1: Policing Statistics Thompson

Criminal Statutes	**Number of Reported Infractions**				
	2009	2008	2007	2006	2005
Total Assaults	760	780	816	826	873
Total Breaking and Entering - Business	35	21	43	42	52
Total Breaking and Entering - Residential	86	84	125	91	168
Total Theft Motor Vehicle	86	60	59	51	54
Total Theft Over $5000	8	6	4	12	22
Total Theft Under $5000	368	293	355	459	570
Total Frauds	45	47	65	71	83
Total Drugs	86	133	90	95	91
Total Other Criminal Code	3,279	3799	3991	4127	4073
Criminal Code Traffic	216	228	205	164	192
Provincial Statutes					
Intoxicated Persons Detention Act	3,875	3019	3400	3003	2941
Total Liquor	115	174	111	117	138
Provincial Traffic	1,038	1701	1281	825	512
Collision	496	668	505	486	525

Source: Thompson Municipal Policing Reports.

Table 5E-2: Policing Statistics TCN at Split Lake and YFFN at York Landing

Type of Crime	2009	2008	2007	2006	2005
Criminal Statutes:	**Number of Reported Infractions**				
Total Assaults	82	81	83	94	49
Total Breaking and Entering – Business	5	2	8	6	6
Total Breaking and Entering – Residential	22	11	6	10	7
Total Theft Motor Vehicles	6	7	3	10	8
Total Theft Over $5000	0	0	0	1	0
Total Theft Under $5000	8	1	1	2	0
Total Frauds	3	1	1	4	0
Total Drugs	0	1	0	1	1
Total Other Criminal Code	49	37	40	39	31
Criminal Code Traffic	4	8	7	5	5
Provincial Statutes :	**Number of Reported Infractions**				
Intoxicated Persons Detention Act	0	0	0	0	0
Total Liquor	5	1	1	1	0
Provincial Traffic	11	7	11	10	6
Collision	10	14	12	2	16

Source: Shelly Watt, Thompson RCMP December 21, 2009.

Table 5E-3: Policing Statistics Gillam[1] RCMP Detachment

	2009	2008	2007	2006	2005
Criminal Statutes	**Number of Reported Infractions**				
Total Crime vs. Person[2]	42	62	49	82	51
Total Crime vs. Property[3]	66	53	68	108	49
Common Police Activities - Assist General Public[4]	129	172	172	154	96
Firearms Act & Offensive Weapons	6	17	6	13	10
Total Theft Over $5000	7	1	6	1	0
Total Theft Under $5000	15	13	8	13	12
Major Fraud & Theft	0	0	0	0	1
Total Drugs [5]	3	7	8	8	14
Total Other Criminal Code	175	222	182	149	108
Criminal Code - Traffic [6]	21	11	7	5	11
Provincial Statutes	**Number of Reported Infractions**				
Intoxicated Persons Detention Act	26	9	10	20	5
Total Liquor	33	23	24	24	15
Provincial Traffic	102	122	225	86	13
Collision	26	37	26	32	25
Child Welfare Act & Family Relations Act	3	6	3	14	8
Mental Health Act	19	8	25	22	23
Total Provincial Statutes	209	205	313	198	89

Source: Gillam RCMP Detachment.

Notes:

1. Totals calculated by InterGroup Consultants.
2. Crimes vs. person include sexual, assaults, robbery/threats, kidnapping/hostage, and related to death.
3. Crimes vs. property include mischief, fraud, arson, and breaking and entering. (A large majority of crimes vs. property in each year was mischief).
4. This includes common activities such as index check, animal calls, false alarms, assisting the general public.
5. Includes trafficking and possession.
6. Included impaired operation related offences, dangerous operation, and other traffic offences (a large majority consists of impaired driving).