Literature Review

Local and Traditional Knowledge In the Athabasca River Watershed

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Summary Points

Given the limits of resources and time established for this project, this report should not be considered a comprehensive overview of all available documented Traditional Knowledge for this watershed. The Athabasca River Watershed comprises both Treaty #8 and Treaty #6. There are at least nine Aboriginal groups with historic or contemporary connections to this watershed. Many of these groups relocated to British Columbia with the settlement of Alberta in the 19th century. Definitions, methods and formats of documented Traditional Knowledge vary significantly. While libraries, the internet, and scholarly journals house some sources of knowledge, there are many kinds of reports prepared by and for Aboriginal communities that are not available to the public for political, cultural, and socio-economic reasons. There are many kinds of Traditional Knowledge indicators of ecosystem health and ecological change; some of these indicators are synergistic with Western Science. Other kinds of indicators are unique to Traditional Knowledge and may be difficult to integrate into a standardized 'State of the Watershed Report.' There is significant spatial differentiation related to where such knowledge is documented; some communities in the lower Athabasca have been more active in documenting Traditional Knowledge due, in part, to the resources and pressures to do so that have come with planning, assessment and monitoring of oil sands mining and its impacts.

1. Introduction

The Athabasca River Watershed has played a vital role in the social, economic, and cultural well-being of many Aboriginal peoples. Given their reliance on and stewardship of its resources, many Aboriginal peoples have developed valuable knowledge about the state of aquatic ecosystem health that can contribute to our understanding of historic and contemporary issues of planning, management, and monitoring. Many of the themes and indicators of ecosystem health identified by elders and land users are synergistic or parallel to those identified by Western Science; others are unique in focus and meaning. In general, Traditional Knowledge offers a holistic and integrated perspective, with a combined focus on both the biophysical and human dimensions of ecosystem health. Given that this report aims to identify sources of knowledge that might be used in a future 'State of the Athabasca Watershed Report,' sources of Traditional Knowledge were identified and then interpreted to identify key themes and metrics for assessing and communicating about ecosystem health relevant to many audiences.

We discuss Traditional Knowledge in relation to three geographic areas—the upper, middle, and lower Athabasca River Watershed. Within these geographic areas, the report presents knowledge according to broad themes and perspectives on ecological health. These include water quality, quantity and flow, fish, waterfowl, aquatic wildlife and related habitats. In addition, the report offers perspectives on Aboriginal access and use of the resources of the Athabasca River, particularly pertaining to hunting, trapping, fishing and related traditional practices. A further section highlights issues of community well-being as they relate to these access and use patterns. The report ends with a section highlighting Aboriginal perspectives on the effects of other human use (including resource development) in the watershed.

There is significant spatial differentiation in where such knowledge is documented; some communities in the lower Athabasca have been more active in documenting Traditional Knowledge due, in part, to the resources and pressures to do so that have come with the planning, assessment, and monitoring of oil sands mining and its impacts. This report strongly recommends that resources be made available for a more comprehensive and regional approach to documenting Traditional Knowledge.

There are notable challenges in meaningfully integrating Traditional Knowledge into a standard 'State of the Watershed Report;' some of these challenges are technical and can be overcome with thought and effort. Some communities and resource peoples, however, may see the conflicts between Traditional Knowledge and Western Science as more deeply rooted. To address these conflicts, the report recommends that careful attention be paid to the socio-economic inequities that perpetuate the marginalization of Aboriginal voices in decision-making about resources in the Athabasca River Watershed.

Given the limits of resources and time established for this project, the report should not be considered a comprehensive overview of all available documented Traditional Knowledge for this watershed. It is also important to recognize that definitions, methods and formats of documented Traditional Knowledge vary significantly. While libraries, the internet, and scholarly journals house some sources, there are many kinds of reports prepared by and for Aboriginal communities that are not available to the public for political, cultural, and socio-economic reasons.

2. Methods

The identification, synthesis, and reporting on Traditional Knowledge is complex, owing to the large number of Aboriginal groups who have documented historical and contemporary land and resource use and interest in the region, the absence of documented Traditional Knowledge research (particularly in the upper and middle watershed), as well as the socio-economic and political inequities and tensions that exist between regional and provincial governments and many Aboriginal communities. Some Aboriginal groups may feel there is little purpose in devoting valued time and resources to sharing their knowledge to a reporting process that is largely structured according to western science parameters and would seem to benefit a public council rather than their own communities.

In 2010, the scope of work was amended to include the preparation of a separate Traditional Knowledge document. This amendment was made based on a recognition that Traditional Knowledge is generated differently from 'western science' and is tied to a unique set of values, perspectives, and historical/contemporary experiences. It is important that the Athabasca Watershed Council–Watershed Planning and Advisory Council (AWC-WPAC) Technical Committee acknowledge that:

- Traditional Knowledge has many meanings; it is generally broader and more holistic of other ecological and socio-cultural variables than conventional scientific definitions of 'aquatic ecosystem';
- Documented and public sources of Traditional Knowledge only recognize a small percentage of existing Traditional Knowledge;
- The collection of Traditional Knowledge should increase the capacity of First Nations and Métis communities to participate in the planning, monitoring, and management of the Athabasca Watershed;

Based on these assumptions, and with the interest of ensuring a respectful approach to the collection and reporting of traditional knowledge, we proposed that, in addition to identified deliverables, a report from this scope of work (data collection) is submitted directly to the Treaty 8 and Treaty 6 First Nations of Alberta and Métis Nation of Alberta and/or other organization(s) identified by the First Nations and Métis representatives on the AWC-WPAC.

Searching for Secondary Sources of Publicly Available Traditional Knowledge

A search of publicly available sources of Traditional Knowledge was carried out between December 2010 and March 2011. This report accounts for six different kinds of secondary sources of Traditional Knowledge and related community studies gathered through the Athabasca River Watershed.

The majority of information was found through searches of public databases. including:

- Academic Search Elite Database (University of Alberta);
- Google/Google Scholar;
- Royal Commission on Aboriginal Peoples Database (Our Legacy)
- National Energy Board (NEB) of Canada/Energy Resources Conservation Board (ERCB) of Alberta;
- Northern River Basins Study (Database);
- Personal Communications / Sharing of Reports;

Through this search, the following kinds of documents were found:

Oral Histories

Traditional Knowledge is most closely associated with oral histories about the land, water and wildlife in specific regions. As a consequence, much Traditional Knowledge documented to date in the region has focused on understanding the distinct worldview, values, and way of life of Aboriginal peoples.

Traditional Land Use Studies

Land and resource use studies are fundamental to our understanding of Traditional Knowledge in the Athabasca River Basin. For many communities and scholars, traditional land use practices like hunting, fishing, trapping, and plant harvesting are the means by which Aboriginal people have come to know about ecosystems and ecosystem change. In other words, Aboriginal people have come to know about the land, not by some detached method of investigation, but by living or dwelling within the ecosystems. Any changes or decline in ecosystem health, in that sense, are not viewed as data, but as a threat to the socio-economic and cultural well-being of communities. Such living on the land has also created a strong emotional and spiritual connection to the environment that may make Traditional Knowledge holders particularly attuned to ecosystem change. As noted by the late Lutsel K'e Dene First Nation elder Maurice Lockhart, "Some people who don't care so much won't notice the changes" (Maurice Lockhart in Parlee *et al*. 2005). Similarly, to oral-history research, accepted methods for land and resource use studies vary across the Watershed.

Ecological Knowledge Studies

Traditional Knowledge is of increasing interest to policy-makers and environmental managers, in large part because of the potential expertise and insight that can be gained about the environment and environmental change. In that context, communities, working in collaboration with anthropologists, ecologists, and others have focused on documenting aspects of ecosystems and ecosystem change. Relevant to this research is knowledge related to sustainable management, including ways of respecting the land, water, and wildlife (e.g., rules, practices, and tools).

Assessment / Impact Specific Studies

Traditional Knowledge studies conducted in the Athabasca River Basin that relate to specific human activities or impacts (such as agriculture, oil sands mining, etc.) have been somewhat common, particularly in the Lower Athabasca River region. Considered within this context are community-based studies related to local risk perception and those that seek to communicate about environmental risk. As noted by scholars such as Usher *et al*. (1992), the perception that something is *wrong* with a given resource can be profoundly disturbing to land-based communities whose livelihoods depend upon the continued health and sustainability of those resources. The Northern Contaminants Project (NCP) and other work undertaken through such agencies as the Centre for Indigenous Peoples' Nutrition and the Environment (CINE), provide valuable guidance on documenting risk perception in northern communities.

Traditional Knowledge Monitoring

An emergent area of Traditional Knowledge documentation and sharing focuses on community-based monitoring and regional monitoring initiatives such as the *Guardians* program in Fort Chipewyan, led by the Mikisew Cree First Nation and Athabasca Chipewyan First Nation.

Other

Given there are significant gaps in the availability of Traditional Knowledge, particularly in the upper and middle regions of the watershed, this report has also made room for other kinds of knowledge and information that would be considered outside the definition of 'Traditional Knowledge.' These included initiatives that address the following:

i) Did the study involve documenting sources of Traditional Knowledge (i.e., documentation of the values, knowledge, practices, and institutions of a particular Aboriginal group?
ii) Was the study focus defined by Traditional Knowledge (i.e., selection of issues or valued ecosystem components being studied)?
iii) Was the study led or guided by an Aboriginal community?
iv) Did the study have some other relevance to Aboriginal communities?

Studies that were either defined or guided by Aboriginal organizations or communities were recognized as important to our understanding of community perspectives on the state of the aquatic ecosystem. The inclusion of other kinds of knowledge and information is important to many communities who consider themselves informed by many sources of knowledge and information.

A complete listing of the sources can be found in the reference section to this report.

Literature Review:

The analysis of the literature was interpreted according to a series of criteria and questions.

Table 1: Criteria for Identifying and Interpreting Traditional Knowledge

Relevance	Does the source contribute to our understanding of the State of the Athabasca River Watershed? To what extent does the source reflect 'Traditional Knowledge' of Aboriginal peoples in the basin? i) Research represents a documented source of Traditional Knowledge (i.e., values, knowledge, practices and institutions) of a particular Aboriginal group? ii) Research focus was defined by Traditional Knowledge (i.e., selection of issues or valued ecosystem components being studied) iii) Research was led or guided by an Aboriginal community.
Availability	Is it currently available or do the data need to be collected?
Frequency	How often is the indicator currently collected?
Time series	Is there historical information to show change over time?
Geographic detail	Is it available at a regional, or community level or is it place-specific?
Responsiveness	Will the indicator change over time?
Variability	Is there extreme variation in the indicator from one period to another that makes trend identification difficult?
Outcome indicator	Outcome indicators are preferred over output, input or other indicators.
Relevance	Is the indicator relevant to social conditions?
Understandability	Is there a reasonable expectation of most being able to understand the indicator?
Reliability	Is the data source reliable, ongoing, and free from bias?
Comparability	Are there comparable data for other jurisdictions?

It is also important to recognize that there are no consistent methodologies for the documentation of Traditional Knowledge. Just as there is a large breadth of science that has been amassed about

the Athabasca River Watershed, there are many differences in scope, themes, timelines, indicators/measures, and formats of documented sources of Traditional Knowledge. More explanation follows:

- **Scope—**Much of the documented Traditional Knowledge goes beyond the framework of 'data' about fish, water quality and water quantity and has a much broader and integrated perspective (including a spiritual perspective) on aquatic issues of concern to Aboriginal groups involved in the AWC. Such an integrated perspective may be one that can guide the report.
- **Themes—**While some of the themes may be the same (e.g., fish health, water quality), other themes may differ. It is suggested that the report consider including a section on community well-being and health, as well as on access to land for traditional use.
- **Timescales—**The timescale for the literature review was 2000-Present. While this provided a useful guide for identifying sources, the perspectives offered can and often do extend beyond this time period. It is therefore important to consider timescales in presenting the data since it may be disjointed with the 'science' in the report.
- **Indicators/Measures—**Differences in the indicators/measures for communicating about the state of the aquatic environment are anticipated between Traditional Knowledge and western science. Given the immense size, ecological scope, and socio-cultural diversity of Aboriginal communities and heterogeneity of issues driving Traditional Knowledge research in the basin, differences are also likely to emerge between Traditional Knowledge holders.
- **Format—**The Traditional Knowledge studies reviewed were documented for different purposes, and vary in approach, methods, analysis and communication of results (interventions in environmental assessments, Master's theses, community and board reports, land use studies and contracted studies, etc.). The format of the report will have to be flexible to accommodate these differences in presentation of Traditional Knowledge.

3. Traditional Knowledge Indicators of Ecosystem Health

Traditional Knowledge is considered to be the body of accumulated knowledge that has developed over many generations about the environment (Berkes 2008). The term 'traditional' knowledge is sometimes contested by those concerned about its interpretation as 'historical' knowledge. Traditional Knowledge is considered more accurately as a continuously evolving body of knowledge with relevance to contemporary socio-cultural and ecological issues, including the environmental impacts of development activity. Although the rationale for including Traditional Knowledge in monitoring and management in the reporting on the Athabasca River Watershed may be perceived as political, the deeper meaning and value comes from its association with sustainability. Many scholars and policy-makers with an interest in Traditional Knowledge focus on the wisdom that can be gained about environmental change and how to preserve and conserve resources for future generations. The International Union for the Conservation of Nature (IUCN), for example, identifies the following potential value of Traditional Knowledge:

- Traditional Knowledge offers new biological knowledge and ecological insights;

- Some Traditional Knowledge systems provide models for sustainable resource management;
- Traditional Knowledge is relevant for protected areas and conservation education;
- The use of Traditional Knowledge is often crucial for development planning; and,
- Traditional Knowledge may be used in environmental assessment.

(Berkes 1993)

There are many challenges to the documentation of Traditional Knowledge, and even further challenges to its meaningful inclusion in resource management contexts. The challenge in engaging both scientists and Traditional Knowledge holders in monitoring is to maintain the socio-cultural foundations of Traditional Knowledge and avoid the 'bureaucratization' or 'scientization' of Traditional Knowledge.

Categories of Traditional Knowledge for Assessment, Monitoring, and Management

Category 1: Factual/rational knowledge about the environment. This includes statements of fact about such matters as weather, ice, coastal waters, currents, animal behaviour, traveling conditions and the like, which are typically based on (a) empirical observations by individuals of specific events or phenomena; (b) generalized observations based on numerous experiences over a long time; or (c) generalized observations based on personal experience, reinforced by the accounts of others both living (shared experience, stories, and instruction) and dead (oral history and customary teachings). **Category 2**: Factual knowledge about past and current use of the environment (e.g., patterns of land use and occupancy, harvest levels), or other statements about social or historical matters that bear on the traditional use of the environment and hence the rights and interests of the local aboriginal population in the regional environment. **Category 3**: Culturally based value statements about how things should be, and what is fitting and proper to do, including moral or ethical statements about how to behave with respect to animals and the environment, and about human health and well-being in a holistic sense. **Category 4**: Underlying the first three categories is a culturally based cosmology—the foundation of the knowledge system—by which information derived from observation, experience, and instruction is organized to provide explanations and guidance. It is the framework with which people construct knowledge from facts.

Traditional Knowledge, like science, is multifaceted. Berkes describes the three elements of Traditional Knowledge to be: local knowledge, resource management practices, and worldview. Usher (2000) defines four different categories of Traditional Knowledge in an effort to elucidate its role in institutions and processes of environmental assessment, monitoring, and management. Neis *et al.* (1999) offer slightly different categories of Traditional Knowledge as it relates to fisheries, including:

- Empirical data on the environment, including spatial distribution of the components, behaviour, relationships between species, and interpretation of natural phenomena;
- Use of environmental resources;
- Management system covering natural resources, including conservation practices and mechanisms for assessing the state of resources;

- Worldview.

The term 'Traditional Knowledge' is an overly broad term that does not effectively capture the complexity of empirical information and other knowledge held by particular community experts. Although there has been a tendency in environmental assessment processes and related resource management activities to consider Traditional Knowledge as a 'commodity,' held exclusively by elders (and usually male elders), it is important to recognize Traditional Knowledge as more than an historical body of information. Rather, it should be seen as an evolving process of learning by all members of the community, including male and female elders, adults, and children. That being said, consideration must be given to the role that particular individuals play within this learning process. Expertise on a particular research question may vary depending on place-based experience (e.g., fish camp on Lake Athabasca), harvesting experience, gender, age and education. For example, one might talk about Traditional Knowledge more culturally specific as 'Cree Knowledge,' 'Stoney Knowledge,' or 'Denesoline Knowledge,' or spatially specific as 'Knowledge of the Athabasca River.' Knowledge might also be discussed as species-specific. In eastern Canada, for example, knowledge of fish and fish habitat is increasingly being described as 'Fisheries Ecological Knowledge' or FEK. "FEK is local knowledge concerning inter-annual, seasonal, lunar, diet and food-related variations in the behavior and movements of marine fishes and mammals […]. Such knowledge is passed from generation to generation of fishers and influences the nature, timing, and location of their fishing." In this fisheries context (and in resource management generally), scholars have tended to compare or characterize Traditional Knowledge as a form of 'science;' the essential common element between Traditional Knowledge and western science is the basis in empirical observation.

> Scientific knowledge needs a wide range of methodical observations to establish a model of a situation—for instance, to estimate the development of a certain stock of animals within an ecosystem. Before a biologist can come to a conclusion about the development of the stock, he must collect great amounts of quantitative data over some time. A local fisherman who is familiar with the area will react spontaneously to observations that deviate from the usual pattern. He will be observant to qualitative changes—signs which indicate that something unusual is happening. He will interpret such signs within the context of his own experience and Traditional Knowledge and discuss his interpretations with fellow fisherman and neighbours (Eythorrson 1993).

Although both are based on empirical observation, scientists may organize their observations differently, as was perceived to be the case in a Greenland study on beluga and narwhal. "Hunters observations are more loosely organized in informal and flexible systems, whereas the scientist structure and evaluate their observations in terms of repeatability and comparability" (Thomsen 1993). The assumption implied by these characterizations—that Traditional Knowledge is not repeatable and comparable—can be contested by other evidence in which Traditional Knowledge has formed the basis of monitoring (Moller *et al.* 2004; Parlee *et al.* 2005).

By viewing Traditional Knowledge as analogous to science, however, there is a tendency to disregard the context or process by which this knowledge is generated or constructed. Such

disregard has led to frustration and criticism from communities and those scholars involved in Traditional Knowledge research. Cruikshank (2004) argues that the tendency to categorize Traditional Knowledge to fit into western-defined bureaucratic categories (i.e., fisheries management) can have significant socio-cultural implications. She asks:

- What are the consequences of categorical practices that distance people from lived experience?
- How does authorizing particular kinds of knowledge change its social function?
- Does the local knowledge of northern people maintain its own integrity when it becomes bound into larger narratives?
- What forms do such transformations take in differing geopolitical circumstances? (Cruikshank 2004:32).

Among the most important links between Traditional Knowledge and the socio-cultural context or 'lived experience,' is the link to the socio-cultural processes associated with the generation or construction of that knowledge. What are those socio-cultural processes? Among the most common references are land-use practices, including harvesting and related resource uses. There is, however, much complexity and diversity in theory on how Traditional Knowledge is constructed. Some scholars point to phenomenological or cosmological relationships between the knowledge holder and the environment. Other scholars refer to the construction of knowledge as a journey or process of 'learning' or 'learning by doing.'

One of the most comprehensive Traditional Knowledge studies in the Athabasca River Watershed was the Northern River Basins Study (NRBS). The broad objectives of the NRBS research program were to identify and quantify the multiple and diverse stressors acting on the Athabasca, Peace, and Slave river basins and to assess the ecological consequences of exposure to those stressors. Goals, objectives and guiding questions were identified by the Study Board.

A decision was made to undertake a Traditional Knowledge study separately from the other aspects of the study on water and ecosystem health. Greater efforts could have been made at a combined approach to research and reporting of results to develop a more holistic understanding of environmental change. The key questions guiding the study included:

- *How has the aquatic ecosystem been affected by exposure to organochlorines or other toxic compounds?*
- *How can the ecosystem be protected from the effects of these compounds?*
- *What is the current state of the water quality of the Peace, Athabasca, and Slave river basins, including the Peace-Athabasca Delta?*
- *Who are the stakeholders and what are the uses of water resources in the basins?*
- *What are the contents and nature of contaminants entering the system and what is their distribution and toxicity in the aquatic ecosystem with particular reference to water, sediments, and biota?*
- *What is the distribution and movement of fish species? Where and when are they most likely to be exposed to changes in water quality and where are the important habitats?*
- *What concentrations of dissolved oxygen are required to protect the various life stages of fish, and what factors control dissolved oxygen in the rivers?*
- *Recognizing that people drink water and eat fish from these river systems, what are the current concentrations of contaminants in water and edible fish tissue and how are these levels changing through time and by location?*
- *Are fish tainted in these waters and, if so, what is the source of the tainting?*

- *How does and how could river flow regulation impact the aquatic ecosystem?*
- *Have the riparian vegetation, riparian wildlife and domestic livestock in the river basins been affected by exposure to organochlorines or other toxic compounds?*
- *What Traditional Knowledge exists to enhance the physical science studies in all areas of enquiry?*
- *What predictive tools are required to determine the cumulative effects of man-made discharges on the water and aquatic environment?*
- *What are the cumulative effects of man-made discharges on the water and aquatic environment?*
- *What long-term monitoring programs and predictive models are required to provide an ongoing assessment of the state of the aquatic ecosystems? How can study results be communicated most effectively?*
- *What form of interjurisdictional body can be established, ensuring stakeholder participation for the ongoing protection and use of the river basins?*

The Northern River Basins Study, which was carried out in the mid 1990s, however, largely centred on the impacts of the W.A.C. Bennett Dam with a geographical focus on the Peace, and Peace-Athabasca and Slave River deltas.

Traditional Knowledge Indicators

Indicators are measures used to track changes in the state (health) of a system or resource over time. Northern Aboriginal peoples, as well as other indigenous peoples around the world, have always used indicators or signs and signals to understand and communicate about ecological change (Berkes *et al*. 2000; Berkes 1999). "They have been used for centuries to guide environmental and livelihood planning and action, long before scientific knowledge attempted to understand the processes of environmental change and development" (Mwesigye 1996). Among the Cree and Inuit of Western Hudson's Bay, indicators are the voices of the earth that are always talking to us (Tarkiasuk 1997). For many Aboriginal peoples, physical and spiritual signs and signals that the land is healthy are very important to their own feelings of health and well-being and that of their communities. As described by a Cree man from Chissasibi Quebec, "If the land is not healthy, how can we be?" (Adelson 2000:6). Most importantly, it's not just Cree spiritual and psychological health conveyed here, but the physical as well. People derive their sustenance from that land, be it trees to build homes and provide warmth, or the wild game and fish they eat, and the water they drink (from Parlee *et al.* 2005)**.**

Historically, little attention was given to Traditional Knowledge. Although this is changing, there is still a tendency to categorize Traditional Knowledge as broadly spiritual with little consideration given to the specific detailed knowledge held about ecosystems. For many scholars, Traditional Knowledge should be considered a form of 'science' with its own basis of empirical data gathering, interpretation, and knowledge-sharing. Unlike conventional scientific indicators, Traditional Knowledge indicators are socially and culturally relevant, thereby retaining a key link between knowledge generated about change and the communities affected by that change. They have been used in a wide range of research and management contexts, including agricultural land management, research on desertification, sustainable resource management in mountain forests and climate change research (Kofinas *et al.* 2002; Berkes *et al.* 2000; Mwesigye 1996). In some cases, the research has provided direct insight into the links between environmental and human health. An emerging body of literature on First Nations

health in Canada, for example, reveals how indicators of environmental decline correspond directly with many social and human health problems (Hambly 1996). While the most meaningful indicators may be those that are developed on a site-specific basis (Berkes *et al*. 2000), there are commonalities in the way indigenous peoples interpret changes in the health of their environment. For example, the percentage of body fat of birds, caribou and other animals at harvest is one ecological health indicator which appears to be common among many indigenous groups, including the Cree of northern Quebec (Berkes 1999), the Gwich'in of Alaska (Kofinas *et al.* 2002), and the Maori of southern New Zealand (Lyver 2002). Many indigenous groups in circumpolar regions use similar indicators related to ice and weather conditions to communicate about complex changes associated with global warming (Riedlinger and Berkes 2001; Krupnik and Jolly 2001).

Traditional Knowledge indicators can be both quantitative (e.g., counting or measurement) or qualitative (e.g., descriptive) and can equally offer important perspectives on change or industrial impacts on aquatic systems. Some examples of quantitative indicators include:

- catch per unit of effort (number of fish harvested);
- length – weight ratio of fish (skinny fish);
- thickness of fat around organs (ducks, fish);
- water levels.

Some examples of qualitative indicators include:

- qualities and characteristics in wildlife behaviour;
- smell of water;
- texture and colour of fish flesh;
- taste of water.

Much Traditional Knowledge not only details the condition of particular ecosystems but the relationship of people to each other and to the ecosystem. Some indicators relevant to measuring such relationships are:

- respect of land users/historical relationship of people to the land;
- 'bothering' of fish or wildlife (e.g., tagging);
- offerings of respect to the land (e.g., prayers).

The increase in community awareness and concern about industrial contamination of the rivers and foods such as those of the Athabasca River Watershed, has led to an increased interest and debate about the usefulness and validity of Traditional Knowledge in understanding both the point source and cumulative effects of industrial development such as oil sands mining. Research in northern Canada has revealed many parallels in how the science and Traditional Knowledge make sense of contamination of the ecosystem. According to a study by the Department of Fisheries and Oceans (DFO), the observation on fish health made by Aboriginal peoples are very similar to those symptoms of contamination known to toxicologists (Table 2).

Research on community knowledge or perception of contaminants also reveals indicators, which might be classified as 'risk indicators':

- proximity of harvest area to an industrial or disturbed site;
- extent of related ecological change (e.g., air/water temperature change; change in population or health of other species);
- perceived human health risk.

Table 2: Examples of Community Indicators related to Contaminants (Adapted from Cobb *et al.* 2005)

Decrease in the quantity and size of whitefish and trout eggs	Yukon First Nations
Changes in texture and consistency of fish flesh	Yukon First Nations
Altered migratory behaviour in spawning salmon (upstream travel distance reduced)	Yukon First Nations
Changes in fish flesh quality and fish numbers	Dene Nation
Fish (burbot, *lota, lota)* with spotted, shriveled, or discoloured livers	Dene, Mackenzie River area
Increases in deformities	Dene Nation
Thinner marine fish, reduced firmness of flesh	Tuktoyaktuk
Pacific herring with white spots in fish and altered taste	Tuktoyaktuk
Trichinosis in walrus associated with suspected negative environmental influences	Sanikiluaq, Hudson's Bay
Sores on the insides	Avativut Report, Nunavik/Labrador

The development of a 'State of the Athabasca River Watershed' should thus consider a wide range of indicators of ecosystem health.

4. Background and Area

The Athabasca River is known by many names among the many Aboriginal peoples who currently and historically inhabited the area. This 1230 km long river, which originates in the Columbia icefields and finds its end in Lake Athabasca, is a source of life for hundreds of species of fish, geese, ducks and aquatic wildlife. At its headwaters, the river forms within the glaciers of the Rocky Mountains. As it moves eastward, three major tributaries flow into the river (McLeod River, Pembina River, and Lesser Slave River). Further east, it is fed by the Clearwater River and smaller Steepbank, Muskeg, Firebag, MacKay and Ells rivers. At its end, it joins the Peace River and meets the Slave River, forming the Peace-Athabasca Delta, eventually emptying into Lake Athabasca.

The natural pattern of water movement into and out of Lake Athabasca depends on water levels in the lake and the Peace River. The W.A.C. Bennett Dam irrevocably changed these patterns which fed the delta. For most of the year, water flows into Lake Athabasca through the Athabasca River Delta and other tributaries, and northward out of the lake via the Rivière des Rochers and Chenal des Quatre Fourches. These two channels join the Peace River to form the Slave River, which flows northward to Great Slave Lake, the Mackenzie River, and, ultimately, the Arctic Ocean. During spring or summer flooding, however, water levels in the Peace River can exceed the water level of Lake Athabasca, causing reverse flows (southward to Lake Athabasca) in the Rivière des Rochers and Chenal des Quatres Fourches.

The watershed is situated within two treaty regions: Treaty #8 and Treaty #6. In both these territories, the 'river' has significant historical meaning in relations between Aboriginal and non-Aboriginal peoples. The Treaties name the Athabasca River and other rivers in the region as the guarantee of Aboriginal rights—those who signed the Treaties were promised the right to pursue their usual vocations of hunting, trapping, and fishing, 'so long as the rivers flow.' For many Aboriginal peoples, changes in the health and integrity of the Athabasca River consequently have a deeper set of political and cultural meanings.

The Athabasca River is largely located in Alberta, crossing only into the province of Saskatchewan through Lake Athabasca. However, the river has also been important to Aboriginal peoples currently located on the western slopes of the Rocky Mountains in present day British Columbia. Oral histories and ethnographies explain the dynamic nature of land use in

this area, preceding and during the period of European trade and settlement, with the consequent westerly movement of Aboriginal groups (e.g., Cree and Assiniboine) who were relocated away from their lands in the plains and eastern slopes of the Rocky Mountains with the construction of the Canadian Pacific Railway and the creation of Jasper and Banff national parks.

Figure 1: *Athabasca River Watershed.*

Figure 2: First Nations of British Columbia.

Figure 3: ***The Athabasca River Watershed—Treaty 8 and Treaty 6***

Figure 4: ***Lake Athabasca in northern Saskatchewan***

5. Aboriginal Peoples of the Athabasca River Watershed

The Athabasca River Watershed is thought to have been home to at least nine Aboriginal groups: the Dane-zaa, Sekani, Secwepemc (Shuswap), Salish, Ktunaxa, Nakoda/Stoney, Woodland Cree, Chipewyan (Denesoline), and Métis.

The **Dane-zaa**, also known as the Beaver tribe, are an Athapaskan population who currently reside in British Columbia as part of Doig River First Nation, Blueberry River First Nation, Halfway River First Nation and Prophet River First Nation communities. Although currently these communities reside outside the watershed, prior to 1800 they inhabited lands further east, near the Athabasca River and Clearwater River, and north to Lake Athabasca as well as the territory north of the upper Peace River.

Sekani (Tsay Keh Dene) are an Athabaskan people also called Secunnie, Siccanie, Sikani and the French Sékanais. The population is largely represented by the band government of the Tsay Keh Dene First Nation. They currently reside in the northern interior of British Columbia and their territories extend within the sub-watersheds of the Finlay and Parsnip rivers of the Rocky Mountain Trench. Historically, their traditional use areas included regions further east within the Athabasca River Watershed.

Ktunaxa also known as **Kootenai, Kutenai or Kootenay** are part of the Ktunaxa Nation in British Columbia. There are five Ktunaxa Bands in British Columbia. The Ktunaxa Nation distinguishes between the sub-groups of the 'Upper Kootenay' and the 'Lower Kootenay,' recognizing that each have developed specialized knowledge about water resources, fish and waterfowl harvesting, and the use of plants.

Secwepemc (Shuswap) people have a traditional territory ranging from the eastern Chilcotin Plateau and the Cariboo Plateau, southeast through Thompson Country to Kamloops and the Shuswap Country, spanning the Selkirk Mountains and Big Bend of the Columbia River to include the northern part of the Columbia Valley region. The Secwepemc are perhaps the most numerous of the Interior Salish peoples represented by at least eleven bands, including the Sexqeltqin, Tk'emlups te Secwepemc, Kenpesq't, Little Shuswap, Neskonlith, Skeetchestn, Splatsin, Bonaparte, Pellt'iq't, Simpcw.

Salish (Flatheads) initially lived entirely east of the Continental Divide, but established their base near the eastern slope of the Rocky Mountains. Occasionally, hunting parties went west of the Continental Divide but not west of the Bitterroot Range. The easternmost edge of their ancestral hunting areas is perceived to be the Gallatin, Crazy Mountain, and Little Belt ranges.

The **Nakoda** (also known as **Stoney**) are a First Nation group, indigenous to both Canada and, originally, the United States. Their traditional use areas historically included parts of British Columbia, Alberta, Saskatchewan, and Montana. The Stoney population is thought to have located in the region in the mid 17th century, which anthropologists attribute to the westward push of Cree and Assiniboine further south and east. There is a significant gap in research, including oral history research, however, leading to much uncertainty about both the time of entry and route taken by the first Stoney speakers to enter the foothills of the Rockies west of Edmonton in the region drained by the headwaters of the Athabasca and North Saskatchewan rivers (Anderson 1970).

Woodland Cree comprise the largest Aboriginal population in northern Alberta. They are of Algonquian origin, having originated further east of the Athabasca. Prior to the 18th century, their territory was around Hudson Bay, as far north as Churchill and east of James Bay to Lac

Mistassini. Although their western boundary was uncertain, they had ventured into Northern Saskatchewan and Manitoba by the 18th century as middlemen, trading with western tribes. The Woodland Cree were one of the first nations to trade with European fur traders, as early as the 17th century. By 1800, the Cree were well-established in Alberta, from the Peace-Athabasca Delta in the north, along the Peace River, and south as far as the Saskatchewan River. Woodland Cree use legends to convey stories throughout time. Many legends are about aspects of the environment, such as *How the Raven Stole the Sun* and *Deawitchita and the Fire Rock*. It is said that those who tell the legends have the most *ikanisha*, which means 'wisdom' in the Cree language.

The **Chipewyan** (Denésoliné or Dënesųłiné) are a Dene Aboriginal people in Canada, whose ancestors were the Taltheilei. There are approximately 11,000 Chipewyan living in the Canadian Arctic regions around Hudson Bay, including Manitoba and the Northwest Territories, as well as northern parts of Alberta and Saskatchewan. There are four communities in the Athabasca River Watershed considered home by the Denesoline: Fort McKay First Nation, Fort McMurray First Nation, Janvier and Athabasca Chipewyan First Nation (Fort Chipewyan).

Métis are represented within many communities throughout the Athabasca River Watershed. Alberta has the single largest provincial population of Métis people (67,000). The Métis people were born from the marriages of Cree, Ojibwa and Salteaux women, and the French and Scottish fur traders, beginning in the mid-1600s. Scandinavian, Irish and English stock was added to the mix as western Canada was explored. Unlike other Métis populations in Canada, the Métis were given land rights (1,280,000 acres) by the province (1936) in the form of Métis Settlements. There are three official Métis Settlements in the Athabasca River Watershed: Peavine, Gift Lake and East Prairie, which are located in the Lesser Slave Lake region.

6. Defining Aquatic Ecosystem Health for the Athabasca River Watershed

Ecosystem

Any discussion of ecosystem health must begin with some understanding of what is meant by the concept of ecosystem. Traditional Knowledge holders do not always define and describe ecosystems in the same ways as western scientists. Aboriginal language is among the greatest entry points for understanding these traditional ways of knowing; place-names can provide particularly valuable insight into both the structure and dynamics of ecosystems and ecosystem change.

> As environmental conditions change, place names (or toponyms) may change or persist, providing insight into the nature of those changes and the adaptations that accompany them. The extensive naming of places, often using descriptive terms, creates an important frame of reference for navigation, with crucial implications for safety, travel, and hunting. Many of the place names refer to features or phenomena that may be highly sensitive to environmental change (Huntington *et al.* 2005:66).

The Athasbasca River is thought to have originated from the Woodland Cree word *aeapaskāw* meaning 'where there are plants one after another.' The word for 'river,' often written as 'ko,' 'quo' or 'ka,' is prominent in Carrier Sekani place names (Brown 2002:25). Among the Chipewyan, the term river—Deze—refers to both the water and the life it supports as well as a

travel route and place of socio-cultural significance. There are many characteristics of rivers, however, which are also represented in place names. For example, in the Denesoline region of the Northwest Territories, terms like *eda* (river narrows) or *kahdele* (area of the lake/river which does not freeze in winter) are used.

Table 3: Cree terminology for River Features (Northern Quebec)

Cree Term	Definition
Sipiy	'a river'
Sokiciwan	'it flows through fast'
Ka sapostek wiyak	'it flows or runs through'
Sipiy ka pimeakak	'what makes the river flow or travel'
Patoteciwan	'water that misses or does not follow the path'
Pawistik	'a rapids'
Paskestikweyaw	'place that goes off the main river and splits'
Sipastik	'a river which branches off then returns to the main river'
Sakitawak	'end of a river where it pushes the water through'
Wapak	'narrows of a river'
Wawakamon	'a crooked or curved part of the river,' meander
Natimik	'the area upstream'
Sipisis	'small body of water flowing into a river'

In Cree, the word 'river' is *sipy,* but there are many different kinds of river characteristics that are also delineated in the Cree language, as evidenced by Cree place names research in northern Manitoba.

These terms (Table 3) clearly provide ecological knowledge but are equally useful as guides for land use and livelihood practices such as hunting and fishing. While some names are generalizable (i.e., one name for many different places), others are location-specific. Among the eastern Cree, habitats valued for beaver are defined as *aniipsiskaach,* 'damp place where the willow grows,' that is, warmer lakes characterized by muddy rather than rocky bottoms (Nakashima and Roue 2002).

Little place names research of this kind has been carried out in Alberta and the Athabasca River Watershed. Further Traditional Knowledge research is needed to document these toponyms, which can yield valuable insight about the Athabasca unique from western science. In the absence of these culturally appropriate categories, this report uses the scientific categories of water quantity and flow, water quality, waterfowl, and aquatic wildlife to communicate the observations and experiences of elders and land users within this region. We also include aspects of land use and community well-being.

Water Quantity and Flow

The levels and dynamics of water flow have been a key theme of Traditional Knowledge research in many areas of Canada. Much knowledge has been documented in relation to the impacts of hydro-electric development which have severely altered flows in many Aboriginal homelands, including Labrador's Churchill River Dam in Innu territory, the Great Whale Project in Cree and Inuit regions of northern Quebec, the Little Long Rapids hydro dam on the Mattagami. River in northern Ontario, Manitoba Hydro's Nelson River Hydro Project in the territory of the Nisichawayasihk Cree, the Talston Hydro Electric Project in the Northwest Territories, and the W.A.C. Bennett Dam which had major impacts in the Peace-Athabasca

regions of British Columbia, Alberta and downstream in the Mackenzie River Basin. Some of the key parameters of water quantity revealed in the narratives of Traditional Knowledge holders include aspects of the following:

- water levels (distance receded as measured by shoreline or depth dropped as measured by river bank);
- flood patterns;
- incidence of extreme flood events;
- ease of river travel/navigability (minimum flow);
- ice thickness and colour;
- timing of spring breakup/freeze up;
- incidents of 'unnatural' freeze/thaw events;
- small creek/tributary dry ups;
- shifts in creek beds/flows.

Documented sources of Traditional Knowledge about water quantity and flow are limited in both the upper and middle ranges of the watershed. Some perspectives on potentially available knowledge can be gleaned from other regions—specifically that related to river structure, river flow, habitat, and use. In the Gitxsan territory, Johnson (2010) explains:

> Reflecting the importance of the rivers for fish and travel, there are many terms that describe different parts of drainage systems and features of rivers. These include rock canyon—*ts'ilaasxw*, bay—*k'aldixgaks* or *wil luulamjax*, sandbar—*wisax /wisex,* waterfall—*ts'itxs*, whirlpool—*ts'a'lixs*, dangerous and unnavigable whirlpool—*antk'ulilbisxw*, back eddy—*luuguuksbax*, back channel—*ts'oohlixs*, slow side channel—*t'aamiks*, rapids—*laxk'elt aks,* 'hilly or ridged water' and confluence—*wilnawaadihl aks* 'where the waters get to know each other.' A word with particular significance for navigation is *ts'iliks*, a place where the water goes over a rock that's just inches under the surface with no large visible standing wave (Johnson 2010).

There has been limited documented Traditional Knowledge of similar taxonomies within the upper Athabasca River Watershed. Most of the knowledge documented in the middle and lower Athabasca River was precipitated by the Northern River Basins Study and community concerns over the W.A.C. Bennett Dam, and more recently by oil sands mining (See section 7 of this report). Within the lower range of the watershed, major changes have been observed in water flows in the Athabasca River, and smaller tributaries as well as changes in flood dynamics. While much of this is attributed to oil sands mining and previous impacts of the W.A.C Bennett Dam, elders also identify climate change as an influence. The drying up of wetlands as well as creek beds, while at the same time experiences of major flood events, are of concern in some areas. One of the major reference points related to some change in 'water quantity' is the ability of people to use the river. Land users are finding it increasingly difficult to navigate the Athabasca River, as its levels continue to fall. Although in the past the Athabasca River had lots of water, today there are land users who can no longer pass through or access some traditionally used areas due to low water levels.

> The Athabasca River is no longer the 'big river.' The Athabasca River is now full of sandbars. When the waters of the Athabasca River are high, Jackfish Lake should be full. Currently, however, mudflats make up the majority of the mouth of this lake.

> "Well the water was high in them days, you could go anywhere like, a lot of cutouts, you would go in there, side creek and stuff like that, you could go in there, now you can't do it. Mostly sandbars. And travelers would come by boat ... and we used to come every spring, hunting, spring hunt, hunting beaver and stuff like that. But now you can't use these cuts out, you have to stay in the main channel, the main river... Yeah, you could drink water anywhere them days when I was younger, drinking off the river, and now you can't do that, you have to carry special water when you go anywhere, any place you go, any place like even the Park area like when you go out in the woods you have to carry your own water. You can't drink water from anywhere." (M03 in Candler et al. 2010: 17).

Water Quality Indicators

Many Aboriginal communities have observed a marked decline in water quality in the Athabasca River over the last 50 years. Some of the key parameters include:

- colour
- silty, muddy water
- smell
- algal growth
- tea scum
- proximity to development projects/sites (perceived contamination)

There is limited Traditional Knowledge related to water quality documented in the upper and middle ranges of the watershed. In the past decade, however, much Traditional Knowledge research has been precipitated by oil sands development. Among the most active in documenting such knowledge has been Fort McKay, Athabasca Chipewyan, and Mikisew Cree First Nations as part of traditional land use studies, environmental assessments, and related studies.

Fisheries Indicators

Traditional Knowledge research related to fisheries resources is among the most well-developed in Canada and elsewhere. Some of the most well-known studies have involved the Chisasibi Cree of northern Quebec. More recently a body of Traditional Knowledge research related to the east and west coast fisheries has been documented as part of a related effort toward community-based resource management. Some of the most common references to fisheries health relate to abundance and diversity of species; some indicators have been historically useful in guiding fishers' decisions about where and when to harvest. As documented by Berkes, the Chisasibi Cree would move the location of their fish camps when they were no longer catching the same number of fish in their nets, thus allowing the community to continue to meet its basic needs for fish resources and the fish stock to replenish. Common indicators used for communicating about body condition are 'skinny fish' (length-weight ratio) as well as the quality of flesh (e.g., prevalence of lesions, colour, texture).

Table 4: Traditional Knowledge Indicators used to Describe Fish Health

Size/Shape	Length/weight ratio (some natural variation)
Population/Community	Catch per unit effort
Fat	Fat around organs
Organs	Parasites

Flesh	Depth of colour (e.g., darker red meat of trout is preferred)
Water levels	Levels in streams, rivers, lakes
Water quality	Taste (tea), smell, contaminants / chlorine
Respect	'Paying' the land (i.e., offering respect)

The diversity of fish species within the each lake and across the traditional territory is another important indicator of ecosystem health. In the upper and middle ranges of the watershed, for example, such diversity is described here:

> The many streams and lakes in the Carrier Sekani territory are rich in fish. These include resident freshwater species (trout, char, suckers, sturgeon, whitefish) and anadromous Pacific salmon that spawn in the headwaters of the Fraser and Skeena watersheds. Salmon runs in the Fraser, Nechako, and Babine watersheds have traditionally provided an important food source for the Carrier communities on these waterways (Brown 2002:24).

Given that western science and Traditional Knowledge experiences and outlooks on 'fisheries' resources can differ, it is important to refer to specific Aboriginal terminology for fish 'parts' or taxonomy as a basis for understanding the basic elements of discussion and to ensure accuracy (Table 5).

Table 5: Chipewyan Terminology of Fish 'Parts'

(From Lutsel K'e Dene First Nation (Parlee and Marlowe: 2001), West Kitikmeot Slave Study Society)

Chipewyan	English	Chipewyan	English
Łue tthën	Flesh	Łue tłą tthen	Fish tail meat
Łue tthı	Head	Łue che ghay	Tail fins
Łue beyeda	Mouth	Łue gothe	Scales
Łue k'ase	Gills	Łue tła	Tail
Łue dzı	Heart	Łue chı	Skin
Łue ddher	Liver	Łue nëne	Backbone
Łue k'uné	Eggs	Łue ghaıye	Fins
Łue dzıne	Stomach	Łue chą	Guts
Łue tłës	Fat		

Ducks, Geese and Aquatic Wildlife

The Athabasca River Watershed, including the shared Peace-Athabasca and Slave Delta, provides some of the most valuable habitat for aquatic waterfowl in North America. The Pochahantas Marsh provides habitat for more than 60 kinds of waterfowl. The Peace-Athabasca Delta is the largest boreal delta in the world, and the varied habitats found there—including shallow lakes, mud flats, fens, meadows, and forest—provide habitat for more than 200 species of birds, 44 species of mammals, 18 fish species, and thousands of different insects (Wetlands International 2008). The delta is also one of the most important waterfowl nesting and staging areas in North America. Four major migratory flyways intersect the delta. Breeding ducks and geese on their way to the Mackenzie River lowlands, Arctic river deltas, and Arctic islands use the delta as a staging area, with up to 400,000 birds using the delta in the spring and over one

million birds present during the fall. The delta is the nesting area for the only known breeding population in central Canada of the vulnerable Peregrin Falcon (Wetlands International 2008). Because of its ecological and habitat value, the Peace-Athabasca Delta has been designated a wetland of international importance under the *Ramsar Convention*. Due to the significance of this habitat, the Aboriginal peoples of the delta have a strong and even spiritual relationship to the aquatic birds as described here by an Athabasca Chipewyan First Nation elder:

> The old people could recognize these calls. They could listen to the loons talk and tell what was happening around the water… . The Traditional Knowledge of the Elders comes in many forms. The ability to hear different meanings of the calls of the loon is an example of the complexity of Traditional Knowledge and the relationship between Traditional Knowledge and what western thought has classified as 'the environment' (ACFN 2003:122).

Other highly valued species, which are well represented in Traditional Knowledge studies are the beaver and muskrat. Muskrat were an important resource in the fur trade and a valued indicator of aquatic ecosystem health in the delta regions. Historically, the muskrat was the heart of the trapping economy—people used to harvest hundreds of muskrats for clothing as well as for the fur trade. Hydro-electric development is acknowledged to have had a significant impact on muskrat populations as a result of decreased water levels, and changed patterns of flooding. Elders in the community of Fort Chipewyan also perceive oil sands activity as affecting populations. One key indicator of concern is mortality of the 'die-off' of muskrats at various times of the year.

> Muskrat die-offs might have something to do with the water… . Years ago his dad had a trapline. There was a nice slough off the Athabasca across … . the river flooded into the slough and we thought there'd be lots of rats after the flood; no rats came; still today, no rats on that slough (Courtereille, in Timoney 2008).

> There were big die-offs of muskrats over the years. In the past (more than 10-15 years ago), when they would die-off, [but] next year they'd be back. Now, when they come back, in the first winter they are dying again… they just can't increase, they keep dying (Ladouceur, in Timoney 2008).

The population and health of beaver populations are a key indicator of the health of the Athabasca River Watershed, particularly the delta as was documented during the Northern River Basins Study and more recently by First Nations in the Peace-Athabasca Delta.

> Historically, one of the most important biological modifiers of river ecosystems throughout the Rocky Mountain region was the North American beaver. The beaver's current ecological importance to river systems derives not form their presence but from the consequences of their extirpation by early Euro-American fur trappers… (Baron 2002:114).

Livelihood and Traditional Foods

'Ecosystem health,' based on a Traditional Knowledge perspective, is fundamentally connected to the capacity of Aboriginal peoples to sustain a 'traditional' way of life. When people are

unable able to continue that way of life in a holistic sense (often characterized by hunting, trapping, fishing, medicinal plant harvesting, berry harvesting), it is often assumed that the ecosystem has surpassed the threshold of ecosystem health—i.e., it is no longer a healthy place to live. That being the case, some discussion on the 'traditional way of life' is warranted here. A full discussion of the complex and dynamic patterns of land and resource use of the nine Aboriginal groups within the watershed cannot be offered here, in part due to the limited scope of this report, but also due to the relatively limited oral history research that has taken place within this region. What follows is a very brief overview of traditional livelihoods. For a fuller and more detailed account of western plains ethnography, readers should consult the *Handbook on North American Indians—Plains* (Volume 13) edited by DeMallie *et al*. (2001).

In the Upper Athabasca region, a rich set of livelihood strategies were developed over thousands of years. Archaeologists and oral histories tell of continuous occupation of the upper Athabasca (specifically Jasper National Park area) over the last 11,000 years. Limited ethnographic, archaeological, and oral history work has been done to understand who, where, and how Aboriginal peoples lived. The most comprehensive accounts begin at the advent of the fur trade, subsequent exploration and settlement of the region followed railway construction. Changes in livelihood during this period were tremendous and tragic, owing to the widespread devastation caused by smallpox, tuberculosis, and influenza. It is thought that many tens of thousands of Aboriginal people died during the mid 18th to mid 20th century; those that survived were forced onto reservations through the signing of Treaties 6 and 8, on lands considered unsuitable for agriculture and too small in size to sustain resources for hunting, trapping, and fishing.

Key areas within the Columbia ice fields served as passes or travel routes for those accessing resources from both the eastern and western slopes of the Rocky Mountains. The Athabasca Pass is among the areas attributed to use by Aboriginal peoples within western Alberta and British Columbia. On the eastern slopes of the Rockies, the focus was on spring fishing as well as spring/fall elk and deer hunting. People seemed to move seasonally between the eastern and western slopes of the Rocky Mountains using the Athabasca Valley–Yellowhead Pass route as the main corridor of movement.

> Fishing figured most prominently in the Shuswap subsistence. Shuswaps were known to have used nets made from Indian hemp, nettles, cedar bark or willow bark; weirs and traps; advanced fishing spears (harpoons, leisters) and torchlight at night from a canoe); and fish hooks. They also used special clubs for dispatching fish and roe for later use, and used advanced culinary techniques in preparing fish for meals (Mayhood 1992:46)

The Kootenays, Sekani, Stoney, and Beaver have similar fishing strategies involving nets, hooks, weirs, traps and spears (Mayhood 1992:47). Livelihood practices were dynamic in this region, in part due to the uneven and dynamic nature of food resources.

> Given that the distribution of traditional resources was uneven, an extensive network of trails and waterways was used for trading surplus goods between neighbouring hunter-gatherer groups. Because the northern and central Carrier had access to relatively large, stable salmon runs, their lifestyle was somewhat more sedentary and their villages larger and more permanent, as compared to the southern Carrier and

Sekani. Economic cooperation among neighbouring nations was secured through trade, intermarriage, and sometimes through borrowing of cultural practices (e.g., clan systems, feasting, traditions). The combination of a rich natural resource base, well-adapted technology, trade, and social cooperation normally provided the people of the Carrier and Sekani territories all the basic necessities of life: food, clothing, shelter, medicine, social support, and spiritual sustenance (Brown 2002:24).

In the 1870s, the pack route between the Hudson's Bay Company (HBC) posts at Fort Edmonton and Fort Assiniboine became impassable because of mud and swollen rivers. In hopes of finding an alternate route to send its goods north, in the spring of 1874 the Hudson's Bay Company sent a scout to survey the terrain from Fort Edmonton to the south loop of the Athabasca River and the idea of Athabasca Landing was born… . In the 1870s Metis labourers assembled scows to ship supplies to Lesser Slave Lake and posts further north and east… . An immediate stimulus to the Landing Trail and Athabasca Landing came about in the early 1880s—the HBC decided to ship trade-goods and furs out of the north-west via steamboats. Henceforth, the Athabasca River became not only the HBC's main route to Lesser Slave Lake and the Peace River country but also to Lake Athabasca, Great Slave Lake, and the Mackenzie Valley.

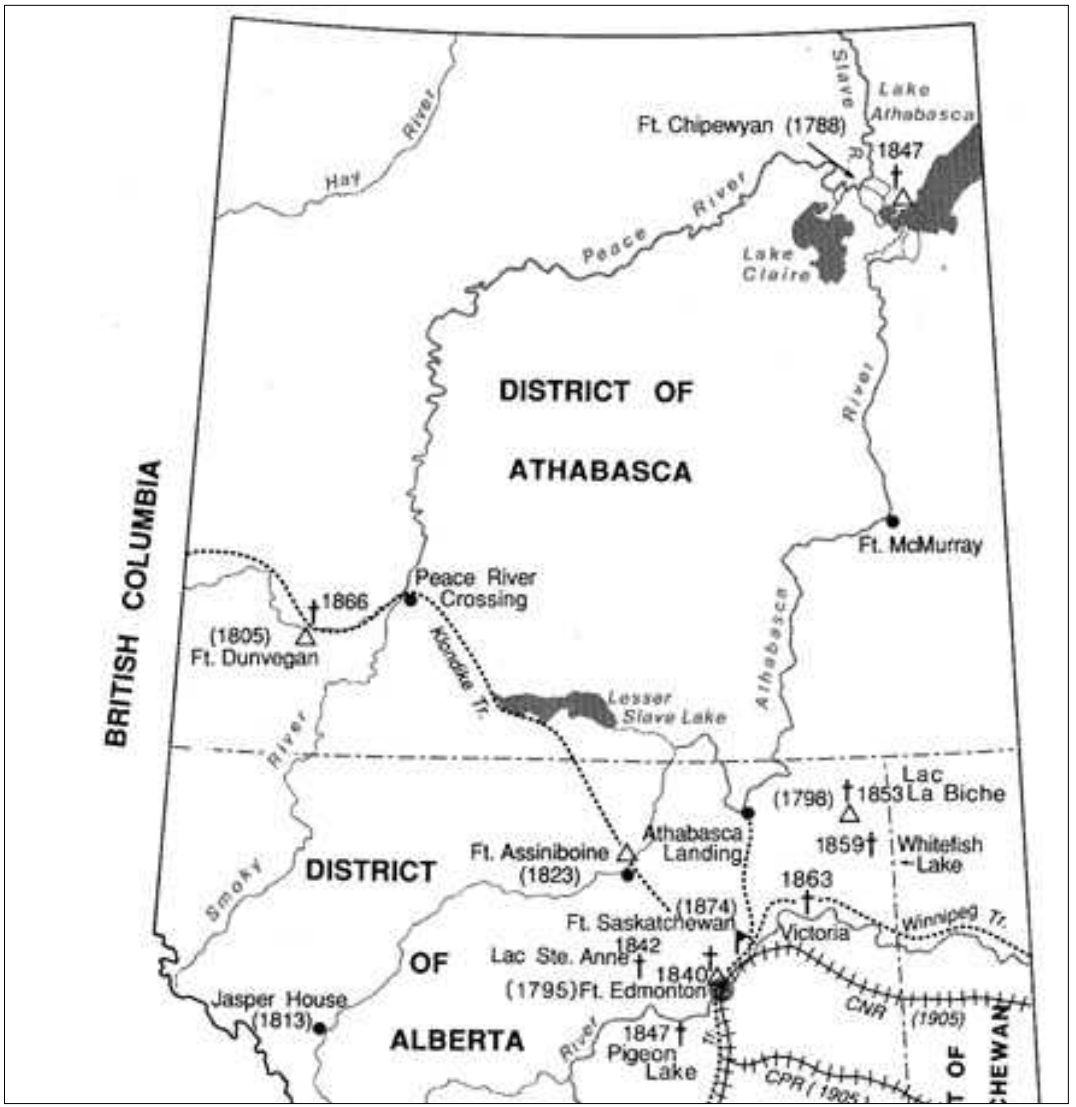

Figure 5: *Historical Settlements of Alberta*

Change in Travel within the Athabasca River Watershed.

The traditional, or 'bush' economy of the Aboriginal peoples of the lower Athabasca region was based on a continuous cycle of five seasons: dry-meat hunt, early winter hunting and trapping, late winter hunting and trapping, spring beaver hunt, and the 'summer slack' (FMTA 1983:78-86). Although most people here no longer make their living solely from the land, traditional use still occurs and remains integral "to their history, culture, and present existence" (FMES 1997:6).

The Athabasca River played an important role in the fur trade period of western Canada through in the 19th and early 20th centuries. Fort Chipewyan, Fort Assiniboine, and Jasper House were important places of Aboriginal–Settler interaction. The records kept here by the Northwest Company and others can provide valuable knowledge about ecological conditions in the Athabasca River during this historic period. Little effort has been made to date, however, to assess these records for insights about ecosystem health. Oil and gas exploration in the region began in the late 1950s. In 1987, a pulp mill was opened near Fort McMurray and logging began along both sides of the Athabasca River. These developments brought an increase in population, increased presence of the market economy and related goods, increased access to traditional lands, and increased pollution (FMES 1997). Many FMFN members are employed in the oil and gas sector. Fort McKay peoples continue to have a strong connection with the land, which provides not only natural renewable resources, but also opportunities for social activities, ensuring cultural continuity and a place for individual spiritual renewal (FMkFN-IRC 2008a; 2005b; FMkFN 1994)

> This was our land. This was our livelihood, and they destroyed everything we had. They destroyed our water. They destroyed the air. They destroyed the bush. Like they cut all the trees down and chased all the animals away. You know? (FMkFN-IRC 2008: 32)

Closely related to livelihood as an indicator of ecosystem health is the health and availability of traditional foods. The Athabasca River Watershed offers numerous species of fish that are valued as traditional food by Aboriginal peoples in the region. The quantity and diversity of species harvested from each of the lower, middle, and upper regions of the watershed varies as a result of the abundance of those species, but also due to other factors such as harvester access (physical/institutional) to harvesting areas, and the availability of Traditional Knowledge and skills for harvesting.

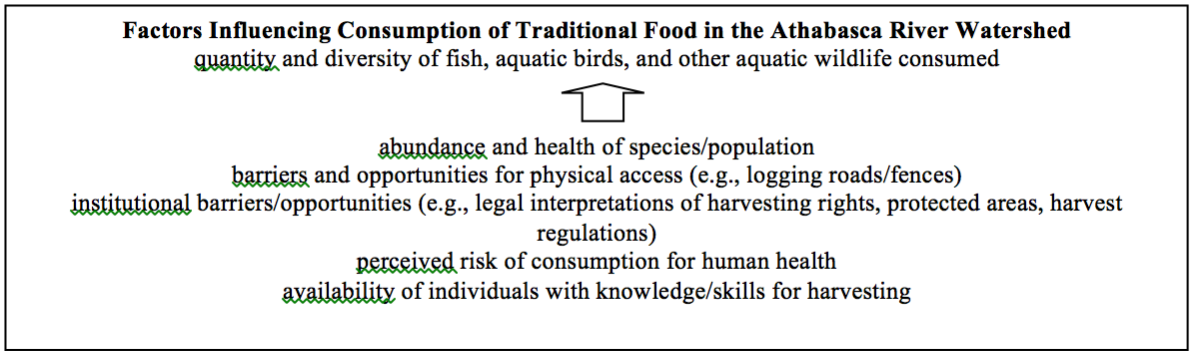

Figure 6: *Factors influencing consumption of traditional food in the Athabasca River Watershed.*

The perceived health of the species and perceived risks of consumption on human health also matter significantly. Factors influencing consumption of traditional food in the Athabasca River Watershed include:

Historic and contemporary harvest and consumption of fish, duck, geese, and related aquatic species is not well documented in the Athabasca River Watershed. Harvest studies, such as those carried out through the implementation of land claims in northern Canada to identify minimum-needs levels, have not been a feature of traditional land use and occupancy studies in Alberta or British Columbia.

In the upper Athabasca, Dolly Varden, Rainbow Trout and Rocky Mountain Whitefish contributed to the diet of the Shuswap, Sekani, Kootenay, Salish, and Stoney who historically frequented these mountain regions prior to European contact and during the early 19th century period of trade. Although not naturally abundant in the swift current and silty headwathers, these fish species would have been key sources of food for harvesters and families who would venture into the mountains for bigger game. Although oral histories have been little documented, the early 19th century records from Henry House and Jasper House on the Athabasca River provide some indication of the significance of this harvest to local diet. As noted by Mayhood (1992), annual harvests of whitefish and trout was recorded to be in the 'thousands' for even a small group of 50 people.

> De Semt's (1847) party of 54 people and 20 dogs comprised only a part of the occupancy of Jasper House during his 26-day stay in the vicinity in 1846. According to his account, his party consumed 780-1300 whitefish alone during that time and perhaps as many as 600 trout… .. If these figures are typical of the numbers of fish consumed at Jasper House and environs, annual catches must have numbered in the thousands. A fishery of this size probably would have had little impact on populations in large systems, such as the Athabasca River that are open to migrant [fish populations]. Prosecuted intensively over several successive years in small lakes and streams, however, it might have been of sufficient magnitude to severely reduce, even completely eliminate some fish stocks (Mayhood 1992:69)

In the mid-Athabasca River Watershed, dependence on fish species increases proportionately to abundance and distribution. Historically, Stoney, Nakoda, Dane-zaa and Cree communities depended on many kinds of fish, waterfowl, and aquatic wildlife. Community consumption of mammals, in declining order of preference, include: moose, snowshoe hare, beaver, whitetail deer (much preferred over mule deer), mule deer, muskrat, and wood bison (not a regular staple). Birds eaten, in order of preference, include: ducks, geese, swans, grouse (sharptailed, ruffed, and spruce) and ptarmigan (not really popular) (FMES 1997). Historically, communities fished year-round in various lakes and rivers in their traditional lands. Species valued as traditional food included: whitefish, pike, walleye, burbot, grayling, trout, goldeye, and sucker. Those harvesting and consuming traditional foods are known from research in other regions to be highly sensitive to changes in the health of these species.

7. Indicators related to Impacts of Resource Development

Due in part to legislated requirements of national and provincial laws for environmental protection and associated resources, and institutional capacity for research and monitoring, point-

source ecosystem disturbances or 'environmental impacts' are among the best studied and best documented of the indicators of ecosystem health. This is true in terms of western science as well as Traditional Knowledge. For many Aboriginal peoples, the specific projects are part of a larger cumulative story and history of settlement and development that has transformed both the biophysical and cultural landscape of the region.

> Nature has been transformed in Canada, first by the westward expansion of agricultural settlement, later by the relentless incursions of the modern industrial machine into the northern hinterlands (Quinn 1991:138).

One of the key distinctions between Traditional Knowledge and western science is this recognition of the human dimension of ecosystem change and the complex and reverberating effects of railways and highways, mining, hydro-electric projects, pipelines, and other projects on the cultures, societies, economies and health of Aboriginal communities.

These kinds of impacts are compounded by the lack of responsibility and accountability to address the issues; it has been suggested, in a variety of studies, that Aboriginal people bear a disproportionate burden of the environmental costs of development, while at the same time seeing few sustainable benefits. This combined set of environmental and socio-economic stress has arguably nurtured a culture of hopelessness and despair among many populations, including their youth.

> The Indians of Cheslatta were never given an opportunity to discuss the merits of the Murray Lake Dam. They were told about the dam after it had been built and after the flooding had already begun. The people of Cheslatta received meager sums of money in compensation for their losses, all of which was required to buy land to resettle. Most of the people were forced to live in tents between April and November, 1952, before the Department of Indian Affairs finally found property for them. They were forced to build a new life in a farming community with which they had little in common. Many were forced to abandon their traditional occupations of hunting, trapping, and fishing. A once proud people had for a time lost all dignity and succumbed to despair and alcohol. Whereas no Indians living at Cheslatta had been reliant on social assistance, now Band members have very few other sources of income (Carrier Sekani Tribal Council 1984 in Quinn 1991:146).

The kinds of indicators that are often tied to resource development are similar to those identified in earlier discussions. Research in the area of health risk perception with northern Aboriginal people has also revealed other kinds of indicators that might be best described as 'risk indicators.' Some of these may include:

- Proximity of harvest area to an industrial or disturbed site;
- Degree of ecological change attributed to development (e.g., air/water temperature change; change in population or health of other species);
- Perceived human health risk;

An additional set of 'community well-being indicators' also influence decision-making:

- Respect shown for Treaty rights ('as long as the rivers flow');
- Respect for Aboriginal rights to harvest resources from the Athabasca;

- Degree of shared use (e.g., percentage of land taken up for agriculture, tourism, resource development *versus* that available for traditional harvesting);
- Community trust in decision-making/institutions for management;
- Social, economic, and cultural effects of environmental change.

Resource Development in the Upper Athabasca

There has been limited resource development in the upper Athabasca River Watershed, owing in part to a lack of 'development' options for this rugged landscape of the eastern Rocky Mountain slopes. The development of protected areas in these regions in the early 20th century also aims to preserve this natural heritage—specifically Jasper National Park.

Despite the age of the park, relatively little Traditional Knowledge research has been documented in this region. Among the few references in historic journals to Samson Beaver and *Chabe Imne* is Maligne Lake, which has become a major tourist destination (owing to early writings here by Mary Schaffer in 1917) but has important cultural and spiritual significance to many Aboriginal peoples.

The creation of the Park went hand-in-hand with expanded settlement of western Canada by non-Aboriginal peoples; the Park was not, however, established and managed for the average settler. The Canadian Pacific Railway provided upper and middle class populations with access to 'sanitized views' of the mountains and related curiosities; it was only later that protection of 'wildnerness' became important. Throughout the settlement process, which arguably continues today, Aboriginal peoples have been systematically excluded from living, hunting, trapping as well as fishing in the Park. This history of marginalization is similar to many other protected areas established in the first half of the 20th century. The tragic irony associated with Banff and Jasper National Parks and others of that era was that they were purposed to preserving game for sports and recreational pursuits but not subsistence. At the same time Aboriginal peoples were being removed from the Park due to their impact on nature, settlement and tourist-service communities were being established in the Parks to serve the interests of outsiders or visitors who would come from elsewhere. The signing of Treaties did little to alleviate this exclusion.

Figure 7: *Samson Beaver (Glenbow Museum, Calgary)*

> Treaty Number 7 [and Treaty 8] stated that the Indians retained the "right to pursue their vocations of hunting throughout the tract surrendered as heretofore described," but "*subject to such regulations as may, from time to time, be made by the Government of the country acting under the authority of Her Majesty; and saving and excepting such tracts as may be required or taken up from time to time for settlement, mining, trading or other purposes by her Government of Canada, or by any of her Majesty's subjects duly authorized therefore by the said Government."* This institutionalized the constant tension that has existed between aboriginal hunting rights and the goals of game conservation in Canada (Binnema and Niemi 2006:726).

Some of the conflicts between subsistence and sports hunting were described by Binnema and Niemi (2006) as follows:

> Aboriginal hunting methods were an affront to sportsmen. Sportsmen developed and adhered to a system of rules intended to guard hunting's respectability. This meant that animals had to be killed 'fairly.' Fish were to be hooked, not speared, netted, or lured to torchlight; wildfowl were to be shot on the wing; and game was to be stalked, so that it had a reasonable chance of evading and escaping the hunter…. Because aboriginal hunters offended the values of sport hunters in so many ways, and since sport hunters were so politically and economically influential and active, it is not surprising that sport hunters and government officials were among the most important opponents of aboriginal hunting rights, not just in parks, but more generally (Binnema and Niemi 2006:731).

In the late 19th century, with increased settlement in western Canada and the loss of the buffalo in the plains, reliance on the resources of the eastern Rocky Mountains increased by many Aboriginal peoples, including the Stoney.

> In 1914, the district inspector of forest reserves in Alberta noted that many Stoney traveled along the east slope of the Rocky Mountains, especially between Morley and the Saskatchewan River where they depended "almost exclusively upon the wild game of the east slope for sustenance… . By contrast, when the Blackfeet groups and Sarcee chose their reserves, they chose places farther from the Rockies, and by 1903, they rarely hunted there (Biennema and Niemi 2006:727)

Increased forest fire activity in the upper and middle Athabasca River Watershed attributed to the construction of and travel on the Canadian Pacific Railway is thought to have increased the reliance of Aboriginal peoples on fisheries, as game was driven further west and north or/and extirpated from certain regions. According to Binnema and Niemi (2006), the Stoney subsequent to this period maintained a strong presence in the eastern slopes of the Rocky Mountains, however, increased regulation and limitations on hunting in both Banff and Jasper National Parks was problematic.

> *they tell us that we must not hunt the goat and sheep in the mountains; … that we must not kill more than one moose, one caribou, one deer and that we must pay*

$2.50 before we can hunt. Now, when we made a treaty with your chiefs, we understood that there would always be wild animals in the forest and the mountains. But the white men come every year, more and more, and our hunting grounds are covered with the houses and fences of white men. We are poor people. We do not know how to get money as white men do … Look kindly upon us, oh white chiefs. Let us still hunt the game in the fall as our fathers did. We work hard and make all the money we can, and we buy what the white men eat, but sweeter to us than all, is the flesh of the wild animals … Give us freedom to go into the mountains and the forests to look for meat of the wild animals, and the birds, when our children ask for it (Stoney Chief in Binnema and Niemi 2006:737).

By 1888, many Stoney had moved even further west into British Columbia, owing to the depletion of traditional food resources in the region.

With respect to reporting on the current state of the Athabasca River Watershed, consideration must be given to the historic displacement of Aboriginal peoples from the area now defined as the upper Athabasca and the extent to which First Nations and Métis peoples are marginalized in the context of the use, development and protection of the watershed.

- How are Aboriginal Treaty Rights being respected in the Upper Athabasca River?
- To what extent are Aboriginal rights to harvest respected in the Upper Athabasca River?
- How are lands and resources being shared equitably in the region? (i.e., what proportion of lands are private, public and/or available to Aboriginal peoples for traditional livelihood pursuits such as hunting, trapping and fishing). How do some land use practices preclude others?

Development in the Middle Athabasca River

The Lesser Slave Lake Cree currently occupy the southern edge of the present day Peace River Watershed known as *unchaga* or 'peace' in Cree. *Unchaga* is thought to refer to a treaty developed between the Cree and Beaver over lands and resources with the Peace River, which formed the boundary of neutrality. Like other Woodland Cree, their livelihood was and continues to be closely connected to the seasonal availability and health of species such as woodland caribou, moose, elk, wood bison, white-tailed deer, fish, and small mammals such as beaver, hare, muskrat. The main fur-bearing animals were beaver, mink, marten, otter, lynx, fox and muskrat (Helm 1981:257). Lesser Slave Lake was a strategic settlement area for the Beaver Cree, not only because of the abundance of local resources but because of its position relative to both the Athabasca and the Peace rivers and consequent links to the Slave and Mackenzie rivers. It became a particularly important location during the fur trade; posts were established at the west end of the lake by both the Northwest Company (1801) and the Hudson's Bay Company (1815). The two posts were later amalgamated in 1821. Those settling at Lesser Slave Lake were strategically connected to water routes that linked the Athabasca and Peace rivers with the Mackenzie River.

Treaty Commissioner McRae visited the Lesser Slave Lake area in the summer of 1900 and laid out temporary Indian Reserve Boundaries for the Driftpile Band and other surrounding communities. In 1901, two years after the signing of Treaty 8, three reserves were created around Kapawe'no—Freeman to the north of town, and Halcrow and Pakeshan to the west. In 1970, these three reserves amalgamated to form Kapawe'no First Nation Reserve, which today is still

governed by tribal custom (Kapawe'no FN 2007); as of December 2007, Kapawe'no First Nation had a registered on- and off-reserve population of 299.

The area was a key transportation hub initially by waterway and later by road and rail. The development of the highway north during the post World War II era was significant in linking the area to centres further south and resources to the north. The rise of agricultural commodity prices in the 1950s and the comparative availability of 'cheap land' led to further expansion of what was considered by the province as one of the last agricultural 'frontiers.' Wheat was the principal cash crop of the region; however, other crops such as legumes, alfalfa and pasture land for cattle were also on the rise during this period (Vanderhill 1963:38). The *Veterans Act* facilitated the arrival and homesteading of hundreds of demobilized service men. Many of the tracts of land were not well-suited to agriculture, however, which meant little success for new farmers. Commercial fishing during the 1920s to 1940s was an important source of income for many new settlers in the region. Fish from the lake were taken to a processing plant on the south shore and subsequently shipped to markets in the United States. The commercial fishery collapsed by the 1940s however, in part due to the rise of mink farming. The small nets used by farmers to catch small feed fish negatively impacted on many other lake species. The scope of this activity is noted in this farmer's story;

> "…our ranch reached a peak of 4000 requiring about 2000 pounds of fish per day for the first 5 months of the year… fish production become unreliable by the mid-1960s." (Rippin 2005:2).

The discovery of oil at Swan Hills in 1957, the third largest deposit in Canada, began a wave of exploration similar to that following the 1947 Leduc discovery, which started the postwar oil boom in Western Canada. A key peak in gas exploration was between 1970 and 1976. The total number of leases in eastern Alberta climbed significantly during this period (Schneider *et al.* 2003). By the 1980s, however, the Government of Alberta developed and implemented policies aimed at reinvigorating a downturned rural economy. Alberta's forests became the subject of extensive and 'unprecedented state-sponsored expansion by the pulp and paper industry' (Tupper *et al.* 1992:40); most of the expansion was linked with the construction of mega pulp mills, including Daishowa Canada at Peace River and the Alberta Pacific (ALPAC) Forest Industries Inc. mill at Athabasca. The resurgence of the oil and gas exploration in the 1990s led to further loss and degradation of wildlife habitat in the region.

The Swan Hills Waste Treatment Centre was developed just west of Swan Hills in 1987 to provide hazardous and special waste treatment services for Alberta. A mechanical failure of a transformer furnace on October 16, 1996 resulted in the release of an unknown quantity of polychlorinated biphenyls (PCBs), dioxins, and furans into the surrounding environment. Following the incident, Alberta Health issued a health advisory recommending limiting human consumption of wild fish (6 oz./week), and wild game (13 oz./month) harvested within a 30 kilometer radius of the site. In 2009, another leakage, initially not reported or investigated by the Government of Alberta, further compounded local concerns about contaminants in the regional ecosystem (Baxter and Lee 2004).

Oil and gas exploration continues to be significant in the Swan Hills, Mitsue Lake, and Marten Hills areas and within Lesser Slave Lake Provincial Park. Currently, there are hundreds of oil/natural gas wells (active and inactive) in the drainage basin, particularly in the southeastern region. The majority of land zoned for agriculture lie within the Driftpile and Swan River deltas

and in the Joussard—High Prairie—Grouard triangle to the west of Lesser Slave Lake. There is approximately 189,445 ha of farm land (436 farms) in this area. The forest management zones in the Lesser Slave Lake region are primarily managed by the Slave Lake Pulp Corporation (629,284 ha) which it harvests for spruce (*Picea* spp.), aspen (*Populus* spp.) and pine (*Pinus* spp.). The Forest Management Plan for the area estimated an annual allowable cut for all deciduous trees at 588,832 m3/yr and for all coniferous trees 369,043 m3/yr (ASRD 2003). The Annual Allowable Cut (AAC) for the Lesser Slave Lake area is approximately 4 million m^3. Together, these activities have had a profound effect on local and regional ecosystems. The specific details and nature of those cumulative effects are, however, little understood. It is in this context that research with Lesser Slave Lake Cree communities was carried out.

Table 6 – Observations of Ecological Change in the Lesser Slave Lake Region (Adapted from Geertsema 2008).

Observation	Narrative	Reference:
Increased incidence of flash flooding	"Before the development, you would know if there was a flood [coming], you knew in advance because it was a slow process. Now today if you have a flood, it could happen within an hour…"	Cree Harvester in Geertsema (2008)
Siltation in creeks, streams and lakes		Cree Harvester in Geertsema (2008)
Creeks, streams, wetlands are drying up	"The creeks, streams and wetlands are drying up. This problem is because it's got a lot to do with the climate as well but definitely the open land area [clearcuts].."	Cree Harvester in Geertsema (2008)
Change and interruptions in stream flow	"It's only when you are really hunting in the bush you can see [the impact] because you can see all these roads they've built out there, and you see some of the natural watercourses that are now diverted by these roads so some areas where there was a lot of water…".	Cree Harvester in Geertsema (2008)
Lack of availability of clean drinking water	"….. when I was younger you can go out in the bush and, you know, you can eat off, you can drink off of the stream…. or you can go to a muskeg, dig a hole and get fresh water. You wait a little bit till it clears, then you can drink from there. Now ….. the water just tastes bitter.."	Cree Harvester in Geertsema (2008)
Contamination of water quality and fish from Swan Hills Treatment Facility	"we still have a thirty kilometer radius that there is a warning not to consume too much wild meat, let alone even try and eat the fish… "	Cree Harvester in Geertsema (2008)
Declines in abundance and diversity of fish populations (historic overfishing from mink farming industry and tourism);		Cree Harvester in Geertsema (2008)
Disturbance of fish habitat and movement	"Today I don't know if [the fish] even go ten, fifteen kilometres south of the lake because of the obstructions that they have to face, they don't survive as well when they go to their spawning areas and that's due to the type of [development occurring]…"	

The Cree and Metis populations who have most recently inhabited this region have made many kinds of observations about the kinds of ecological changes that have occurred in the region; many of these changes are attributed to resource development. A thesis by Geertsema (2008) describes many kinds of changes in the health of species in Lake Athabasca. Observations of change in aquatic resources are found in Table 6.

These kinds of ecological effects have in turn impacted on the well-being of Cree harvesters and their communities. Key concerns are related to a lack of ability to harvest and acquire traditional foods such as fish. There are effects on how people 'feel' about the land and themselves that are less measurable but nonetheless critical in the context of human-environment relationships. For example, in relation to the Swan Hills Waste Treatment facility, the perception that the environment is no longer healthy has led to worries about human health as well.

> It's hard on your mind, and it's hard on your body, because every moose you shoot you hope that it is good, and you hope you don't get sick…. It has affected us mentally, and health-wise there seems to be more cases of cancer, and more cases of diabetes. Something is definitely happening out there, and this was not happening to us before (Interview #22, November 8, 2007).

In addition to these socio-cultural and economic concerns, several interviewees noted the deeper feelings of loss or grief experienced by community members, including young people.

> We have a lot of our young people who do not even go into the Swan Hills area because of the waste treatment plant [Alberta Waste Treatment Centre]; they just absolutely refuse to. So, not only health-wise, but I guess it has also affected their spirit. .. there's no more socializing out on the land, and being in touch with nature; just having a good time out there, you know? (Interview #6, September 22, 2006).

Development in the Lower Athabasca River

The Cree, Dene and Metis peoples who currently live in the Lower Athabasca River region have experienced significant change in the watershed and its resources, particularly over the last fifty years. The W.A.C. Bennett Dam and oil sands mining in the Fort McMurray region have precipitated many studies, including Traditional Knowledge research. The cumulative effects of such smaller types of development activities on the landscape as agriculture, tourism and forestry have also precipitated significant concern on the part of First Nations and Metis. The following sections discuss changes in fish, water quality, quantity, use, and health in the regions affected by these projects.

Traditional Knowledge documented about the effects of the W.A.C Bennett Dam, although focused in part on the Peace and Williston are of concern to those living downstream, including the First Nations and Metis in the Lower Athabasca. The concerns (noted below) of First Nations in eastern British Columbia, including the Sekani are also important and relevant, given that this cultural group historically depended on the resources of the Athabasca River. Some of the key indicators of change included: forced relocation; loss of homes and personal property; decreased availability and resources for hunting; food gathering, and fishing; as well as loss of trap lines (Brown 2002:39).

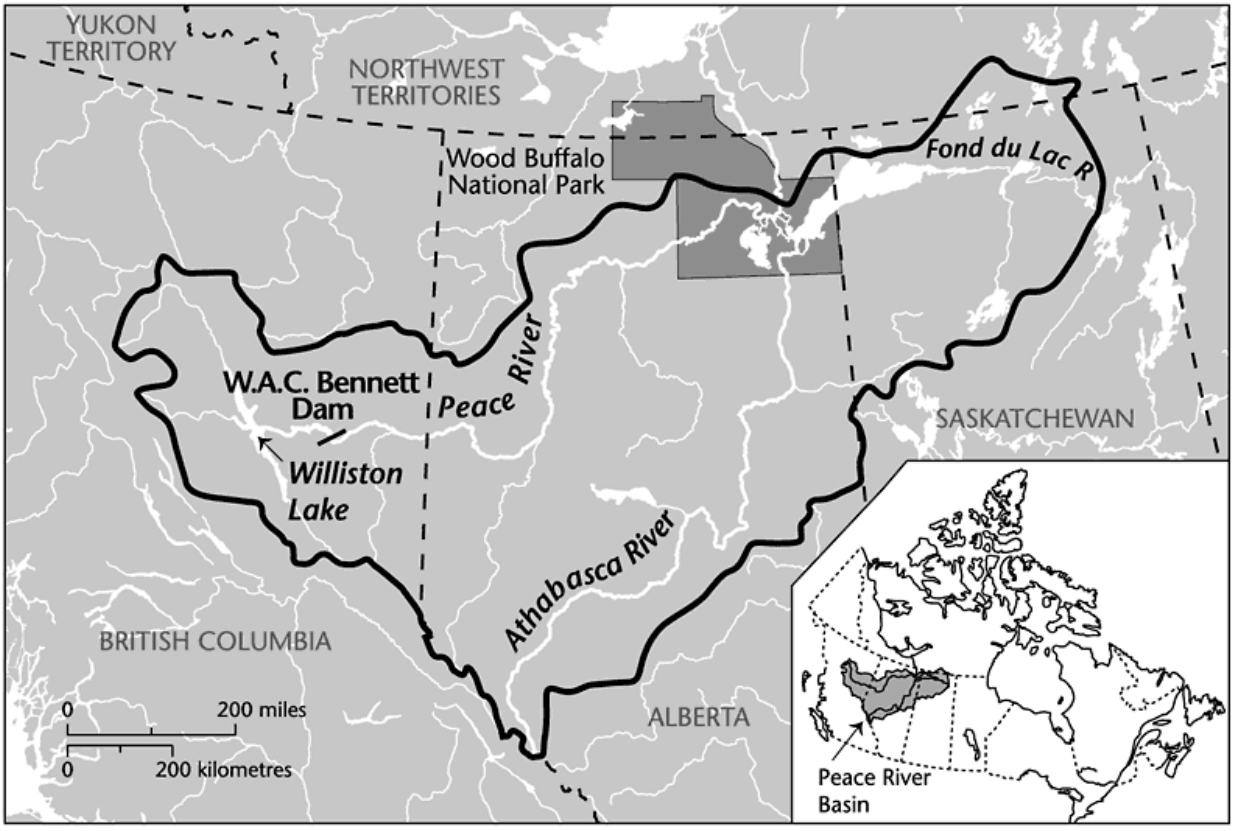

Figure 8: *Peace River Basin* (from Loo 2007).

The Northern River Basins Study documented other kinds of changes in water quality as observed by Aboriginal peoples in the region. Among the issues was an increase in algae growth, higher turbidity and sedimentation, and changes in taste and smell, all of which were attributed to decreases in water levels and flow. Poor quality was partially attributed to high sediment loads and increased amount of algae growth in Lake Athabasca; fears of disease in the river were also noted as concerns of Aboriginal residents (Bill *et al.* 1994). A summary of these indicators of ecological change can be found in Table 7.

Table 7: Observations of Ecological Change Attributed to Hydro Electric Development

Observation	Narrative	Reference:
Water quality	"Traditional users indicated unanimously that the water quality was poor and now carry water supplies whenever they travel on the land. Taste and odor problems were identified and fear of disease was a reality..".	Bill *et al*. 1994
Water levels and flow changes	"[decreased] water levels and flow changes have contributed to increased shrub growth and changes in river channels…"	Bill *et al*. 1994
River dynamics	"…changes in flood patterns were experienced directly as decreased natural flooding had effects on subsistence users of the land.	Bill *et al.* 1994

Delta flood dynamics	"the delta has been drying out…" "The delta has been drying out…The swamps have been turning to meadows and the meadows to woods."	Stuart & Assoc 1998:32
Abundance and distribution of Muskrat	"Some species of fish and wildlife have become scarcer. The muskrat is one of these species. Its' meat is a favorite food of the local people and its' fur was once their single greatest source of income…."	
Population/diversity of Fish	"…fewer fish"	Bill *et al*. 1994
Fish size	"smaller fish"	Bill *et al.* 1994
Fish flesh texture /taste	"poor quality of taste and texture were identified…"	Bill *et al*. 1994
Increased incidence of fish deformities	"…bull trout with white gel on their gills" "..fish with gill sores and worms in their stomach and gills…"	Stuart & Assoc 1998; Bill *et al*. 1994
Contamination of fish	"..the fish have high mercury content… people do not eat fish from that area anymore.."	Stuart & Assoc 1998:32
Declines in waterfowl	"A flock of 20 is a lot now, when before you'd see 200."	Stuart & Assoc 1998:32
Level of effort required to harvest	"Hunters still catch ducks, but it is harder to do.." .	Stuart & Assoc 1998:32
Changes in flood dynamics		
Changes in ice conditions—travel patterns	"Ice was noted to be weaker and its formation affected the manner in which natural ice jams were created by natural forces. This also affected winter travel of traditional users…"	(Bill *et al.* 1994).
Land use impacts Forced resettlement; loss of traplines; loss of hunting areas		

The oil sands region is defined here as those areas and communities located in the Athabasca River Watershed of northeastern Alberta and northwestern Saskatchewan. Although there are perceived to be other areas downstream of the Mackenzie River that are affected by oil sands activities, the scope was limited for the purposes of this report.

Figure 9: *Oil Sands Region*

> I know more about the land around Fort McMurray. Before the railroad, highway came into Fort McMurray, everyone lived off the land. The land provided meat, fish, berries for food, timber for their cabins, and roots and herbs for the sick. People can still live off the land as long as the young people know how to do it. I wish they wouldn't destroy our land that we have lived on for so many years. I want the oil outfits, sawmill and loggers to have a little respect for traditional lands. They should talk to some older people so those people can tell them what is out there and how we can all share and enjoy it (Julian Powder FMkFN 1994:64).
>
> When the oil sands plants opened it was good for jobs but it ruined our country. We won't have fish or berries to eat. The animals will be unfit to eat and we won't be able to drink the water. Our lifestyle will be different… (Emma Faichney in FMkFN 1994: 81).

Concerns regarding the impacts of development expressed by communities and First Nations regularly involve cumulative effects management of resources. Limitations of current cumulative effects assessment strategies include a lack of trust by stakeholders including First Nations, in the cumulative effects process (Lawe *et al.* 2005:209).

Many Aboriginal communities, particularly those immediately downstream—including the Athabasca Chipewyan First Nation and Mikisew Cree First Nation—have valuable perspectives on the changes in the Athabasca River based on their observations and experiences. As with western science, these observations about what is going on today are generally interpreted as healthy or unhealthy, normal or not normal according to a baseline of knowledge (largely held by elders) about the Athabasca River prior to development.

Table 8: Observations of Ecological Change Attributed to Oil Sands Mining

Observation	Narrative	Reference:
General health of aquatic ecosystem—cumulative impacts of development	"…we're the dumping ground... It's very dangerous to live here... I call it a danger zone, a red zone in this area, we've lost so many people…"	Ladouceur, in Timoney 2008
Water flow	Inadequate water flows "Most of the travel by the Mikisew Cree to their traditional lands is by boat, and many have been unable, due to low water levels, to reach their cabins in recent years…"	Mikisew Cree First Nation
Water quality—algae growth	Algal blooms are more common than they used to be. Fishing nets, when pulled, are nowadays often coated with a blackish slimy material. There's a gummy stuff that sticks to the nets in winter. It started at least 10 years ago; it's worse now. After two nights or so in the river, the net is just brown... it's a scum or something...dirty... years back... thirty, forty years ago, it wasn't like that... sticky, slimy thing... brown.	Piche in Timoney 2008 Courtereille in Timoney 2008 Ladouceur in Timoney 2008
Water quality—potability	"People don't drink untreated surface water, even	Fraser, in Timoney 2008.

	when they are away from the community out on the land because the water is dirty…" "The water doesn't taste good anymore. It's not sweet; there's a sour taste to the water… You have to boil the water now. Dip your cup into a pot of tea; the water coats the cup brown; it didn't used to be like that…".	 Courtereille, in Timoney 2008
Ice quality	Ice is no longer blue in winter. It is slushy and weaker	Courtereille in Timoney 2008.
Contamination from tailings ponds	…"Chemicals leaking from tailings ponds affect anybody or anything that relies on water as a source of drinking or a place to live in [including fish, moose, and birds]"… "There is a different taste and color to the Athabasca River now. When you boil water, it leaves a scum on the pot; there isan oily sheen on top. He has noticed an oily sheen on the surface of the river when the water is flowing smoothly and there is no wind.."	George Poitras Ladouceur, in Timoney 2008
Fish population and diversity	There has been a decrease in the abundance of many fish in the Athabasca River that were once a main source of food for the Athabasca Chipeywan and Mikisew Cree First Nations.	
Fish health—skinny fish	There are more skinny fish than there used to be; the fish are unhealthy looking.	
Fish taste	"Whitefish don't taste as good as they used to; they taste 'mossy'…" Fish flesh is softer than it used to be; e.g., northern pike… when you would cook it, it was hard in the past. Now it's mushy. Walleye flesh are very soft now.	Courterille in Timoney 2008 Ladouceur in Timoney 2008 Fraser in Timoney 2008
Fish mortality	"Last spring there was a big fish die-off in Lake Claire; that water was so damn low in the winter…"	Courtereille in Timoney 2008
Fish deformities	"Horror stories about grossly deformed fish downstream of the tar sands developments abound…" There's deformed pickerel in Lake Athabasca... Pushed in faces, bulging eyes, humped back, crooked tails... never used to see that. Great big lumps on them... you poke that, it sprays water…" The skins on the whitefish are starting to turn red. Before they used to be white...What's in the water?... Even goldeyes... they're red... never seen that before. The lake trout on Lake Athabasca—great big heads and skinny little bodies... One of the healthiest lakes in Canada is now one of the deadliest lakes.	George Poitras in Timoney 2008 Courtereille in Timoney 2008 Ladouceur in Timoney 2008
Contamination of fish; perceived human health risks	"I used to [eat] burbot liver, but haven't for some time since I heard the liver can make you sick…"	Ladouceur, in Timoney 2008
Muskrat abundance/mortality	Muskrat die-offs might have something to do with the water… Years ago his dad had a trapline. There was a nice slough off the Athabasca across … The	Courtereille in Timoney 2008

	River flooded into the slough and we thought there'd be lots of rats after the flood; no rats came; still today, no rats on that slough. There were big die-offs of muskrats over the years. In the past (more than 10-15 years ago), when they would die-off, [but] next year they'd be back. Now, when they come back, in the first winter they are dying again… they just can't increase, they keep dying.	Ladouceur in Timoney 2008
Environmental effects on human health—incidence of cancer in the community	"Fort McKay is [at] the epicentre of the tar sands development….The government tells us that there is no pollution. They have done studies that say there is no pollution. But we say they are wrong, because we have seen the changes that have taken place in the environment. The pollution has not only damaged the environment, it has made the people of Fort McKay sick. For a small community of 300, we have high rates of cancer and other illnesses…"	Dorothy McDonald, then Chief of Fort McKay First Nation – RCAP 1996.
Changes in land use—Resulting from landscape change	"In many instances, the impacts of these oil sands projects are so extensive that the known cultural landscape no longer exists..."	Garibaldi 2009:329
Traditional food consumption	"Mikisew are now afraid to eat animals that were once a traditional part of their diet…" "People eating the fish, hunting the moose, the ducks and geese, they are the most disproportionately affected compared to the rest of the Alberta public due to the bioaccumulation of toxins that occurs in wildlife…"	George Poitras in Timoney 2008

One key observation that underlies many concerns about development in the oil sands region and the health of aquatic ecosystems is the number and scale of development projects and the associated runoff or discharge of effluents that often accompany such projects. As noted by the elder, there is a perception that the region has become a development wasteland or dumping ground. Many elders and harvesters who have shared knowledge about change in the Athabasca River centre concerns about contamination of lakes and rivers on oil sands tailings ponds. One important marker/indicator used to address this question is colour and smell. A related indicator, noted by many elders is also the residue or 'scum' that is left after boiling water, including tea water. The following quotes from elders in the community of Fort Chipewyan highlights the depth and range of concerns on this indicator. Algae growth is another indicator of water quality and general aquatic ecosystem health used by Traditional Knowledge holders. The extent of change in algal growth or seasonal variability in growth is measured in terms of the amount of algae coating fishers' nets.

Water quantity is another indicator of aquatic ecosystem health that is of increasing concern, particularly given the growing need for water by developers in the region. Decreases in water quantity and changes in flow were acutely experienced in the Peace River and Peace-Athabasca Delta with the development of the Bennett Dam. The requirement of water for bitumen processing in the oil sands region is perceived to be exacerbating this problem. There is concern that assessment of instream flow needs have not considered Traditional Knowledge or

scientific information about historical trends in water supply, nor anticipated reductions in water quantity associated with climate change.

Fish are a key indicator of aquatic ecosystem health by Traditional Knowledge holders and scientists alike. People spoke of its importance to the diet; the security of a healthy fish population is key to a sense of well-being in the community. In most of the Mackenzie River Basin, including the oil sands region, fish were tied strongly to the social, economic, and cultural patterns of community life. In the summer, when big game such as caribou were more scarce, people would gather in larger groups in fish camps along the shores of the rivers, and lakes (Wiles *et al.* 1999). In winter, fishing also contributed significantly to the diet of many families.

The main fish consumed in the oil sands region were whitefish, jackfish, pickerel, goldeye, red and longnose suckers, ling cod (burbot), grayling, chub, perch, brook trout, lake trout, and deep water whitefish (ACFN 2003:115). For many fishers in communities like Fort Chipewyan, oils sands development has contributed significantly to changes in the population and diversity of fish in the Athabasca River. People are not catching the same number, nor the same kinds of fish that they did prior to development taking place. Although historically abundant, disturbances in water quality and quantity have affected the sustainability of many fish populations. Another important indicator of fish health in the oil sands region is the prevalence of fish mortality, particularly sudden 'die-off' incidences. One particular event, a die off in Lake Claire in 2008 is noteworthy:

An important indicator of fish health common to both biologists and Traditional Knowledge holders is the prevalence of skinny fish or length/weight ration. Fishers in many communities in Fort Chipewyan have been systematic in calculating the number of skinny fish caught in their net relative to normal or 'fat' fish over weeks or months. As a general trend, elders and harvesters who set net in the Athabasca have observed increases in the number of skinny fish relative to the period prior to oil sands development. The palatability of fish including taste, texture and odour is an indicator of fish health that is unique to Traditional Knowledge. As noted by elders in Fort Chipewyan, people have observed and experienced a decrease in the palatability of many fish including whitefish, pickerel and walleye.

Contaminants are a predominant concern in the oil sands region. In a study done for the Athabasca Chipewyan First Nation, several contaminants were highlighted as a concern, particularly for those dependent on traditional food.

Although often an indicator of western science or technical in nature, the perception and reaction to contaminant risk is one that is strongly rooted in Traditional Knowledge and local experience. Many harvesters and elders who identified contaminants as an issue were quick to say they no longer eat the fish. A trend that is perceived to be related to contaminants and is of grave concern is the number of fish found in nets that have deformities, tumours, cysts, and lesions.

Many of the changes in the fish are associated with a general decline in the quality of fish habitat in many parts of the Athabasca River. As noted in this quote from a Canadian Environmental Assessment Agency (CEAA) publication, the Athabasca is well recognized by both scientists and Traditional Knowledge holders as valuable fish habitat. As noted in the sections above, concerns about the state of fish habitat are tied to harvester observations of the following: decreases in the availability of water in key migratory or spawning seasons, changes in flow and rates of flow in certain areas, increased turbidity (dirty water), eutrophication (increased algae growth), debris and contaminants (from both air and effluent) accumulation.

Muskrat were an important resource in the fur trade and a valued indicator of aquatic ecosystem health in the delta regions. Historically, the muskrat was the heart of the trapping economy—people used to harvest hundreds of muskrats for clothing as well as trade. Hydro-electric development is acknowledged to have had a significant impact on muskrat populations as a result of decreased water levels and changed patterns of flooding. Elders in the community of Fort Chipewyan also perceive oil sands activity as affecting populations. One key indicator of concern is mortality or the 'die-off' of muskrats at various times of the year.

As noted in research elsewhere, Traditional Knowledge of water fowl has tended to focus on aspects of population (numbers, age structure), diversity, habitat use, body condition (fat), and body condition abnormalities. In Fort Chipewyan, where gathering of eggs was important to the diet, harvesters have also tended to have more detailed knowledge about the health of eggs and young.

The use of tailings ponds as habitat has been a major concern by community members for many years. In 2009, the publicity around several hundred ducks who died after landing in one of the largest tailings ponds, affirmed many harvesters' previous observations of water fowl behaviour (use of contaminated sites) and body condition.

The downstream effects of water pollution have been a significant issue of concern for communities located on the Athabasca River and Athabasca Lake in northern Alberta and northeast Saskatchewan. In Fort Chipewyan, community residents have long raised questions about contaminant levels in the water, and their influence over disease patterns in the community include rates of rare forms of cancer. These concerns have been echoed by other communities and elders, such as the late Chief Dorothy McDonald from Fort McKay.

The impact of oil sands development on the aquatic ecosystem has been extensive; as noted below by Garibaldi (2009), in some cases the landscape—including water levels, dynamics and health—have been so irrevocably changed that community members are faced with almost complete discontinuity between the landscape of previous generations and the one around them today. Such cultural discontinuity presents significant emotional strain on individuals as well as the community as a whole. Water and other elements of the aquatic ecosystem are part of the spiritual and physical well-being of many communities. In northern Saskatchewan, degradation of the aquatic ecosystem impacts upon this physical-spiritual connection described in Cree as *'pimâcihowin'*.

> When treaty Elders use the word 'pimâcihowin,' they are describing a holistic concept that includes a spiritual as well as a physical dimension. It is an integral component of traditional first nations doctrines, laws, principles, values, and teachings regarding the sources of life, the responsibilities associated with them, including those elements seen as necessary for enhancing the spiritual components of life and those associated with making a living.

There is particular concern in communities like Fort Chipewyan and Fort McKay about the cumulative effects of this environmental change on youth populations. As noted by the following elder, alienation of youth from the natural landscape has compounded the lack of pride that many youth feel as Dene people.

> We are always left out. If you look at the young people here today and the young people are not as well off as they used to be. That's who we are talking for. . . If

> there is a way of instilling pride again into our young people, maybe some people can help us train our young people to become proud again. We, as Dene, are talking about our land here, this is our land (Elder in Wiles *et al.* 1999:111).

The Mikisew Cree have noted that much of their knowledge and interest in continued monitoring of environmental change is linked to their 'sacred obligation' to be stewards of the environment.

> The Mikisew Cree people believe "it is their sacred obligation to act as stewards of the environment in cooperation with the government." For the First Nation, the survival of their ecosystem is linked to the survival of their culture and cannot be separated from their economic and physical well-being.

8. Conclusions and Recommendations

Ecosystem Approach

The belief that everything is alive and has spirit—is sentient and knowing—is fundamental. It strongly influences or defines the way in which many Aboriginal peoples in the north read the landscape around them. Harvesters have learned over time (generations) that if they are to survive and live well, they must maintain proper relationships with the animals they harvest, which includes giving thanks to the animals, water or Creator for what has been provided, and not taking or harvesting in excess of what is required. The rule, 'take only what you need,' is common in hunting, fishing and other kinds of human–environment interactions. The destruction and degradation of lands and resources or molestation and mortality of wildlife and fish for reasons considered 'greedy' or 'unnecessary' can be profoundly disturbing.

This report has identified some sources of Traditional Knowledge for the Athabasca River Watershed as well as indicators (metrics) that might potentially be used to communicate about ecosystem health and ecosystem change in the watershed. The fragmentation and decontextualization of Traditional Knowledge into such themes and categories as water quantity and water quality, etc. should be done carefully, however, with a recognition that Traditional Knowledge is an integrated and holistic body of knowledge; any distillation of that knowledge into data segments may be viewed as inappropriate and contradictory to the integrated and holistic nature of the concept and common practice of storytelling (narration).

The identification, analysis and sharing of Traditional Knowledge must also be considered simultaneously with the participation of Traditional Knowledge holders in the reporting process. Since western settlement, Aboriginal peoples have historically been marginalized from the governance of lands and resources of the Athabasca and neighbouring regions. Many communities continue to bear a significant burden of the negative effects of such development, including the loss and degradation of lands and resources valued in traditional livelihoods as well as the environmental harms of contaminants. Part of respecting and integrating Traditional Knowledge into a 'State of the Athabasca Watershed' report must involve recognizing Aboriginal histories, rights and interests and the Treaty promises that people would be able to continue a traditional way of life 'so long as the rivers flows.' Some of these principles have been laid out in policy documents such as the *Alberta Land Use Framework*:

> The Government of Alberta has the constitutional mandate to manage lands in the province for the benefit of all Albertans. However, the Government of Alberta will

> continue to meet Alberta's legal duty to consult aboriginal communities whose constitutionally protected rights under section 35 of the Constitution Act, 1982 (Canada) are potentially adversely impacted by development… Aboriginal peoples will be encouraged to participate in the development of the seven regional land-use plan (Government of Alberta 2010: 40).

Future Traditional Knowledge Studies

The sources of documented Traditional Knowledge are limited with more knowledge being available in the lower regions of the Athabasca River Watershed. There are many significant gaps in the availability of Traditional Knowledge in the upper and middle regions, and when compared to research that has occurred in other regions. This report provides a general overview of some studies available and examples of what kinds of Traditional Knowledge has been documented elsewhere. There are many different ways of defining and characterizing Traditional Knowledge. This report should thus not be considered prescriptive of the kind of information to be collected. Discussions with First Nations and Métis communities about definitions and key concepts and elements of Traditional Knowledge required for the management of the Athabasca River Watershed is fundamental to appropriate and meaningful knowledge-sharing.

The report also aims to offer suggestions about methods for collecting Traditional Knowledge. There are as many different ways of documenting Traditional Knowledge as there is in documenting 'science.' Historically, most research associated with Traditional Knowledge came from the cultural anthropology and ethnographic fields of study. More recently, as Traditional Knowledge is recognized for its contributions to sustainable resource management, other kinds of methods from human geography, biology, ecology and other disciplines have been used. Table 9 provides examples of research methods used in documenting Traditional Knowledge related to aquatic ecosystems in other regions. Many of these research activities are ongoing processes of monitoring and study, which is consistent with the idea that Traditional Knowledge is more than a pool of data but is a system of watching, listening, learning and understanding, and adapting to ecosystem change.

Table 9: Examples of Other Kinds of Traditional Knowledge Research

Theme/Indicator	Research Activity	Case Study Example
Marine wildlife/adult fish population change	Use of harvesting (recall) diaries (daily total catch/tallies) or guided interviews about harvest success in a given location/season/year.	Moller *et al.* 2004; Berkes and Henley 1997
Distribution of bird species, coastal shoreline features, changes, human activity impacts (hydro), sea-ice conditions, floe edge conditions	Community-based study; semi-structured interviews, community-based and regional workshops.	McDonald *et al.* 1997
Water quality	Community-based data gathering for science-based indicators.	Deutsch *et al.* 2001

Beluga and narwhal population dynamics	Policy debate (Greenlandic Commission of the Conservation and Management of Narwhal and Beluga Whales).	Thomsen 1993
Halibut population and distribution	Informal documentation of local harvester knowledge.	Sejersen 1998
Cod movement, stock structure	Collection, aggregation, and interpretation of fisheries science, harvester ecological knowledge.	Murray *et al.* 2008
Fisheries and marine wildlife taxonomies, spatial distributions of living and non-living resources, timing of significant biological events		
Ashkui (freshwater quality, aquatic habitat, migratory birds)	Waterfowl inventories and hydrometric research (15 sampling stations) carried out in cooperation with traditional Innu users of *ashkui* sites; training and capacity-building.	Sable *et al.* 2002
Impacts of Exxon Valdez oil spill on marine ecosystem (fish and fish habitat, marine wildlife & habitat, human health and well-being)	Documentation and collection of raw materials and data (interview data, notes, photos, audio tapes, video)	Miraglia 1998
Integrated water management, human centered system	Participatory, capacity building.	Merrey *et al.* 2005
Marine bird habitat (protected area habitat)	Incorporation of Traditional Knowledge into scientific surveys designed to identify marine bird habitat.	Mallory *et al.* 2006
Spatial dynamics of fish stocks, rules for predicting stock dynamics distribution of adult herring	Documentation and analysis of local fisher knowledge and fisheries biologist knowledge. Use of CLUPEX analytic model. Identification of 'rules' for predicting stock dynamics distribution of adult herring.	Mackinson 2000
Quality of drinking water, surface water	Participatory research (empowerment), capacity-building.	Ruiz Cordova *et al.* 2006
Protection, restoration of water resources	Participatory research (empowerment) capacity-building.	Deutsch *et al.* 2001
Stock assessment	Angler diaries, zooplankton sampling.	Green *et al.* 1993
Fish movement and stock structure (cod—Newfoundland)	Collection, aggregation, and interpretation (mapping) of commercial fishers' knowledge—integration with scientific data.	Murray *et al.* 2008
Contaminants in marine ecosystem	"	De Bruyn *et al.* (2006)
Ecosystem health/dynamics	Land Use and Occupancy Study; impact analysis.	Bryce-Bennett 1977; Furgal et al. 2002.

Sources of Traditional Knowledge and Related Research

First Nations and Metis organizations in the oil sands region have completed many kinds of Traditional Knowledge reports for the planning, assessment and monitoring of specific projects in the oil sands region. While some of these are available publicly (posted on the web and through the regulatory agencies), others are proprietary in nature. Readers should contact the Energy Resources Conservation Board (ERCB) of Alberta and individual First Nations and Metis organizations to access these reports.

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