NORTHERN VOICES, NORTHERN WATERS: TRADITIONAL KNOWLEDGE AND WATER POLICY DEVELOPMENT IN THE NORTHWEST TERRITORIES

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Abstract

Water is universally recognized as the source of all life – it is essential to human existence and health and to the well-being of the environment. Understanding the value of our water resources, the critical role they play in economic prosperity, and the need to protect and manage this essential resource is a defining issue of the 21st century. Indigenous peoples from around the globe state that this awareness of the importance of water to the health and well-being of all living things is not new.

Within the context of the critical need to protect and manage global water resources in a manner that preserves water quality, quantity and flow for future generations, this paper explores the state of traditional knowledge in northern Canada. It then considers in some detail the challenges associated with use and application of traditional knowledge, and the opportunities for its enhanced use and application to inform environmental management and decision-making in the north generally, and water management specifically.

Acceptance not only of the credibility of traditional knowledge, but also of its relevance and importance to environmental management, is increasing around the world; and its compilation and codification is an evolving field. This paper examines the barriers to the use and application of traditional knowledge, and proposes that for a number of reasons, the time is right for considerable progress to be made in this area.

Finally, the paper proposes a way forward and makes practical recommendations for future actions by governments, indigenous groups, academic institutions and resource developers, using current policy initiatives by the Government of the Northwest Territories (GNWT) as a focal point.

Note: The term “indigenous knowledge” is in common usage throughout much of the world. In the Northwest Territories, the term “traditional knowledge” is more commonly used, but can generally be understood to be synonymous with “indigenous knowledge”. For convenience, this paper will use the term “traditional knowledge”.

Background

The Northwest Territories (NWT) of Canada covers 13% of Canada’s land mass, an area of 1,346,106 million square kilometres, which is larger than Great Britain, Northern Ireland, France and Germany combined. The NWT is a geographically remote area with, until recently, largely undisturbed landscapes and habitats. The NWT is home to huge water bodies, and its pristine and extensive water sources are one of the most valued features of the territory’s natural capital. 12% of the surface of the NWT is fresh water. This includes the Mackenzie River, which is the largest river in Canada and whose watershed is among the world’s ten largest. The 1.8 million square kilometre river basin encompasses one-fifth of the entire area of Canada. The NWT is home to Great Slave Lake and Great Bear Lake, Canada’s fourth and fifth largest lakes. In addition to these well-known water bodies, the NWT landscape includes a multitude of lakes, rivers, streams and ponds; many deltas, extensive wetlands that are critical for migratory waterfowl, and widespread permafrost.

The NWT has a population of approximately 43,000 people, of whom half are of Aboriginal descent. The territory has a population density of 0.03 persons per square kilometre, while Canada has a corresponding density of 3.5 (2006 census). By way of comparison, Argentina’s population density is 14.9 persons per square kilometre.

Aboriginal cultures are known to have inhabited the area for thousands of years, relying on the land and its resources to provide for food, clothing, water and all the necessities of life, leading to a detailed knowledge of the land, animal behaviour, seasonal and climatic changes and ecological relationships. Aboriginal people in the NWT today maintain strong ties to their traditional way of life and cultural traditions, even as they adopt and embrace modern technology and lifestyles.

The lives of the peoples of the NWT are inexorably linked to the NWT's waterways. Rivers and lakes have provided traditional transportation routes, and are imbued with deep cultural and spiritual significance. The fish and wildlife that have been the source of food, clothing, tools and other necessities, as well as the vegetation that provides food, medicine and shelter, all rely on the water to grow and flourish. More recently, the water systems of the NWT have continued to play a critical role in the evolution of the northern economy. Barges bring much-needed fuel and supplies to northern communities with no road access. Hydroelectric developments supply much of the NWT's electricity. Resource extraction industries rely on ice roads across frozen water bodies to haul supplies and equipment to remote mine sites. And the NWT's pristine wilderness and world- class fishing and boating opportunities are a strong draw for tourists.

Management of land and water in the NWT

Aboriginal rights to the continued use and ownership of certain lands in the NWT are established through a Constitutionally-based legal framework, beginning with the signing of treaties by the Government of Canada with the Dene in 1900 and 1921. Among other provisions, the treaties contain a promise that Aboriginal people will be permitted to continue their traditional activities of hunting, trapping and fishing in perpetuity. More recently, the legal and constitutional basis for governing in the NWT has changed dramatically. In 1982 the *Canadian Charter of Rights and Freedoms* entrenched a combination of Aboriginal rights to resources and Aboriginal treaty rights in s. 35 of the *Constitution Act*. Canadian courts have recognized Aboriginal rights and federal government policy has established processes where those legally recognized rights are negotiated through land claims agreements.

The completion of these agreements has resulted in a complex but progressive governance framework in the NWT, with jurisdiction split among Canada, the Government of the Northwest Territories and Aboriginal Governments. The regulatory framework that governs the management of renewable and

non-renewable resources is not static, but evolving as each land claims or self-government agreement is finalized and implemented. It involves numerous agencies, who work within a common legislative framework.

The Government of Canada retains lead authority for environmental assessment, issuing land use permits and water licenses. This authority is exercised through the Mackenzie Valley Land and Water Board, which has jurisdiction in areas where land claims are not settled, and which also ensures consistency of regulation and policy across the territory and deals with transboundary issues. Co-management boards provide a forum in which the Aboriginal governments can exercise shared jurisdiction with Canada for land and water regulation within their claims areas, and with the territorial government for management of wildlife and forestry. Five other federal departments exercise some measure of jurisdiction over water. Within the GNWT, the Department of Environment and Natural Resources has legislated authority for environmental protection, including safeguarding the sustainability of water resources. Three other departments play an active role in ensuring the quality of drinking water.

In addition to legal responsibilities established through legislation, the Government of Canada also has a Constitutionally-based fiduciary obligation established through land claims agreements, which call for waters "to remain substantially unaltered as to the quality, quantity and rate of flow".

As the second largest river basin in North America, the Mackenzie River Basin supports many diverse and sensitive ecosystems, and stretches across the legal jurisdiction of three Canadian provinces and two territories. In 1997, a Trans-boundary Waters Master Agreement was signed among the governments of Canada, Saskatchewan, Alberta, British Columbia, the NWT and Yukon. The parties agreed to a series of principles to guide their actions in carrying out their legislative responsibilities in the Mackenzie River Basin. A 13-member Mackenzie River Basin Board was established as a result of

the agreement, with representatives from the federal, provincial and territorial signatory governments, and Aboriginal groups in each jurisdiction. However, the Board has no regulatory authority, and no legal or policy basis to regulate water resources. The Board can provide information to regulatory processes, but with few resources and no real commitment from member jurisdictions it has not played an effective role.

Northern Voices, Northern Waters: NWT Water Stewardship Strategy

Northerners have long understood that maintaining the quality of northern water systems is essential to maintaining a way of life. Water quality has a direct impact on the daily lives of individuals and the health of communities. Water is increasingly recognized as an economic resource, given the key role that it plays in energy production, manufacturing and the agricultural sector; and as southern jurisdictions begin to face challenges with the quantity and quality of local water sources, they will turn to northern Canada to tap into the vast reserves of northern lakes and rivers.

Northern Canada's water systems are not immune to the impact of industrial and agricultural use elsewhere in North America. Water flows in the Mackenzie River Basin have been affected by upstream hydro-electric developments and a host of other developments – especially oil sands in Northern Alberta. Industrial toxins such as mercury have been found in the flesh of Mackenzie River fish. Climate change, whether anthropogenic or otherwise, appears to be affecting the Peace River and Athabasca Rivers, as higher temperatures and reduced precipitation rates combine to result in reduced flows and the associated cumulative impacts. Residents of communities along the Mackenzie River particularly have expressed concerns repeatedly over the past 20 years, to regulatory agencies and government departments, about deteriorating water quality, as evidenced by numerous indicators; including among others the taste and appearance of the water, flow levels, health and quality of fish, changing vegetation and aquatic habitat productivity.

The massive development of the northern Alberta oil sands uses enormous quantities of water to extract oil from the sandy soil. The water then contains a highly toxic mix of hydrocarbons and other chemicals, and has to be disposed of as waste material. This process poses two threats to the Mackenzie River Basin – a direct impact on river flow levels as countless millions of cubic metres of water are diverted to the oil sands project, and a potential long-term impact on surface and groundwater quality. The Province of British Columbia has just announced plans to conduct an environmental assessment for a proposed massive hydro-electric project on the Peace River, which could also have a direct impact on water levels in the Mackenzie River Basin if it proceeds.

Concerns about threats to the quality and quantity of NWT waters led the Government of the Northwest Territories (GNWT) to undertake a collaborative, multi-stakeholder process to develop a strategy to begin the daunting task of safeguarding northern waters. *Northern Voices, Northern Waters: The NWT Water Stewardship Strategy*, which was made public in May 2010, is the result of three years of collaborative effort between the GNWT and the Government of Canada, working in collaboration with Aboriginal governments, northern land and water boards, and organizations from across the territory. The *Strategy* outlines a series of goals designed to ensure the continued quality of waters not only in the NWT, but also in adjacent jurisdictions that flow into or through the NWT. It aims to ensure that aquatic ecosystems are healthy and diverse, and that residents of the NWT can rely on safe and plentiful supplies of water for drinking and to support traditional cultural activities. It outlines a broad-ranging and ambitious set of tasks to accomplish these goals, ranging from increased research and monitoring, to development of a system of community-based monitoring on NWT waterways, to strengthened transboundary water agreement negotiations with neighbouring jurisdictions.

Of most significance to the discussion in this paper is the emphasis in the *Strategy* on the recognition and use of traditional knowledge through each aspect of managing water resources. Aboriginal governments, organizations and users of traditional knowledge were involved in the development of the

Strategy, recognition of traditional knowledge is a guiding principle of the *Strategy*, and the use and application of traditional knowledge in protecting northern waters is a key feature.

Traditional Knowledge

The concept of "indigenous knowledge" or "traditional knowledge" is a relatively recent area of exploration in the scientific, academic and regulatory arenas. Indigenous cultures throughout the world have lived in a close and interdependent relationship with their natural environment over centuries, and have relied on an intimate knowledge and understanding of the natural environment to survive. Their traditional knowledge is based on historical continuity in resource use, within a prescribed geographical area, and generally in a non-industrial society.

It is important to note that there is a wealth of locally acquired knowledge among populations of people, irrespective of cultural or ethnic orientation, who live in close contact with the land, through agriculture, fishing or other land-based activities; and who have accumulated a lifetime of observation and experience of a particular environment. Their knowledge is equally valid and has been demonstrated to play an important role in environmental management and decision-making. What distinguishes traditional knowledge is the accumulation of knowledge over many generations, leading to a broad and deep understanding of baseline conditions and patterns over time in a particular area.

Much energy has been expended in the literature on debating the most appropriate term, and definition, for the concept. Some take exception to the term "traditional", concerned that it may imply knowledge that is archaic and out-of-date rather than of use in contemporary society. Some take exception to the use of the term "indigenous", feeling that it excludes important local knowledge that is not embedded in the language and culture of a specific group. A generally accepted definition of traditional knowledge in Canada is, "a cumulative body of knowledge, practice and belief, evolving by adaptive

processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and their environment" (Berkes 1999).

Because traditional knowledge covers such a broad range of concepts, some have argued that it is more accurate and appropriate to use the term "traditional environmental knowledge" when discussing knowledge related to ecosystems, that is, to the subject matter that might be studied in the biological, environmental and earth sciences. The discussion in this paper will focus primarily on this narrower construct.

Traditional knowledge is made up of a logical system of organized knowledge, based on empirical data that draws on observations over time; and historically has been codified and transmitted through oral narrative. The acquisition of traditional knowledge is not an activity distinct from everyday life – knowledge is experiential in nature. Stories told by elders recount their personal experiences, or those of their ancestors, while incorporating important information both about environmental elements and processes, and the underlying values or world view that informs their interpretations of changes in the environment.

In northern Canada, there is an important concept underlying all traditional knowledge, which is a broad definition of what in English might be known as "the environment". Aboriginal people do not distinguish between human beings and the rest of the natural environment, while western science has historically perceived the natural environment to be separate and distinct from humans. All Dene languages have a term that refers to the entire ecosystem as understood by Aboriginal people, including the land and natural features, water and water systems, vegetation, wildlife populations and their behaviour, the climate, the wind, and the human inhabitants.

Although traditional knowledge flows from and deals with a very broad concept of the natural environment, categories of knowledge can be identified (Usher 2000). Traditional knowledge related

to the natural environment includes factual, rational knowledge which is based on empirical observations by individuals, drawn from the experiences of numerous individuals' experiences over a long time, as expressed through shared experience, stories, and teachings. It also includes knowledge about a specific indigenous group's historic and contemporary use of the environment, including harvest patterns, methods and yields, patterns of land use, travel routes, and changes over time in response to changing environmental conditions. A third category of information can be described as culturally based value statements about how people use the land, including rules about respecting the land and animals, when and how to harvest, how to prepare and dispose of harvesting products, and other social mores.

These categories are presented only for the purpose of providing an overview. These are not distinctions that are generally made by indigenous people, and underlying all these categories is an inherent cosmology, or knowledge system, which is inextricably linked to culture.

What is of particular significance for environmental management is that this knowledge constitutes a comprehensive baseline of information accumulated over generations, which can provide a reference point for monitoring changes; and includes a detailed and subtle understanding of the interrelations within a natural system which can be used to interpret changes.

Comparing and contrasting traditional knowledge to western science

Much effort has been put towards identifying the differences and similarities between traditional knowledge related to the environment and western scientific knowledge. Some key distinctions noted by various authors include:

- western science knowledge is acquired through experimentation and field research, while traditional knowledge is acquired through daily interaction with people and the environment;

- western science is compiled and transmitted through written records, traditional knowledge through oral narrative;
- western science is derived from testing of hypotheses, and is rooted in the scientific method; while traditional knowledge is based on examples and anecdotal information.

A more complex distinction has been made about how the two types of knowledge are understood. Many propose that western science is understood in a secular context, and is distinct from the belief systems of western culture; while traditional knowledge has a spiritual dimension, and is linked to cosmology and cultural values. Other distinctions have been drawn, describing western science as "intellectual" while traditional knowledge is "spiritual", or asserting that western science is not practical while traditional knowledge has practical application. Such comparisons are somewhat subjective, rooted in the world view and values of the observer, and do little to inform the important discussion about the role that traditional knowledge can play in environmental management and protection.

Perhaps more useful than attempting a black-and-white contrast of western scientific and traditional knowledge is to consider how the two fields are perceived. Barnaby and Emery (2008) suggest that practitioners of western science may regard traditional knowledge with scepticism due to several factors, including distrust of non-scientific data (i.e. data that are not derived through accepted scientific methods), uncertainty about the accuracy of data and repeatability of derived relationships asserted through traditional knowledge, and dismissal of non-familiar indicators of change in biological systems. Similarly, traditional knowledge practitioners may be equally sceptical about the results of western scientific exploration as it relates to their geographic areas of expertise, based on distrust of the findings of scientists who have no direct relationship to the field of study, distrust of a sampling approach which may be seen as incomplete, and distrust of data that is accumulated over a short period of time as opposed to generations.

More recently, observations in the literature have dismissed the contrasts outlined above as artificial distinctions. In northern Canada, anthropologists and geographers including Harvey Feit, Fikret Berkes, Peter Usher and Milton Freeman have spent decades studying harvesting practices of Aboriginal peoples, and concluded that traditional knowledge is used not only to ensure success in harvesting, but also to make resource management decisions. Hunters monitor population trends and changing conditions, and can detail those trends over many years. They monitor indicators that are similar to those used by biologists, for example for moose and caribou they observe the size of groups, frequency of calving, frequency of twinning, trends in survival rates of young, and changes in age or sex composition of populations. They are aware of fish migration routes and spawning areas, and they understand when wildlife populations are most vulnerable. More importantly, this knowledge has been put into practice to ensure the integrity of ecosystems through adaptive management practices. Adaptive management is practiced both through the establishment of harvesting rules to protect species integrity, such as proscription on harvesting pregnant cows; and through responses to changes in population health and trends, for example, ceasing harvesting activities in a specified area for a period of time to allow a population to re-establish.

Traditional harvesting management practices, whether applied to hunting, fishing or forest management, share many characteristics with those of contemporary ecological science. They focus on ecosystem processes, health, and resilience; they recognize discrete natural geographical units, e.g. watersheds; and they consider ecosystem components such as plants, animals and humans within these geographical units to be interlinked. Modern resource management practices increasingly recognize that it is not possible to manage only one discrete category of resource in an environment (e.g. timber) without paying attention to the broader environmental arena. It is now generally understood that ecosystems must be viewed as integrated and holistic entities, whose parts do not function independently but must be understood as a complex and interrelated system. Thus, there is a

convergence between science and traditional knowledge, and the boundaries between the two knowledge systems may be less rigid than was once thought.

This convergence may be most evident with regard to the biological sciences, particularly applied wildlife biology and wildlife management, which tend to be less experimental and more observation-based than what is commonly known as "pure science". Wildlife biology and traditional knowledge both rely on some elements of quantitative analysis and knowledge gained through experiment, combined with extensive observation and intuitive reasoning.

Just thirty years ago, the concept of traditional knowledge was relatively unknown to western academics outside the realm of anthropology. Today, traditional knowledge is a widely recognized and accepted concept in Canada, and its importance and contribution has been acknowledged in policy and legislation at several levels – although there remain substantial challenges to effectively delivering on these commitments, as discussed later in this paper.

<u>Bridging the gap between traditional knowledge and modern management systems</u>

Recognizing the credibility of traditional knowledge, however, is just the first step towards seeing it established as a fully contributing field of endeavour. The Alaska Native Science Commission (no date) notes that traditional knowledge is "more than the sum of its parts":

> *"The richness and complexity of local knowledge systems derive principally from the fact that they incorporate, and are often the resolution of, two very different world views. A researcher cannot separate out any one aspect or component of Native knowledge (e.g. traditional ecological knowledge) to the exclusion of any other without misinterpreting it as Natives see and understand it. This is why Natives want control over how their knowledge is collected, interpreted and used."*

Fenge and Funston (2009) note that indigenous peoples experience frustration in being asked by scientists and policy-makers to quantify and articulate concepts that might not fit easily into scientific or policy templates, and to record their traditional knowledge into user-friendly compendia. The contextual nature of traditional knowledge, and the nature of its transmittal through oral narrative, makes it difficult to separate discrete pieces of information specific to a species, a plant or an area from the broader context within which it is understood.

Scientists, policy makers, regulators and resource developers also experience frustration about "where to go to find (traditional knowledge); how to know it when they see it and how to use it given their adherence to the scientific method which relies on searchable data bases, peer-reviewed reports, experimentation and episodic field-work" (Fenge and Funston 2009).

The use of traditional knowledge to inform or enhance scientific knowledge has often focused on attempts to integrate or combine the two streams of knowledge. There is a perception by Aboriginal groups that this generally results in the western science perspective dominating, and there is a concern that regulatory and management decision-makers will take traditional knowledge out of context and use it to justify policy or licensing decisions. This concern has a political dimension as well, linked to the desire of Aboriginal peoples to have control over regulatory and environmental decision-making on their traditional lands.

The potential for traditional knowledge to contribute to environmental management

Although documentation of traditional knowledge and development of appropriate research methods are still at the early stages, it is generally accepted that there is substantial potential for it to inform environmental management processes. Areas where such knowledge may inform environmental assessments include hydrology and hydrogeology, soil conditions and terrain, air quality, vegetation (abundance, diversity, health), wildlife (abundance, health, nesting or denning areas, migration

patterns), and fisheries (spawning grounds, abundance, health, overwintering areas). Additional information that may be obtained from traditional knowledge informants relates to such issues as cumulative effects, long-term ecosystem effects and trends, mitigation recommendations and monitoring approaches. The MVEIRB Guidelines for incorporating traditional knowledge into the environmental impact assessment process state that "if properly documented, it can add an important historical perspective and understanding of the variability and extent of biophysical, social and cultural phenomena; and traditional knowledge holders are often able to identify links between seemingly unrelated components of the environment."

There are numerous examples that illustrate how traditional knowledge has been used to inform decision-making, or has been demonstrated to have the potential to do so, in some of the above areas.

- In 1982, a proposal by the was made Northern Transportation Company to blast and dredge the Mackenzie River just upstream from the community of Fort Good Hope, close to the Ramparts rapids section of the River, since low water levels were impeding the passage of heavily loaded barges. Concerns were expressed by the community, because local harvesters were aware that this area was a critical spawning ground for several fish species, including whitefish and inconnu. Community concerns resulted in a delay of the proposed activity. Although at the time, the Department of Fisheries and Oceans could not confirm the community's concerns, subsequent migration studies conducted by government field staff did confirm the location of spawning grounds in the Ramparts (DeLancey 1984).
- Biologists have worked with Inuit informants in the Belcher Islands to document information on marine birds. Eider ducks overwinter in the Belcher Islands, feeding in areas of permanent open water. In the mid-1990's, Inuit elders reported a decline in the eider population. Biologists and local informants conducted an aerial survey and confirmed a substantial decline since the last survey in the late 1980's. Inuit elders stated that unusually extensive sea ice had

occurred in the winter of 1991-92, leading to mass starvation of the ducks. Gilchrist (2005) writes that the cause of the changes in sea ice was a volcanic eruption in the southern hemisphere, which lowered circumpolar temperatures that winter. He notes that locals did not know the cause, but detected both changes in sea ice and its impact on the eider population. If Inuit elders had not flagged the issue, "this dramatic population decline would have gone undetected by western science."

Traditional knowledge in northern Canada

Interest in traditional knowledge of northern Canada has been strong among Canadian social scientists for some time. The Government of the Northwest Territories was the first jurisdiction in Canada to officially recognize the role of traditional knowledge and attempt to prescribe its application within a broader governing system through the approval of the *Traditional Knowledge Policy* in the late 1980s. This *Policy* represents an early attempt to define traditional knowledge, and to promote its use by committing that the Government will "incorporate traditional knowledge into government decisions and actions where appropriate". The *Policy* assigns responsibility to all departments to identify areas where traditional knowledge may be relevant, and places particular importance on the role that traditional knowledge can play in "environmental management actions and decisions".

More recently, recognition of traditional knowledge has been formalized in legislation or policy in a number of instances, including the following:

- The *Canadian Environmental Assessment Act* (federal legislation) states that, "Community knowledge and aboriginal traditional knowledge may be considered in conducting an environmental assessment." (16.1)

- The *Mackenzie Valley Resource Management Act* (federal legislation) provides for the use of "scientific data, traditional knowledge and other pertinent information" for the purpose of monitoring environmental impacts."
- Comprehensive land claims and self-government agreements include references to traditional knowledge. For example, the *Tlicho Land Claims and Self-government* Agreement signed in 2003 specifically directs that the Tlicho Government and co-management agencies established under the Agreement "shall take steps to acquire and use traditional knowledge as well as other types of scientific information and expert opinion" when exercising their powers in the areas of wildlife management, forest and plant management, and land and water licensing.
- The *NWT Protected Areas Strategy*, a joint initiative of the GNWT and the Government of Canada, promotes "a balanced approach to land use decisions by incorporating the best available traditional, ecological, cultural and economic knowledge."

The Government of Nunavut has incorporated the concept of Inuit Qaujimatunqangit, or IQ, as a guiding principle for all government operations. IQ can roughly be translated as "Inuit knowledge", although it is a broad-based term which encompasses all aspects of Inuit traditional culture including values, world-view, language, social organization, knowledge, life skills, perceptions and expectations (Wenzel 2004).

Along with increased recognition and formal acknowledgement of the role of traditional knowledge has also come scepticism. As noted above, scientists may question the validity of traditional knowledge because it is viewed as less credible, or less defensible, than knowledge gained through "pure science", i.e. the scientific method. Some scientists dismiss it as anecdotal and too rooted in unscientific values and beliefs, while others who accept the validity of traditional knowledge are unclear as to how it can be verified, and thus uncertain about its application to decision-making processes.

There is a legitimate basis to some of these concerns. Just as western science can reach conclusions that are later disproved, traditional observations and explanations may lack completeness or accuracy. Traditional knowledge is by its very nature linked to a specific geographical area, which makes it difficult to extrapolate to a broader context. Wenzel and Dowsley (2008) have documented an example where harvesters in two Inuit communities observed that polar bear populations were increasing, an observation which was contrary to the assertions of polar bear biologists that populations are decreasing and likely endangered due to climate change. In actual fact, the harvesters' observations were correct within the limited context of their knowledge, as it was subsequently determined that bears were congregating in specific areas adjacent to those two communities due to changing climactic conditions, even though overall populations were declining.

Some scepticism may also be rooted in the broader politics which surround discussions of traditional knowledge, as the need to find ways to apply traditional knowledge to environmental management and decision-making is often linked to the broader discussion of Aboriginal rights and the demand by Aboriginal people for control over their traditional lands and resources.

There is a considerable amount of activity with regard to traditional knowledge in Northern Canada today. Aboriginal groups are working actively to document, translate, and codify their traditional knowledge. This activity is stimulated in part by an awareness that much knowledge lies with the elders, and a sense of urgency to document as much as possible while they are still alive. It is often linked to related initiatives to preserve and enhance Aboriginal language use, and to ensure that language and traditions are transmitted to youth both through the formal school system and through traditional means of education. Another impetus for traditional knowledge work is the need to respond to proposals for development on Aboriginal traditional lands, specifically through the land and water use licensing process. And as the cumulative impacts of increased industrial development are perceived, traditional knowledge is seen as an important contributor to impacts monitoring.

Traditional knowledge studies

Several comprehensive projects have been undertaken in the NWT to document traditional knowledge. Some of this research has been funded through the West Kitikmeot/Slave Study Society, a partnership of Aboriginal and environmental organizations, government and industry that was established to conduct research to develop an information base against which to examine the effects of development in the Slave Geological Province, a geographical area that includes parts of the NWT and Nunavut. The WKSSS has funded several baseline traditional knowledge studies over the last decade.

The Lutselk'e Dene Band undertook traditional ecological knowledge research, and established an extensive traditional monitoring program which used culturally appropriate methods to gather data about environmental indicators that were identified as important in the initial research. The list of indicators monitored was chosen to illuminate the population health, dynamics and resilience of animals, plants and people; and to detect changes occurring in natural cycles and patterns. Information was gathered through standardized questions posed to elders and harvesters through personal interviews, both individually and during collective community land-based activities. Information was organized and stored in a traditional knowledge database, and presented back to elders for verification. The intent of the program was to compile baseline data, and to establish a mechanism for on-going monitoring of environmental trends.

The Dogrib Treaty Council 11 (the forerunner to the Tlicho Government) received funding to document Tlicho knowledge about caribou habitat and caribou migration patterns over time, as well as the relationships between the Tlicho and the caribou. Tlicho elders were concerned about the potential impacts of diamond mines on caribou habitat, and worried that the development of mines would disrupt caribou migration patterns and distribution. The purpose of the study was in part to establish baseline data which would support on-going monitoring of cumulative impacts

of development. Using participatory action research methods, the study involved interviews with elders both in their communities and on the land, language terminology development, and archival research on caribou migrations, mining activity and forest fire activity. Stemming from this work were recommendations for a permanent Tlicho knowledge research and monitoring program, which would continue to compile historical baseline data while at the same time adding to the baseline through contemporary observations. A key emphasis of the Tlicho elders was the need to establish multi-generational knowledge transfer processes that involve elders, active harvesters, young adults and youth working and learning on the land together. In this way, it is felt that knowledge will be passed on in a culturally appropriate manner which ensures it is contextualized.

These studies, and others, faced similar challenges in that they were effectively starting from scratch with regard to the development of appropriate research methodologies, the need to establish accepted terminology and ensure accurate translation, the need to develop Aboriginal residents as researchers, and the need to develop databases capable of storing and retrieving the very specialized information resulting from the research.

Regulatory processes

Pursuant to the requirement in the Mackenzie Valley Resource Management Act that traditional knowledge be considered in environmental impact assessment, the MVEIRB has established *Guidelines for Incorporating Traditional Knowledge in Environmental Impact Assessment* (2005). The generic guidelines, the first of their kind to be developed in Canada, provide background information and advice for developers about traditional knowledge, including an explanation of how traditional knowledge can add value to the environmental impact assessment process, how to work with Aboriginal communities to ensure their policies and protocols are respected, and issues surrounding confidentiality of knowledge.

Community-based monitoring

There is an increasing interest in the potential for using the knowledge and expertise of Aboriginal community residents for environmental monitoring. The first effort to train community monitors was sponsored by the Dene Nation in association with the development of the Norman Wells oil pipeline to Zama, Alberta in the mid-1980's. Since then, several Aboriginal organizations have taken steps towards setting up community monitoring programs. The Inuvialuit Joint Secretariat has implemented a training course for community environmental monitors in partnership with the federal government's Department of Indian and Northern Affairs.

In 2000, an Environmental Monitoring Advisory Board for the Diavik Diamond Mine was created as a result of an agreement among the governments of Canada and the NWT, Diavik Diamond Mines Inc., and several Aboriginal groups. The Board's mandate creates a formal, multi-party structure to monitor all aspects of the project, including environmental impacts, and includes references to traditional knowledge as one means to achieve the mandate.

It would not be possible in the space allotted to give a complete overview of current program and policy activity related to traditional knowledge in the NWT, but these examples provide a sense of the scope and significance of the work that is being undertaken.

Current Application of Traditional Knowledge to Water Policy and Management

Examples provided above illustrate the extent to which traditional knowledge can inform environmental and resource management decision making. Another example from Canada in the Province of Manitoba speaks more directly to the field of water management. Traverse and Baydack (2005) have compared traditional knowledge perspectives about the impacts of the Fairford Dam on Lake St. Martin and the Aboriginal communities surrounding the lake, and concluded that subtle

environmental changes caused by the construction of the dam could not be detected by statistically-based parameters and analysis, but were easily discerned by Aboriginal residents. Hydrological analysis revealed that increases in water levels in Lake St. Martin were not statistically significant. However, water levels in the lake fluctuate as the dam is opened and closed, leading to constant flooding which has caused damage to the land adjacent to the lake. Aboriginal residents have noted that there are fewer fish, and the fish have a "grassy" taste which they ascribe to the changing vegetation as a result of cyclical flooding. Wildlife numbers have also declined, as has the taste and quality of meat, and there are fewer birds. Edible and medicinal plants that previously grew around the lake have been replaced by bulrushes in marshy areas. The authors concluded that Aboriginal observers have been able to discern changes that were not identified by western science based on detection limit methodologies and instrumentation – changes which although not deemed statistically significant have a perceptible and demonstrable impact.

Failing, Gregory and Harstone (2007) describe a structured decision-making process introduced by the British Columbia government to re-examine water allocation at major hydroelectric sites, and how the involvement of multiple stakeholders brought together in decision-making forums to collectively address the systematic treatment of fact-based and value-based knowledge claims results in collective recommendations for action. They provide an example where the input of Aboriginal participants was critical in developing an effective model for major factors limiting fish populations, through their identification of the need to include tributary spawning success as a performance measure in the decision model. Moreover, the dialogue process itself facilitates an enhanced mutual understanding of the substantive issues and interests – which contributes to a more robust level of understanding of the primary and secondary impacts.

NWT Aboriginal peoples have been outspoken in expressing observations about changes to water level and appearance, water quality, the taste of water, and the health and quality of fish, for many years.

They are keen observers of variations over time and continue to monitor and compare contemporary observations with historical trends. Elders throughout the Mackenzie River Valley can comment knowledgeably on the impacts of the construction of the Bennett Dam in B.C. on Mackenzie River water levels, and associated changes in travel, harvesting and fishing habits. A community harvest study in Fort Good Hope identified decreasing fish catches in the mid-1980's. Some NWT communities have changed their drinking water source due to concerns about algal growth, turbidity, and changes in water taste. More recently, changes to water systems as a result of climate change have become part of the dialogue between harvesters, communities, Aboriginal groups and government.

The examples above demonstrate that there is an opportunity for western scientists and Aboriginal people to work together to identify appropriate and accurate indicators of ecosystem health, to ensure that monitoring is robust and comprehensive, and targets the right indicators. From a simple efficiency perspective, engaging harvesters and other users of the land as part of the monitoring network can yield significant increases in field observations and sampling and ultimately reduce operational costs, or support more comprehensive and effective monitoring within current resources.

The Potential for Use and Application of Traditional Knowledge

The exploration of traditional knowledge and its potential applications is a relatively recent field, and one in which research and publication has burgeoned over the past 20 years. Although scepticism about the validity and utility of such knowledge still exists to varying degrees in the scientific community and elsewhere, the degree of acceptance and credibility among both scientists and policy-makers is much greater than was the case 10 or 20 years ago. The most persuasive arguments for the efficacy of working with the two types of knowledge come from those who have actually undertaken field work and analysis in genuine partnership with traditional knowledge holders.

Concomitant with gradually increased acceptance is the developing awareness that the distinctions between traditional knowledge and western science may not, in fact, be as great as was once generally perceived to be the case. The emphasis on the interconnectedness of ecosystems that is characteristic of traditional knowledge is consistent with the concepts and principles of sustainable development. Rather than being distinct from western science, there is an emerging consensus that traditional knowledge and western science are complementary. The strengths of traditional knowledge to expand the store of data accumulated through scientific study and resource management methods can be attributed to several characteristics of this approach:

- The traditional approach generates hypotheses, which can be tested by western science research methods, as with the eider duck example cited above.
- Traditional observers may consider different indicators than those selected by western scientists – for example, a fish species that is valued as traditional food may not be selected as an indicator species by western science - and the identification of these indicators may provide an important insight into monitoring approaches.
- Traditional observers are interested in deviations from the norm, and therefore may focus on outlier events that might be discounted by western science methods – for example, concerns were raised by Dene harvesters in Fort Good Hope in the 1980's about diseased livers in burbot but testing did not lead to any conclusive evidence of a widespread problem. The limits of detection methodologies and instrumentation are contributing factors in excluding what are viewed as qualitative observations.
- Traditional observers take into consideration subtle changes that may not be deemed statistically significant which may nonetheless be important, as with the Lake St. Martin example outlined above.

Further, the depth and richness of traditional knowledge may surpass what is observed by western scientists. Basso (1972) studied the rules of Dene from Tulita for travelling on ice, and determined that harvesters utilised a complex model which specifies the conditions under which ice is safe to traverse, based on a set of categories. He identified thirteen terms that can be translated loosely as "thin ice", but each term incorporates information on a set of eight sub-conditions – state of the ice (solid, melting or cracked); presence or absence of sub-surface water or surface water, texture, thickness, clarity, colour, and cracking features. Thus, for example, one Dene term that might be translated as "thin ice" actually transmits a level of detail, e.g. a condition where ice is solid, has no air pockets, no overflow, is less than one inch thick and is transparent.

These strengths of traditional knowledge have led to considerable discussion in the literature about the potential for it to serve as an "early warning" system in environmental management and monitoring. Bringing together information from two streams of knowledge – western scientific and traditional - can strengthen observations and conclusions, which can only be of benefit to environmental managers and decision-makers. Some authors have noted that traditional knowledge is especially relevant to the field of cumulative effects assessment and management, precisely because of the holistic and integrated nature of the field. Other features of traditional knowledge that directly support cumulative effects assessment and management include the ability to define pre-development baseline information for use in later impact assessment monitoring of effects, the ability to discern relationships among species and between biological and non-biological systems, and the ability to describe subtle variations in many naturally occurring events from year to year . The indicators identified by traditional observers are often similar or identical to the "valued ecosystem components" identified through the environmental impact assessment process.

But in spite of widespread recognition of the potential, the extent to which traditional knowledge has systematically been incorporated into environmental management and decision-making, and the degree

to which opportunities have been formalized to ensure an effective role, are limited. Proponents of traditional knowledge note that it often plays a secondary role to western science; that knowledge which cannot be categorized according to the "who", "what", "where" and "when" criteria of western science is often undervalued or ignored; that traditional knowledge is only deemed credible when it compares favourably with observations and explanations generated by scientific means or bolsters existing scientific evidence; and that it is often dismissed as anecdotal or personal opinion (Barnaby, Emery and Legat 2003, Ellis 2004). An examination of why this state of affairs exists can support recommendations for change.

Challenges to the use and application of traditional knowledge

There are a number of barriers to the effective utilisation of traditional knowledge. These stem both from the inherent nature of traditional knowledge and the need to develop realistic and appropriate expectations for its application, and from challenges that are attributable to the emerging nature of the discipline in a modern context.

Nature of information

Although traditional knowledge can provide a robust, multi-layered and diverse stream of richly contextualized information, its application can be constrained by the geographical boundaries of the individual or collective knowledge holders. Local level observations are not always relevant or accurate to discussions at a larger geographical scale.

Data provided through traditional observation may be viewed as insufficiently rigorous in terms of methods and documentation. Although knowledge is held and shared collectively, there is also a highly individual component in many circumstances which may lead to questions about the integrity of the information, particularly when the information provided by two or more knowledge holders does not agree. This can lead to an assumption by individuals more

comfortable with the methods of western science that traditional knowledge is vague, speculative and value-laden. Traditional knowledge claims may therefore be subjected to greater scrutiny than those of western science, which can be accepted uncritically without recognition of the inherent degree of uncertainty that exists which many scientific assertions, or the fact that western scientists also often disagree. Not every Aboriginal person is a traditional knowledge expert, but there is no established credentialing process to help determine levels of expertise.

In the field of water resources management, where methods are engineering focused and tend to rely on verifiable measures that are deemed "precise", there may be even less openness to accepting the credibility and utility of traditional knowledge information than in fields such as biology. In the NWT, with its spatial expanse of over 1.3 million square kilometres, the lack of consistent and comprehensive baseline data on many areas relating to water resources management means there is a limited basis for comparative analysis which might shed light on the accuracy of traditional observations.

Emerging field of practice

The effort to document and codify traditional knowledge in such a way that it can be used to inform modern environmental management and decision-making is a relatively recent field of endeavour, and as such faces many challenges – both methodological and normative.

One of the greatest strengths of traditional knowledge lies in its nature as a body of observation that has been accumulated over time, which when properly documented can provide badly needed baseline data about a variety of topics – wildlife migration patterns and population trends, weather patterns, impacts of forest fires and other environmental disasters, water levels and flows, and cumulative impacts of development. To date, however, efforts to incorporate traditional knowledge, particularly in environmental impact assessment processes, have tended to

be project-specific, and have been constrained by the lack of thoroughly documented baseline observations. There is also a need for standardized development of geo-databases to permit storage and retrieval of knowledge.

Another drawback is the lack of generally accepted research methods for eliciting, documenting, and storing traditional knowledge; and there are no common standards for collection and use of data. There is a tremendous amount of work occurring in Canada and internationally in this regard, and the continued sharing of best practices will mitigate this to some extent. However, the very fact that traditional knowledge is so deeply rooted in cultural and linguistic context means that methods which are appropriate in one cultural and linguistic context may well not work in a different setting.

The perception of traditional knowledge as anecdotal, or as personal opinion rather than scientific fact, may impede its incorporation in regulatory decision-making processes that deal with highly technical engineering issues – e.g. construction of pipelines, bridges or highways.

Related to this is a concern that the full depth and complexity of traditional knowledge held by elders will be lost as younger generations spend less time learning from their elders on the land, and lose their fluency in Aboriginal languages. Traditional knowledge programs and projects are often integrally linked to language preservation and revitalization for this reason.

Another constraint exists with regard to language and the need for translation of traditional knowledge for incorporation in assessment and decision-making processes that are conducted in the dominant language (generally English). English often cannot accommodate or reflect the richly textured layers of detail that is understood and described in Aboriginal languages. To bridge this gap will require considerable investment of time and resources in the development of

terminology that is understandable and acceptable in the Aboriginal linguistic context and translatable into English.

Data derived from traditional knowledge research cannot be divorced from the context in which it has been accumulated and transmitted, which means that complicated issues may need to be clarified or addressed in order to accurately understand and appreciate the import. This may require dealing with sensitive issues, such as topics that are considered taboo or only appropriate for discussion with certain categories of people, even within Aboriginal communities.

Related to this is the difficulty of bringing together the insights gleaned from two different ways of understanding the world into a meaningful, cohesive whole. Even for those who are open to the prospect, it is not always easy to relate findings from one knowledge system to another without affecting the integrity of either.

There is also a political dimension to this issue which cannot be ignored. In some instances, Aboriginal groups feel that traditional knowledge is being appropriated by western institutions for their own purposes, and are reluctant to see it shared except in situations where they retain full control. At the other end of the spectrum, traditional knowledge representations may sometimes be accepted uncritically by those who are afraid of giving offense by questioning the legitimacy or validity of knowledge claims.

Although there have been numerous projects undertaken in the NWT over the past 20 years, the knowledge gathered by these projects is inconsistent, incomplete, and often not in a format that can be shared, compared and contrasted. In some cases, lack of continuity in funding and personnel has led to the loss of project results. There is limited capacity or resources to aggregate study results into broader baseline summaries, for example, or to bring together the results of community-based monitoring projects to provide insights into broad trends.

Finally, and perhaps of most importance, is the fact that the infrastructure for effective, adequate traditional knowledge work does not yet exist. Traditional knowledge efforts are constrained by limited and inconsistent funding. There are few established funding sources or long-term funding programs in Canada dedicated solely to this purpose, which results in lack of continuity in research and personnel. Training and capacity is also an issue. For effective documentation and codification of traditional knowledge, highly trained cultural interpreters are needed who can work with equal comfort in two arenas – that of environmental managers and that of elders.

The lack of infrastructure creates a Catch-22 effect: traditional knowledge cannot establish its credibility without the appropriate funding support, but funding support will be difficult to justify if the credibility of the knowledge to be gained is not recognized.

In summary, the emerging field of traditional knowledge faces a number of challenges before it can take its place as a respected and fully participating contributor to environmental management and decision-making. These can be summarized as follows:

- The need to establish credibility and overcome resistance by the scientific community;
- The need to establish traditional knowledge as relevant and credible in regulatory processes;
- The need to establish and document generally accepted research methods, while recognizing the need for flexibility to adapt to cultural requirements;
- The need to develop effective mechanisms for storing and retrieving information;
- The need to develop a cadre of trained and competent researchers;
- The need to develop terminology in Aboriginal languages and English that is capable of translating the complex and multi-dimensional aspects of traditional observations and conclusions;

- The need to address sensitive issues like ownership, control and intellectual property rights collaboratively and constructively;
- The need to identify dedicated, adequate funding sources to support this work; and
- The need to overcome the fragmentation of traditional knowledge research and findings.

Finding a Way Forward

The discipline of traditional knowledge is positioned to move into a new era of credibility and increasing utility. In spite of the methodological challenges, work over the past 30 years has resulted in the gradual emergence of effective and accepted research methods. There continues to be increased acceptance of the credibility, the reliability, and the utility of traditional knowledge as it pertains to environmental management and decision-making. The implementation of land claims and self-government agreements have not only given Aboriginal groups greater control political control and the resources to determine research needs and priorities, but they have also resulted in co-management bodies that are more open to using traditional knowledge as a matter of course.

In a time of increased public concern over the need for environmental sustainability, and in the face of environmental pressures like climate change and the Deepwater Horizon oil spill, there is renewed interest in finding ways of adaptive management that allow humans to benefit from the earth's resources without doing irreparable damage.

The importance of traditional knowledge for water management and policy in northern Canada

Nowhere is the need to find sustainable ways of using resources more urgent than as it relates to the need to manage valuable water resources – the NWT's greatest natural capital. In the NWT as elsewhere, water resources need to be managed, protected and preserved to ensure the future health of the environment and the well-being of northern populations. But equally important is the socio-economic dimension. Water represents the largest stock of natural capital in the NWT, and a hugely

important future economic resource. Jurisdictions such as Alberta will increasingly look to the north as their own water resources are depleted through a combination of changing climate patterns and industrial use.

The Aboriginal subsistence economy, while limited in terms of its gross domestic product quantum, continues to play a vital socio-cultural role in the northern economy, and its continued viability is seen by Aboriginal people as critical to the health, well-being and sustainability of their communities.

Tourism is also a significant contributor to NWT economic activity. Like the traditional economy, tourism does not generate large revenues, but provides a sustainable economic activity for northern communities that is dependent on a healthy environment and the continued quality and quantity of NWT water sources.

Investments in protecting NWT waters are thus investments in the future economic prosperity of the NWT. But the challenges are huge. There is a critical shortage of baseline data to support environmental impact assessment and on-going monitoring. This issue is not new – it was flagged in the mid-1980's by the Mackenzie Environmental Monitoring Program – but resources have never been made available to implement a scientific monitoring system that adequately addresses the immensity and complexity of the Mackenzie River Basin system. The need for on-going monitoring becomes increasingly critical in the face of enhanced industrial development upstream.

Attention to impacts on water resources is arguably the single biggest determinant of workload, cost driver, and review process time requirements in the NWT impact assessment process. Water resources governance and management activities comprise a significant proportion of total workload for staff, decision-makers, and interveners. There is a perceived lack of efficacy in this area, in large part due to the insufficient capacity of the regulatory and management system.

The traditional knowledge of NWT Aboriginal people is an invaluable resource that can be drawn upon to strengthen and enhance not only the environmental impact assessment process, but the existing monitoring regime, for NWT water resources. The geographic positioning of Aboriginal communities in the NWT provides a network of potential monitoring nodes strategically positioned to encompass critical components of the Mackenzie River basin drainage system. Many Aboriginal people maintain land-based lifestyles, and continue to monitor and analyse environmental trends as they have always done. They have the expertise, they are on the spot, and they have the political desire to play a management role.

But the knowledge and skills of Aboriginal people should not be seen simply as a resource to help improve existing monitoring processes. The unique strengths of traditional knowledge as outlined above can be brought to the task. Identifying indicators that are meaningful in a traditional knowledge context; tracking subtle changes (i.e. those below current detection and significance limits) that may not be captured through hydrological studies or may not be deemed statistically significant; identifying system-wide changes and interpreting this information through the knowledge base that has developed over centuries; all will position Aboriginal monitors to contribute a range of knowledge that is now absent from existing monitoring approaches.

What is needed

The potential is huge, but it cannot be realized without a concerted effort involving Aboriginal governments and organizations, federal and territorial government departments, co-management boards, regulatory agencies and academia. It will require sustained and broad-based political will, and commensurate resources, over an extended time period, to move forward. With reference to the constraints and challenges outlined above, an approach for success would include all of the elements outlined below.

1. Stakeholders must work collaboratively to establish realistic and meaningful expectations for the role the traditional knowledge can play in environmental management and decision-making. This will include understanding and accepting the differences between traditional knowledge and western science while honouring the similarities. It will include an acceptance that traditional knowledge claims, like scientific claims, must be analytically rigorous and defensible, and subject to challenge. And it will include the establishment of standards of practice, to address the issues such as the fact that not every Aboriginal person is a qualified traditional knowledge practitioner, just as not every non-Aboriginal person is a qualified scientist. Aboriginal communities will play a lead role in defining standards and expectations that will guide appointments to co-management boards, selection of researchers, etc.
2. Stakeholders must work collaboratively to identify sensitive issues such as confidentiality and intellectual property rights, and develop solutions.
3. Government agencies and Aboriginal governments and organizations must work in partnership to establish robust, on-going monitoring programs – not only to provide input to existing monitoring programs but as parallel processes which can contribute insights and data.
4. Stakeholders must work collaboratively to establish mechanisms to bring together two streams of knowledge – traditional and scientific – in a manner that acknowledges the uniqueness of each but finds a way to weave their insights into a cohesive whole. This should happen at a project-specific level during the course of environmental assessments.
5. A broader forum or process needs to be established to provide a means by which traditional knowledge findings from specific Aboriginal groups can be brought together to inform regional, territorial, and interjurisdictional or transboundary discussions that deal with larger geographical areas – for example, caribou migration issues, or managing at a watershed scale.

6. Protocols should be established to ensure the appropriate use of traditional knowledge at all stages of environmental decision-making.
7. Resources will be required for programs to enable all the following:
    - Compile historical and existing baseline data
    - On-going community-based monitoring to contribute to baseline data
    - Development of database systems
    - Training of researchers
    - Development of linguistic terminology.
8. Standards should be developed for geo-database programs to ensure that data can be compared, consolidated and contrasted among regions/jurisdictions.
9. Mechanisms should be developed to enable best practices, research methods and evaluation approaches of traditional knowledge programs.

To be successful, all of this work will require truly collaborative processes, based on partnership and a common vision; and it must be recognized that Aboriginal groups will only be interested in collaboration to the extent that they are not asked to give up control over the process or the results. This is why the GNWT made every effort to involve Aboriginal stakeholders in the development of the *NWT Water Stewardship Strategy* – and the *Strategy* identifies some initial steps towards responding to the actions outlined above.

Based on the results of the GNWT's consultations, the *Strategy* emphasizes the importance of finding ways to utilise traditional knowledge. It proposes to achieve this by completing an inventory of all traditional knowledge protocols already completed in the NWT by Aboriginal, territorial and federal governments, communities and regions. This would be an important first step towards the necessary sharing of best practices. The *Strategy* also proposes to support the development of traditional knowledge protocols where needed, which will help to put all Aboriginal groups and regions in the

NWT on a more even footing. It recognizes the need to develop management decision models that identify appropriate ways to apply traditional, local and scientific knowledge to management decisions through a collaborative process.

At a more local level, the *Strategy* commits to support the development of community capacity through effective community-based monitoring programs. It proposes a pilot study for community water source protection that links aquatic ecosystem indicator development and community-based monitoring. This could be an important first step towards establishing a broader system of community monitoring nodes. In order to make such programs effective and relevant, the *Strategy* recognizes the need for research in a number of areas, including receiving water standards, thresholds and carrying capacity, sensitivity of northern aquatic species to toxins produced by industrial activities, water quality and quantity, and the effects of climate change on ecosystems.

These commitments in the *NWT Water Stewardship Strategy* represent a first step towards finding effective mechanisms to use traditional knowledge to strengthen and support the water management system in the NWT. The GNWT looks forward to continuing its work with all other stakeholders to advance the state of traditional knowledge use and application in northern Canada.

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