

Large Area Planning in the Nelson-Churchill River Basin (NCRB): Laying a foundation in northern Manitoba



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Large Area Planning in the Nelson–Churchill River Basin (NCRB): Laying a foundation in northern Manitoba

November 2016

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Executive Summary

Background

Watershed ecosystems provide a wide range of benefits, from clean water, aquatic habitat and regulating temperatures to cultural, spiritual and recreational benefits to local and global populations. The Millennium Ecosystem Assessment (MA, 2005) highlighted these “ecosystem benefits” as those critical to human well-being and dependent on well-functioning ecosystems, including watersheds.

This report summarizes research on the combined Nelson–Churchill River Basin (NCRB) in Canada and the United States, emphasizing key benefits from this landscape. We then make a strong case for strategic integrated management of NCRB lands and waters for long-term delivery of these key benefits, highlighting specific steps towards this goal. We lead with an assessment in the northern Manitoba portion of the basin, referred to as the “northern NCRB,” with plans for subsequent phases addressing trans-jurisdictional components.

NCRB: An Overview

The combined NCRB is the third largest watershed in North America, with a drainage area of more than 1.4 million km². The Nelson River receives water from Lake Winnipeg and flows through northern Manitoba to the Hudson Bay. The Churchill River flows through parts of northern Alberta, Saskatchewan and Manitoba, with a portion of flow being diverted into the Nelson River at Southern Indian Lake, Manitoba; the remaining waters flow through the Churchill River to Hudson Bay (Newbury & Malaher, 1973). The hydrologic regime of the northern NCRB is very complex and is heavily influenced by hydroelectricity generation and related development in the region, as well as the potential impacts of climate change.

While the region has seen significant changes in its water systems over the past several decades, the northern NCRB provides water, food, jobs, tourism opportunities, recreation and significant inputs into the Canadian economy. The MA framework (2005) organized these kinds of benefits into four categories: provisioning services such as food, water and biomass; regulating services such as climate regulation and water flow management; cultural services such as recreation, spiritual enrichment and aesthetics; and supporting services such as habitat and biodiversity.

Our research highlighted some of these benefits as priority ecosystem services to illustrate the potential economic value of the region and to highlight the need for long-term management.

Provisioning services in the northern NCRB include food, fresh water, hydroelectricity, minerals and metals. The value of commercial fisheries in northern Manitoba lakes was CAD 1.77 million in 2011–12 (Manitoba Sustainable Development, 2012). In 2014, the value of mining in Manitoba was approximately CAD 1.4 billion (metallic and industrial minerals) with five producing mines in or near the northern NCRB (Growth, Enterprise and Trade, 2016). In 2016, Manitoba Hydro produced hydroelectricity worth roughly CAD 1.8 billion (Manitoba Hydro, 2016). In 2015, forestry in Manitoba (some of it in the northern NCRB) contributed CAD 387 million to provincial forestry exports (Natural Resources Canada, 2015).

Regulating services in the basin include flood and drought management, water quality regulation, erosion control and other services. Globally, the boreal is estimated to store “more than 700 billion tons of carbon in its trees, wetlands and soils” (Badiou, 2015).



Cultural services include a wide range of recreational and aesthetic services, as well as various services used by Indigenous communities in the north such as medicines and spiritual benefits. To illustrate the magnitude, the northern region of the province contributed CAD 116 million to the economy from tourism in 2016—8 per cent of tourism spending in the province (Travel Manitoba, 2016).

Supporting services in the study region include habitat for fish, waterfowl and wildlife, and biodiversity in general. This region supports recreational and commercial fisheries including walleye, northern pike, lake whitefish and others.

Ecosystem Management of the Northern NCRB

The notion of large area planning for optimizing benefits is not new to Manitoba or Canada. In 1997, the premier of Manitoba launched a multi-party consultation, the Consultation on Sustainable Development Implementation (COSDI), to “consider and make recommendations to government on how Manitoba can best implement sustainable development principles and guidelines into decision-making, including environmental management, licensing, land use planning and regulatory processes.” The resulting report asserted that “large area level” planning was needed in Manitoba, and strongly recommended that these areas “maximize the use of natural boundaries such as watersheds for defining the large planning areas” (Government of Manitoba, 1999).

Most recently, the Clean Environment Commission (2015) conducted hearings on the regulation of water in Lake Winnipeg, a major reservoir and sub-basin in the NCRB, and stated:

The commission considers that all activities affecting the Lake Winnipeg–Nelson River watershed should be assessed in light of all impacts, taking into account the three pillars of sustainable development: social, economic and environmental sustainability. (p. 19)

In the broader Canadian context, the Mackenzie Valley Land and Water Board decentralizes water management through the existence of regional regulatory boards that emphasize co-management and are empowered to issue and manage land-use permits and water licenses.

We looked at ways to manage the northern NCRB for maintaining long-term sustainability and ensuring that current priorities are met. A literature review identified seven principles of ecosystem management and considered how these apply in the northern NCRB. Specific case studies of how these principles were used in the management of the Fraser Basin in Canada, Mekong Basin in Asia, and the Plan Nord Initiative in Canada provided practical guidance on implementation. These principles and their application in the northern NCRB include:

- 1. Basin Planning:** An overarching principle found in all documents reviewed is that a good blueprint is essential for effective basin management (e.g., Blomquist, Dinar, & Kemper, 2005; Government of Alberta, 2015; Roy, Barr, & Venema, 2011). While there are currently efforts in sub-basins of the NCRB, including the Red River Basin, Assiniboine River Basin, etc., no basin-wide initiative exists for the northern NCRB. Efforts from these sub-basin initiatives would need to be assessed, compiled and scaled-up for strategic management of the NCRB.
- 2. Leadership:** While the specific nature of basin leadership varies (e.g., government; consortium; non-profit; multi-lateral organization, etc.), the documents reviewed (Blomquist, Dinar, & Kemper, 2005; Brandes & O’Riordan, 2014; Roy, Barr, & Venema, 2011; Schmeier, 2012; Sheelanere, Noble, & Patrick, 2014) revealed some common characteristics found in many



leadership entities, including the ability and widely accepted mandate to provide strategic direction, convene interests, coordinate planning, make decisions, obtain or provide necessary resources, etc. Although there is no one obvious regional lead for the northern NCRB, the region does have active planning initiatives that can act as building blocks, including the recently announced task force to lead the Northern Economic Development Strategy (Government of Manitoba, 2016), resource management boards, the Boreal Songbird Initiative, the Boreal Woodland Caribou Recovery Strategy, etc. Recent developments such as the closure of the Port of Churchill, reductions in rail service, uncertainty in the forest industry and impacts on regional economies could be considered systematically in a large-area planning effort.

- 3. Multi-party or multi-scale approaches:** Incorporating different perspectives from a range of levels helps ensure broad support while maintaining on-the-ground knowledge informing basin initiatives. The examples of existing multi-party initiatives in the region, such as the former Thompson Economic Development Working Group, incorporate some of these options. Some of these approaches could contribute to initial discussions and/or evolve into watershed-focused engagement.
- 4. Shared decision making with Indigenous communities:** Due to its presence in northern Canada, it is particularly important that decision making in this basin involves Indigenous communities that have perspectives and legal rights of their own. The land in the NCRB falls under Treaty 5 (Manitoba) and Treaty 10 (Saskatchewan). An estimated 65 per cent of people in northern Manitoba are Indigenous (Government of Manitoba, n.d.a) and many participate in traditional activities such as hunting, fishing and gathering. Traditional knowledge can strengthen planning, and Indigenous involvement in creating a sustainable path forwards is essential. Northern Manitoba's resource management boards present one approach to co-management with Indigenous Peoples, as do approaches of and lessons learned from Manitoba Hydro collaborations with Indigenous communities (e.g., Keeyask).
- 5. Monitoring and reporting:** Robust monitoring and transparent reporting are key components of adaptive management where lessons on what is working are fed back into decision making and resource allocation. Monitoring and reporting is carried out in the northern NCRB by a variety of entities (e.g., Manitoba Hydro, the Government of Manitoba, the Government of Canada, North/South Consultants, mining companies [Vale and Hudbay], forestry [Tolko; any buyer of Tolko's assets would also be expected to monitor and report] and, on smaller scales, various communities). Key efforts under an ecosystem management approach would include increasing coordination between monitoring efforts, coordinating data sharing, enabling reporting and ensuring feedback for decision making.
- 6. A role for legislation:** As appropriate, using legislation for establishing institutions, defining mandates, protecting organizations or establishing environmental or performance standards will be critical for strategic management of this complex, multi-jurisdictional basin in the long term. As part of a long-term planning process, specific roles of existing and potentially new legislation would be discussed.
- 7. Consistent and long-term funding:** Funding is needed not only to plan but also to implement actions for watershed management. This might include infrastructure assessments, technical analyses of land and water systems, community projects, monitoring, etc. In the northern NCRB, significant government, industry and other funding (e.g., the Nisichawayasihk Trust) flows into water and land-related management. Much of this is funding related to government services and



legislative expectations (e.g., water and wastewater treatment; enforcement of environmental legislation; conservation programming) and industry requirements (e.g., mitigation for environmental effects).

Recommendations

Based on our research, we provide six key recommendations for moving towards strategic management of the northern NCRB:

- 1. Prioritize a northern NCRB initiative:** The northern NCRB needs our attention due to a variety of factors. A basin-planning effort is required to ensure that development in the northern portion of the NCRB is sustainable and that decision making is informed by integrated thinking and long-term objectives. This need should be prioritized at the political, policy, and operational levels to ensure that social, environmental and economic objectives for the region are understood and managed.
- 2. Identify, quantify and prioritize ecosystem services in the northern NCRB:** A more complete understanding of the ecosystem service benefits provided by the northern NCRB is important so that the land and waters can be managed with full knowledge of opportunities and possible trade-offs. This knowledge can be gained through a combination of analytical and deliberative processes to ensure coordination on efforts to address biodiversity, flood/drought control, nutrient capture, hydroelectricity generation, carbon sequestration, rural revitalization, tourism, etc. Systematically identifying, quantifying and analyzing these services and getting inputs to help prioritize them for basin management would help governments and agencies align efforts at various levels.
- 3. Form a multi-party, basin-level organization with the inclusion of Indigenous communities:** An essential step towards large-basin management would involve the creation of a multi-party body at the basin scale that could coordinate, fund and manage basin planning and management activities. An important feature of this basin organization would be to ensure meaningful inclusion of Indigenous Peoples from the region.
- 4. Ensure adequate funding for a northern NCRB initiative:** One of the biggest barriers to watershed management success identified in the extant literature is lack of adequate and consistent funding. We recommend that any initiative access diverse traditional and innovative sources to help create adequate and consistent funding. Development of regional markets for strategic private and public benefits would need to be carefully managed in the context of ensuring well-being and security for all communities.
- 5. Use existing entities and processes to build basin-level thinking:** In a northern NCRB initiative, leadership could be provided by a multi-party steering committee, building on current institutional roles and programming. Those to draw on to build basin-level thinking include resource management boards, a current process to create a northern economic development strategy in Manitoba, Government of Canada's support and recognition of the role of Indigenous communities, as well as laws such as the Canadian Environmental Assessment Act and the Manitoba Environment Act.



6. Enhance monitoring, data sharing and reporting: Without sufficient data on environmental, social and economic considerations—including of baseline conditions—management targets and goals (important parts of basin plans) cannot be created. We recommend baselines be systematically established, understanding of temporal and spatial trends be strengthened and priority regions be identified. Importantly, monitoring can help identify the most effective (and ineffective) management actions; this information can then feed back into decision making. In addition, these efforts can be used to enable transparency and trust among watershed interests.

The next steps of IISD’s work on the northern NCRB include further efforts in analyzing specific ecosystem services in the northern NCRB (based on land use, land cover), with inputs from relevant rightsholders and other interests; initial discussions with key government and non-governmental entities to make the case for basin management and build towards recommendations and actions; development of key indicators for well-being for the northern Manitoba part of the basin to articulate regional priorities; and detailed policy analyses to understand current mechanisms and how these could play a role in ecosystem management.





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Abbreviations and Acronyms

CAMP	Coordinated Aquatic Monitoring Program
CEDF	Communities Economic Development Fund
CEPA	Canadian Environmental Protection Act
CESI	Canadian Environmental Sustainability Indicators
COSDI	Consultation on Sustainable Development Implementation
CRD	Churchill River Diversion
EGS	ecosystem goods and services
EIA	Environmental Impacts Assessment
EIS	Environmental Impact Statement
FBC	Fraser Basin Council
FEMP	Federal Ecological Monitoring Program
FREMP	Fraser River Estuary Management Program
IWMP	integrated watershed management plans
IWRM	Integrated Water Resources Management
JKDA	Joint Keeyask Development Agreement
LWCNRSB	Lake Winnipeg, Churchill and Nelson Rivers Study Board
MA	Millennium Ecosystem Assessment
MC	Mekong Committee
MEMP	Manitoba Ecological Monitoring Program
MERN	Ministère de l'Énergie et des Ressources
MRC	Mekong River Commission
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resources Management Act
NCN	Nisichawayasihk Cree Nation
NCRB	Nelson–Churchill River Basin
NDS	Northern Development Strategy
NGO	non-governmental organization
NFA	Northern Flood Agreement
PES	Payment for ecosystem services
RCEA	Regional Cumulative Effects Assessment
RMB	resource management board
SFM	Sustainable Forest Management
TEDWG	Thompson Economic Diversification Working Group
UN	United Nations
WWF	World Wildlife Fund

1.0 Introduction





1.0 Introduction

In recent decades, a global trend in large basins is the development of integrated, large-scale planning efforts to manage watershed ecosystems for key environmental and socioeconomic priorities. Unfortunately, these are often in reaction to environmental problems and crises, such as water shortages, water quality concerns, lack of water for agricultural needs, or industrial impacts on water, flooding, etc. Watershed ecosystems provide a host of benefits (e.g., nutrient capture, flood mitigation, food provision) that support both human and environmental well-being, a realization popularized with the Millennium Ecosystem Assessment in 2005 (Millennium Ecosystem Assessment, 2005). The need to recognize and prioritize these ecosystem benefits in basin planning is increasing (Roy, Barr, & Venema, 2011).

This paper considers the Nelson–Churchill River Basin (NCRB) in Canada—the third largest North American basin—in the context of this trend. We lead with an assessment of the northern Manitoba portion of the basin, referred to as the “northern NCRB,” with plans for subsequent phases addressing trans-jurisdictional components. The northern NCRB has already undergone significant environmental change through the diversion of a portion of the Churchill River flow into the Nelson River, and the development of hydroelectric facilities altering the hydrologic flow of the rivers. Other development pressures include mines, forestry, tourism, infrastructure development and climate change. In light of these trends and the proven benefits of watershed management approaches (e.g., Bach et al., 2011; Blomquist, Dinar, & Kemper, 2005; Brandes & O’Riordan, 2014), we present research making a strong case for integrated management of the northern NCRB system, and demonstrate how existing initiatives, policies and institutions can play a role in building towards this purpose. Such an approach would be intended to sustain (and possibly improve) ecosystem services we obtain from the basin long into the future and to support socioeconomic well-being.

The ultimate goal of this research is to inform a framework for integrated management in the NCRB, focusing first on the northern Manitoba portion of this basin to clarify concepts before beginning the more complicated transboundary aspects of basin policy and management. This report is comprised of two main components. The first focuses on summarizing the biophysical, social and economic characteristics of the basin based on numerous studies already conducted. The second explores appropriate governance and management systems and tools and their relevance to the northern NCRB. We believe that this combination can help lay the foundation for strategic management in the northern Manitoba portions of the basin and, in turn, provide the momentum for sustainable management in the entire NCRB.

1.1 Drivers and Pressures

Over the next few decades, the northern Manitoba portion of the NCRB is expected to experience significant changes due to climate change. A pattern of warming temperatures could reduce snow and ice cover in winter, expose permafrost and reduce soil moisture (Arctic Climate Impact Assessment, 2005; Gagnon & Gough, 2005; Natural Resources Canada, 2004). Given the potential environmental and socioeconomic effects of climate change, planning for these effects will aid in mitigating negative impacts and in capitalizing on positive ones. For instance, a changing climate is already leading to more ice-free days on the Hudson Bay, which may make shipping goods through the Port of Churchill more appealing (and reverse the fortunes of the port, which was closed in 2016). When planned carefully, with risks carefully considered, this type of development provides an opportunity for economic benefits to local populations.

Increases in resource development, including the potential for mining, forestry and hydroelectric development, as well as potential growth in the already sizeable tourism industry in the region, could add new stresses to the environment, but they also present opportunities, particularly to improve socioeconomic



conditions in northern communities. Large-scale basin planning that anticipates negative effects and proactively prevents or mitigates them could support sustainable development in the region. Already, mines in Manitoba, several of them in the northern NCRB, support a CAD 1.4 billion provincial mining industry (metallic and industrial minerals) (Growth, Enterprise and Trade, 2016). In 2015, forestry in the Manitoban portion of the NCRB contributed CAD 387 million in provincial forestry exports (Natural Resources Canada, 2015), though the future of this industry is uncertain at the time of writing, as the region’s forestry operator, Tolko Industries, announced it is closing its operations in December 2016 (CBC, 2016).¹ In 2016, tourism contributed CAD 116 million to northern Manitoba’s economy—8 per cent of tourism spending in the province (Travel Manitoba, 2016).

Urgency for large-basin planning in the northern NCRB comes from several sources, including recent economic challenges (e.g., closure of the Port of Churchill, reduced rail service, Tolko’s withdrawal from forestry operations in the region) and current political priorities. At the provincial level, the Progressive Conservative government elected in April 2016 has announced several initiatives relevant to sustainable development in the region, including increased funding for tourism development in northern Manitoba (Government of Manitoba, 2016a) and the creation of a task force to lead the implementation process for the northern economic development strategy (Government of Manitoba 2016d). At the federal level, the 2016 Government of Canada budget announced CAD 8.4 billion in funding over five years “to improve the socio-economic conditions of Indigenous peoples and their communities and bring about transformational change” (Indigenous and Northern Affairs Canada, 2016). Many of the investments relate in a broad way to good land and water stewardship, such as funding of water and wastewater treatment, waste management, drinking water monitoring on reserves, community infrastructure (including natural disaster mitigation) and supporting public and indigenous participation in environmental assessments (Indigenous and Northern Affairs Canada, 2016). While the northern NCRB is not a specific focus, the support for greater Indigenous engagement and improved relationships complements shared decision making for regions. As discussed in this report, Indigenous communities within the northern NCRB are increasingly taking on management of major infrastructure in the basin, such as in the current proposal from a consortium of communities to buy and operate the Hudson Bay Railway line, which runs to the Port of Churchill. A number of communities have also entered into partnership agreements with Manitoba Hydro in recent years to develop hydroelectric facilities. For sustainable development in the northern NCRB, it is critical that such an initiative be contextualized within broader regional (we argue watershed-based) planning. In addition, based on our research, we make the case that Indigenous Peoples be meaningfully involved and share in benefits.

This report begins to consider these intertwined and complex socioeconomic and environmental considerations in integrated watershed planning of the northern NCRB. Nevertheless, to fully consider them in depth, understand the interconnections and create a full framework for basin-level planning, more work needs to be undertaken collaboratively with all interests to further assess specific ecosystem services and potential trade-offs. Perhaps most importantly, this basin planning requires dialogue and the eventual development of a governance structure in the basin. As such, this report makes few conclusive recommendations; the path forward is ultimately for those with a stake in the basin to decide together. This report is meant to prompt basin-scale thinking and help create a discussion among northern NCRB interests about how their land and waters can best be co-managed. Moreover, we hope any process encouraged by this work ultimately links with basin-level initiatives in the upper (i.e., southern) portion of the greater NCRB.

¹ In November 2016 Tolko Industries Ltd.’s Manitoba operations and assets were sold to American Industrial Acquisition/Canadian Kraft Industries Limited (Government of Manitoba, 2016e)

A winter landscape featuring a frozen lake in the foreground, with snow-covered ground and bare bushes. In the background, a line of evergreen trees is visible against a dramatic sky with a sunset or sunrise, showing vibrant red and orange hues. A large blue semi-transparent overlay is positioned on the left side of the image, containing the title text.

2.0 A Summary of the NCRB in Northern Manitoba



2.0 A Summary of the NCRB in Northern Manitoba

2.1 Introduction to NCRB

Section 2 compiles existing comprehensive information to describe biophysical and socioeconomic characteristics of the northern NCRB to facilitate understanding of the basin’s characteristics. Ecosystem services are being assessed in many regions globally as an approach to address local sustainability challenges (Wong et al., 2015). This summary explains key benefits or ecosystem services that we receive from the basin and identifies ecosystem and socioeconomic priorities and trends. This literature review was conducted through online catalogues, database searches for technical reports, academic theses, peer-reviewed articles and grey literature.

The section begins with a general description of the geography and climate of the basin, focusing on changing conditions and a need for managing future risks. It also discusses the rationale for combining the two basins together as an integrated watershed, providing a brief history of the two rivers based on the understanding that historical trends are often a guide for future planning. A summary of the social and economic information for the northern Manitoba portion of the basin follows; it includes demographics and major economic sectors such as mining, forestry, hydroelectricity, commercial fisheries and subsistence economies. Finally, we present a general review of the hydrologic regime of the basin with emphasis on the major alterations of the system (e.g., water flows, water levels, erosion) that have occurred.

Following the general overview, we introduce a selection of major studies that outline the environmental impacts on the two rivers. While these studies have been carried out mostly in the context of hydroelectric development, the intent here is to simply demonstrate the range of studies that can help develop an integrated management framework for the NCRB. Included is a brief description of the concept of ecosystem services and some examples from the NCRB to be initially considered for management.

Box 1. Basins versus Watersheds

In this paper, the words “watersheds” and “basins” are both used to refer to the same area: the Nelson–Churchill River Basin area as defined by this project. However, while commonly used interchangeably, they refer to slightly different things in geographic terminology. A drainage basin is an area defined by the property of all surface flow eventually converging on a single channel downstream. Basins are nested hierarchically, and may describe a single stream’s alpine headwaters, or a continental-scale basin draining into a major river such as the Nelson or Mississippi. Basins at all scales are separated by lines called watersheds or drainage divides. These borders may be distinct, such as a mountain range, or more nebulous such as those in low-relief plains and grasslands. Both “basin” and “watershed” define within them a region sharing common surface waters and encompass the connection human and natural users have to the quality and quantity of water (USGS, 2016).

2.2 General Overview of the Basin

2.2.1 Geography of the Basin

The NCRB is the third largest watershed in North America. Runoff from four Canadian provinces and four American states drains the 1.4 million km² between the Canadian Rockies mountain range and Lake Superior, conveying water from across the interior of Canada through the northern Manitoban Canadian Shield and into Hudson Bay (Newbury & Malaher, 1973; Shiklomanov & Rodda, 2003). The Nelson



River basin covers 1,072,255 km², beginning on the eastern slope of the Rocky Mountains and travelling through Alberta, Saskatchewan and Manitoba through Lake Winnipeg and ultimately flowing to Hudson Bay (Rosenberg, Chambers, Culp, & Franzin, 2005). The Churchill watershed covers 280,000 km² (Figure 1) (Newbury, 1990; Rosenberg et al., 2005), starting northeast of Edmonton, Alberta, west of Beaver Lake near Lac la Biche, and running parallel to the Nelson River. The river systems veer closer to each other at Southern Indian Lake (the Churchill catchment) and the Rat-Burntwood River (the Nelson catchment) in northern Manitoba.

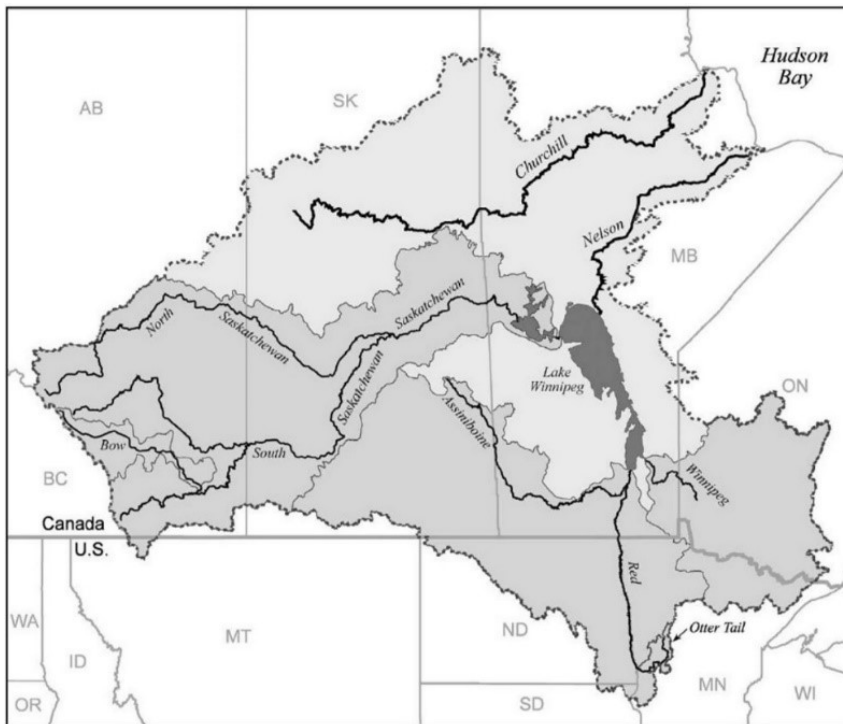


Figure 1. Map showing the geographical location and the extent of the full NCRB.

Source: Rosenberg et al. (2005)²

In the mid-1950s, it was suggested that the Churchill River be diverted into the Nelson catchment to take advantage of hydroelectric power generation. The diversion was completed in 1977, when the damming of Southern Indian Lake caused its waters to rise 3 metres to connect with the Rat-Burntwood River (Hecky, Newbury, Bodaly, Patalas, & Rosenberg, 1984). The Water Resources Branch of the Manitoba Department of Mines granted Manitoba Hydro a licence to divert up to 990 m³/s of water from the Churchill into the Nelson, reducing approximately 85 per cent of the average flow of the Churchill River (Lake Winnipeg, Churchill and Nelson Rivers Study Board, 1975). Currently, Manitoba Hydro has five generating stations on the Nelson River.

Split Lake divides the upper and lower basins of the Nelson River. The upper basin is characterized by the Great Plains and the Prairies, while the lower basin follows the Boreal Shield and Hudson Bay. Because the southern landscape falls within the more populated agricultural belt (Statistics Canada, 2011), it has developed and changed along with the networks of road, rails, retention ponds and culverts that are characteristic of agricultural and urban development. When the Nelson River reaches the remote

² Reprinted from Rivers of North America, Rosenberg et al., Nelson and Churchill River Basins, pages 853–901, Copyright (2005), with permission from Elsevier.



and undeveloped northern hinterland below Jenpeg, population density—and the development that goes along with urbanization—drops: northern Manitoba contains only one city (Thompson) along with a variety of smaller towns and Indigenous communities.

Because they run through the same regions, the Churchill River’s basin resembles the Nelson River’s. It runs through the Boreal Plain and Boreal Shield ecozones in northeast Alberta and Saskatchewan. The billion-year-old craton of the shield has created granite fissures and glacial morphology that shape the run of the river. The northern limits of its lower basin in the Reindeer and Wollaston Lake region drain some of the Taiga Shield until it reaches the low-relief Hudson Plain (Rosenberg et al., 2005).

2.2.2 Focus of Study on Lower (Northern) NCRB

In our efforts to understand the interconnected Nelson and Churchill basins, we have focused on the northern Manitoba portion of the NCRB (see Figure 2). This approach will help us clarify concepts before beginning the more complicated transprovincial and transboundary aspects of basin policy and management in the full NCRB. It will also help us reconcile the ecosystem boundaries with political ones that determine policies and management systems to a large extent. Therefore, we refer to the “northern NCRB” to differentiate this region from the full basin. The Manitoba portion of the northern NCRB encompasses just over 200,000 km²— roughly 91,000 km² in the Nelson watershed downstream of Lake Winnipeg, and 109,000 km² in the Churchill watershed (about 34 per cent of the Churchill watershed’s total area, with the remainder in Saskatchewan and Alberta).

Furthermore, the distinct geographical, social, ecological and hydrological differences between the Lake Winnipeg sub-basin (upstream and including Lake Winnipeg) and the Nelson and Churchill rivers and their immediate tributaries demonstrate that, from a policy and governance perspective, it makes sense to treat these areas as separate regions. However, it is a clear principle of basin management that impacts to water quality and quantity upstream will have effects on stakeholders downstream. Therefore, while our current focus is on the lower (i.e., northern) portions of the basin within Manitoba, we hope to connect with existing and proposed efforts in the upper (i.e., southern) portions, such as those focused on the Lake Winnipeg watershed.

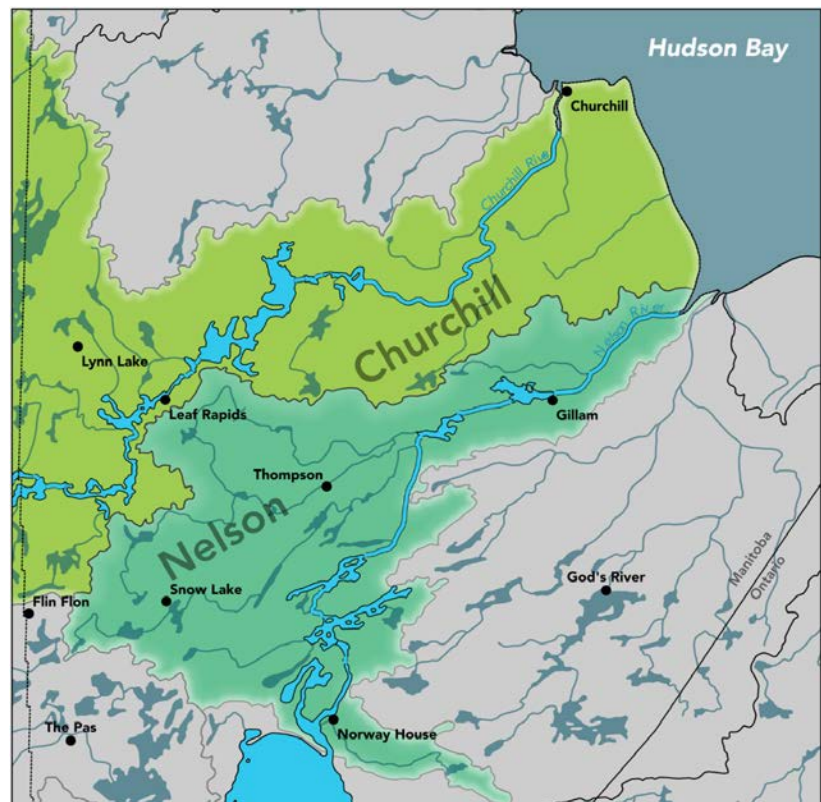


Figure 2. Research area: Northern Manitoba portion of the NCRB



2.2.3 Climate

The northern NCRB experiences a subarctic climate typical of the circumpolar boreal forests, with long, cold winters and short, mild summers. Seasonal averages range from 16.4°C (July, August, September) to -12.0°C (January, February, March), and the annual mean air temperature is 2.3°C (Figure 3).³

At the end of the rivers' run is the world's largest inland sea, Hudson Bay. The bay receives its primary seawater inflow from Roes Welcome Sound on the northwest point of the bay, and sea ice melt from the Arctic flows into the bay from Foxe Basin. The Arctic inflow resides in the bay for 6–16 years (Granksoeg et al., 2011), and the Arctic sea ice typically remains in the bay until July, cooling the surrounding landmasses in the summer (Rouse, 1991).

Most precipitation in the basin occurs during the summer. July is the typically modal month for precipitation, except in coastal communities that experience a lag caused by Hudson Bay. Winters are dry and cold, and what little snow falls tends to remain for weeks or months before melting.

Centuries of long, cold winters have led to the development of permafrost layers that underlie the northern part of the basin. These layers of permanently frozen soil cannot absorb precipitation and runoff, causing the formation of wet peatlands and cold pooled water that can affect the land's heat budget (the balance between incoming and outgoing heat). The line of continuous permafrost that dips to the south around Hudson Bay includes a portion of the downstream NCRB. The line of discontinuous permafrost follows a similar pattern and extends to the tree line, as far south as Thompson, MB.

Global climate change is expected to cause seasonal climate variations in precipitation and temperatures, particularly in polar regions (Arctic Climate Impact Assessment, 2005). Studies by Gagnon and Gough (2005) and Warren and Lemmen (2014) demonstrate that Hudson Bay and adjacent terrestrial regions will experience this warming primarily during the winter months (October to April). With the accompanying loss of snow cover, permafrost will be exposed to greater atmospheric heat fluxes. Coupled with a reduction in soil moisture, these fluxes could include carbon dioxide emissions and a climate feedback effect alongside the current ground ice-affected Arctic (Arctic Climate Impact Assessment, 2005).

Figure 3 shows the mean seasonal surface air temperature for the northern NCRB. Between 1980 and 2010, the average temperature during the winter varies gradually across the basin from -5°C at the southern part of the basin to -20°C at Hudson Bay. In the summer, it varies from 25°C to 10°C. This wide variation across the basin results in a very diverse and rich ecosystem. Temperature is an important abiotic variable of the riverine systems because it controls dissolved oxygen concentrations, photosynthesis, etc. (Vaccaro & Maloy, 2008).

³ NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their website at <http://www.esrl.noaa.gov/psd/>

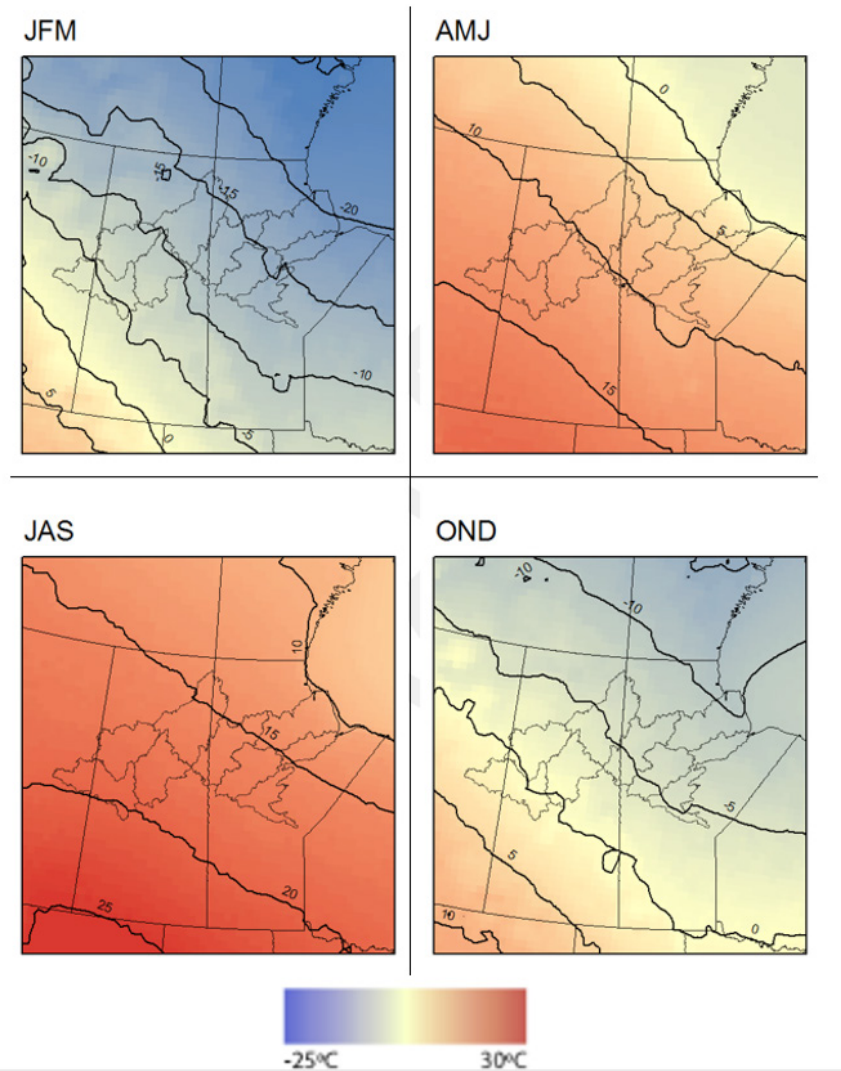


Figure 3. Mean seasonal surface air temperature for the northern NCRB, 1980–2010.

Data source: North American Regional Reanalysis (NARR)

2.2.4 History

The Indigenous Peoples who historically occupied the land have traditionally tied many of their cultural and spiritual traditions to the land and rivers. The Churchill and Nelson rivers also featured prominently in European exploration. The rivers and established Indigenous trade networks allowed European explorers to open the interior of Canada to the fur trade (Rosenberg et al., 2005). These networks helped Europeans establish settlements, economics, politics and diplomatic relations throughout the continent (Manitoba Hydro, 2014a).

In 1610, Hudson Bay’s namesake, Henry Hudson, was the first European explorer to investigate the bay. Two years later, Welsh explorer Thomas Button, who named the Nelson River, and his sailors were “the first recorded Europeans to set foot in the territory which became Manitoba” (Manitoba Historical Society, 2009). Button’s landmarks and maps led to an increase in other Europeans exploring the area. In 1619, the Danish explorer Jens Munk was the first European to discover the mouth of the Churchill River. The Cree and the Chipewyan had been crisscrossing the region for centuries, and the



Cree called the river Missinipi (“big river”). Munk branded his discovery the Danish River, but it was renamed the Churchill River as early as 1686, after Governor of the Hudson’s Bay Company, the Duke of Marlborough John Churchill (Gough, 2010).

The deep connection of Canada’s Indigenous Peoples to this land and watershed is based on their long history and stewardship of the land. Their knowledge in managing these landscapes is integral to integrated watershed-based planning efforts.

2.3 People

In 2011 the population in the northern NCRB was up 2.32 per cent, to 37,215 people, compared to the 2006 census. Though this area covers 31 per cent of Manitoba’s land, only 3.08 per cent of the province’s population lives there (Statistics Canada, 2007, 2012). Many of the residents in the northern communities identify as Indigenous. Distribution of the population is discontinuous—issues surrounding transportation and remoteness from major centres preclude a smoother urban/rural distribution. Many of the residents of the area identify as Indigenous and reside in northern communities within the region.

In Table 1, “settlement area” defines spatially contiguous boundaries of Statistics Canada’s Dissemination Blocks that have a permanent population greater than zero. Figure 4 shows the population distribution in northern Manitoba. As of the 2011 census, there were zero residents in large swaths of the northern NCRB. Most settlements are either on or adjacent to Indigenous communities—a key historical factor in the resulting distribution of settlement in northern Manitoba.

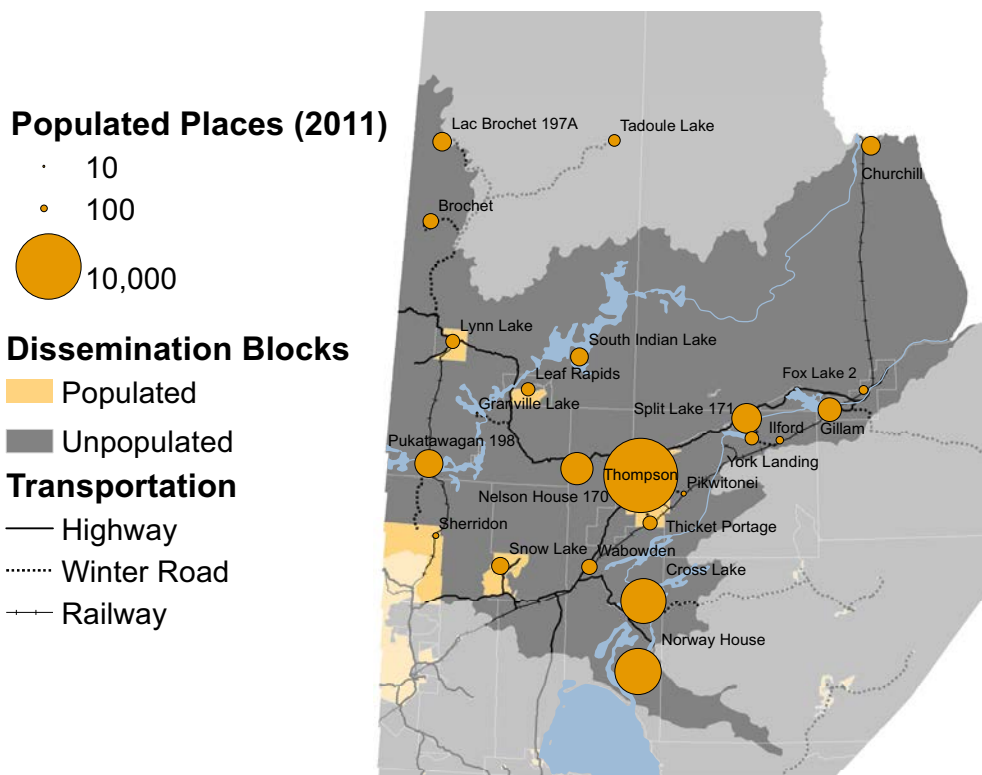


Figure 4. Map of population distribution in northern Manitoba.

Source: Produced by IISD based on the data from the 2011 Canadian census (Statistics Canada, 2012)

**Table 1. Settlement area population (2011).**

Settlement Area	Population	Total Dwellings	Occupied Dwellings
Thompson	12,839	5,394	4,741
Norway House	5,066	1,334	1,234
Cross Lake	4,710	1,048	933
Nelson House 170	2,471	512	463
Split Lake 171	2,107	406	389
Pukatawagan 198	1,826	385	356
Gillam	1,281	553	427
Lac Brochet 197A	816	194	175
Churchill	813	523	351
South Indian Lake	767	151	151
Snow Lake	733	531	328
Brochet	552	157	132
Wabowden	550	226	195
Lynn Lake	482	295	169
Thicket Portage	468	238	176
Leaf Rapids	453	264	140
York Landing	450	114	107
Tadoule Lake	321	141	112
Fox Lake 2	193	50	44
Ilford	141	33	31
Sherridon	80	36	32
Pikwitonei	76	26	26
Granville Lake	16	5	5

Source: Produced by IISD based on the data from the 2011 Canadian census. Source: Statistics Canada (2012)

2.4 Land Use

The vast northern NCRB region has rich natural resources and strong economic development in forestry, mining and tourism. Data presented in Figure 5 and Table 2 show the diverse natural cover in the NCRB, with more than 65 per cent of the area covered in forest and wetlands. Balancing the demand for natural resource development with conservation is crucial to maintaining a healthy ecosystem. Land-use planning and strategic decisions about land-use management are essential to building sustainable communities, and prioritizing what areas are vulnerable and need protection.

This section highlights the major socioeconomic drivers in the northern NCRB—mining, forestry, commercial fisheries, tourism, hydroelectric development and traditional activities—to give an overview of their social, economic and environmental importance to the region.

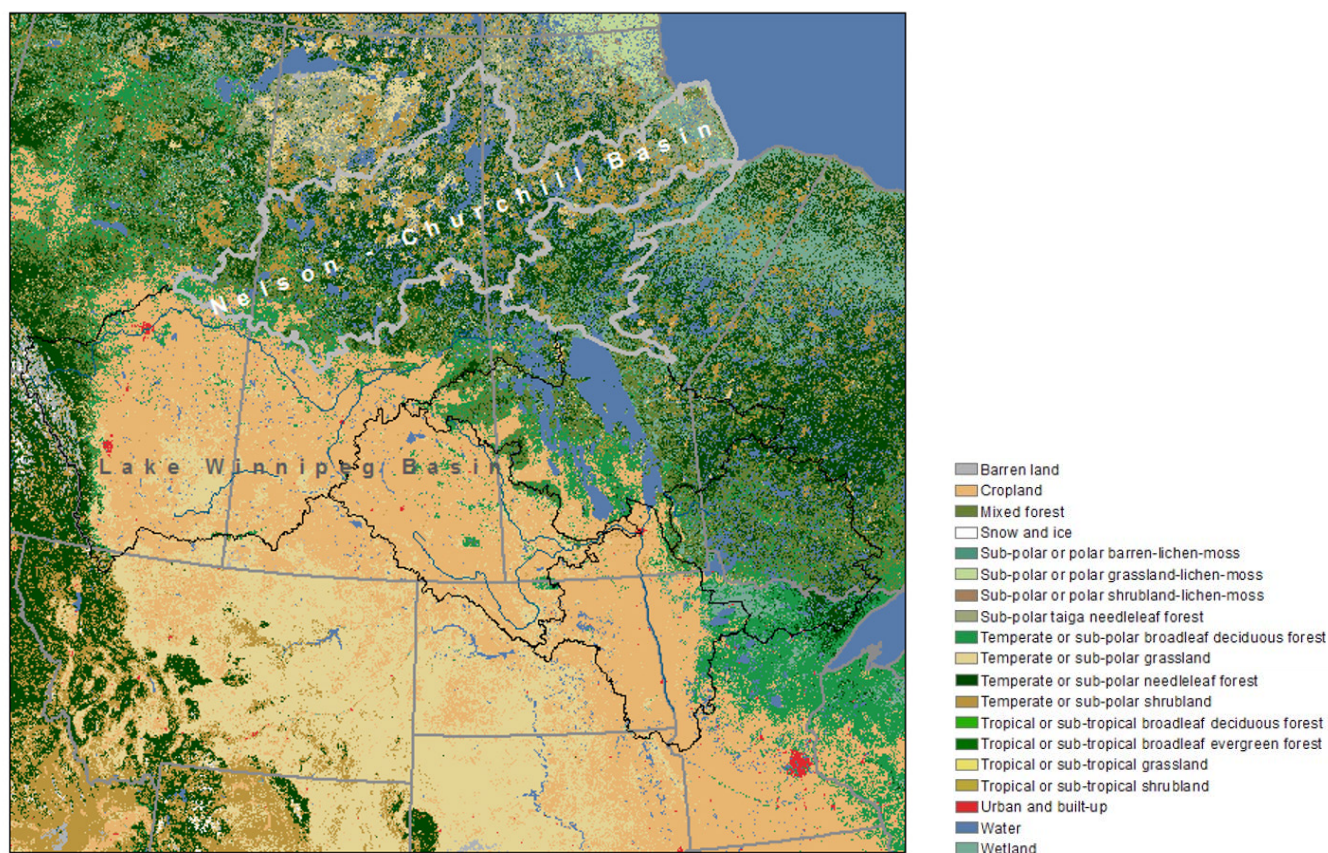


Figure 5. Map illustrating the land cover in the NCRB

Source: Data is derived from the North American Land Change Monitoring System, a product derived from 250 m resolution remotely sensed.

Table 2. Natural cover in the NCRB

Type	Nelson–Churchill	Lake Winnipeg Basin
Temperate or subpolar needleleaf forest	28.24%	9.91%
Subpolar taiga needleleaf forest	7.47%	0.01%
Temperate or subpolar broadleaf deciduous forest	4.67%	9.70%
Mixed forest	15.70%	10.91%
Temperate or subpolar shrubland	11.63%	1.64%
Temperate or subpolar grassland	4.25%	7.07%
Subpolar or polar shrubland-lichen-moss	0.16%	0.10%
Subpolar or polar grassland-lichen-moss	0.30%	0.05%
Wetland	10.02%	2.92%
Cropland	1.93%	47.45%
Barren land	0.10%	0.65%
Urban and built-up	0.01%	0.29%
Water	15.51%	9.22%
Snow and ice	0.00%	0.07%

Source: Data is derived from the North American Land Change Monitoring System, a product derived from 250 m resolution remotely sensed.



2.5 Economic Sectors

2.5.1 Mining

Mining is the second largest contributor (after manufacturing) to Manitoba’s economy. In the northern NCRB, the industry is mainly focused in Thompson, Lynn Lake, Leaf Rapids and Flin Flon, where the Precambrian shield is rich in mineral deposits such as nickel (Lynn Lake, Thompson, Wabowden); silver (Lynn Lake, Snow Lake); gold (Lynn Lake, Snow Lake); copper (Lynn Lake, Leaf Rapids, Thompson, Wabowden, Sherridon, Flin Flon); and zinc (Sherridon, Flin Flon, Leaf Rapids, Lynn Lake, Snow Lake) (Manitoba Mineral Resources, 2015). It should be noted that Flin Flon is, in fact, outside the boundaries of the NCRB.

In the early 1900s, gold was discovered at Herb (Wekusko) Lake and northeast of the Pas (1914), and a copper-zinc deposit was discovered in what is now Flin Flon (1915) (Hudbay, 2015a). This mining boom propelled the construction of the railway and demand for hydroelectricity production projects such as the Island Falls power plant on the Saskatchewan arm of the Churchill River in Saskatchewan, which provided power to Flin Flon (Hudbay, 2015b). In addition to supporting infrastructure development, the mining industry is a major employer in northern Manitoba, providing 3,900 direct jobs and 12,000 indirect jobs (Natural Resources Canada, 2011). In 2011, CAD 1.6 billion in revenues from mining production in the entire province represented approximately 3.7 per cent of provincial GDP and about 6.8 per cent of total exports. Manitoba’s metal commodities comprise “11.9 per cent of Canada’s nickel, 10.2 per cent of its copper, 12.7 percent of its zinc, 5.4 per cent of its gold, 6.8 per cent of its silver and 100 per cent of its cesium” (Northern Development Ministers Forum, 2012).

There are currently five operating mines in the Manitoban portion of the northern NCRB (see Table 3) extracting primarily zinc, copper and nickel. Hudbay and Vale are currently the only companies with open mines, though other companies have mines with suspended operations, or own rights to existing mines that could be reopened.

In line with normal fluctuations in commodity markets, low metal prices in recent years have led to a slowdown in production and exploration for new deposits in Manitoba; however, Manitoba Mineral Resources analysis shows that those declines could be slowly reversing (Beaumont-Smith, 2016).

Table 3. Producing mines in or near the Nelson–Churchill region.

Mine	Company	Nearest Town/City	Primary Materials Mined
777 Mine	Hudbay	Flin Flon	Copper, zinc
Birchtree Mine	Vale	Thompson	Nickel, copper
Lalor Mine	Hudbay	Snow Lake	Copper, zinc, gold
Reed Mine	Hudbay/VMS Ventures	Flin Flon	Copper, zinc
Thompson mine T1, D3 and 1-D	Vale	Thompson	Nickel, copper

Source: *Growth, Enterprise and Trade* (2015)

2.5.2 Forestry

The natural resources supplied by the forests in the northern NCRB support economic development in the region in particular, and the Province of Manitoba in general. While Canadian Indigenous populations considered the forests intrinsic for food, shelter and spiritual well-being, early European



settlers considered them barriers to agriculture. Instead, they saw the forests as a resource for building materials and fuel. The forest industry is now the fifth largest manufacturing sector in Manitoba, with forest products being exported across provincial and international borders (Historica Canada, 2013).

The seeds of this forestry manufacturing sector in the northern NCRB began in 1904, when The Pas Band (now known as Opaskwayak Cree Nation) started to produce lumber for local use. Soon thereafter, American Herman Finger acquired timber rights near the Pas and founded the Finger Lumber Company and a variety of other forestry companies followed suit, including: The Pas Lumber Company (1919–1958); Churchill Forest Industries (Manitoba) Limited (1966–1971, under various owners); Manitoba Forestry Resources Ltd. Crown Corporation (1973–1989; called Manfor after 1982); Repap Enterprises (1989–1997); and Tolko Industries (1997–present) (Historic Resources Branch, 2000). In addition to the larger companies, smaller operators have also participated in the forestry sector. Currently, the Province of Manitoba owns the vast majority of forested land in the province (94 per cent), with the balance owned privately (4 per cent) and by the federal government (1 per cent) (Government of Manitoba, n.d.e).

In the Nelson River basin, the province allows up to 806,290 m³ of softwood to be cut each year, which is the equivalent of nearly 20 per cent of the annual allowable cut for softwood in Manitoba. In the Churchill River basin, the province allows 76,080 m³/year (Manitoba Sustainable Development, 2012). According to Northern Development Ministers Forum (2012), the annual sales of wood product from Northern Manitoba’s forestry is about CAD 900 million and provided approximately 5,000 direct jobs.

2.5.3 Subsistence Economies

Traditional Indigenous economies in the northern NCRB relied on the benefits of the region’s lands and waters, in the form of subsistence fishing, hunting and gathering. The traditional benefits of this ecosystem persist today, but the needs (and the strain on the system) are augmented by higher dependence on the commercial wage-based economy (e.g., trees for forestry; water for hydro and commercial fishing; nature-based recreation for tourism; non-renewable minerals for mining).

The land and waters still offer a variety of local foods, including game, bird eggs, fish, greens, roots, berries, nuts, wild rice, mushrooms, birch syrup and maple syrup (Food Matters Manitoba, 2013). But whether traditional activities such as hunting, fishing, trapping and gathering persist depends on other factors, including the availability of non-traditional work, availability/access to traditional and non-traditional resources, and programs that encourage traditional activities.

A survey by Campbell et al. (1997) revealed that a good portion of residents in Nelson House and South Indian Lake still rely on traditional foods: 66 per cent of households in South Indian Lake included an active hunter (48 per cent for Nelson House), 33 per cent had an active fisherman (34 per cent for Nelson House) and 58 per cent had an active trapper (40 per cent for Nelson House). Sixty-eight per cent of households in South Indian Lake and 53 per cent in Nelson House smoked, froze, canned and preserved moose, whitefish, walleye, northern pike and a variety of berries.

In a study about “self-employment” in Churchill, Manitoba, Dana (1996) defined “self-employment” as encompassing not only the formal sector (e.g., legal enterprise profits), but also subsistence activities, defined as “the activity of gathering food for one’s personal use.” Dana (1996) found that many self-employed Indigenous People were conducting traditional activities, usually on a part-time basis, supplementing other income: “Aboriginal respondents were underrepresented in the [self-employed] service sector, completely absent in retail trade, and concentrated in the informal economy” (p. 281).



While this does not provide a comprehensive view of the magnitude of traditional economies, it does show its significance in regional, watershed-based planning. Responsible stewardship of the ecosystems that support many of these provisioning and cultural benefits is, therefore, important to the socioeconomic sustainability of people living in the region. With a high level of resource exports, NCRB should be managed with some consideration of those outside of the basin.

2.5.4 Commercial Fisheries

When commercial fishing began on northern Manitoba segment of the Nelson River in the 1890s, Playgreen Lake was the main source of commercial fish. As transportation infrastructure grew from water transport to include the Hudson Bay railway in 1931 and air transport after World War II, the fishery extended to increasingly remote regions. In addition to growing infrastructure and technology, the decreasing catches in the southern lakes drove the expansion of commercial fisheries from 20 northern lakes in the 1920s to a peak of 300 by 1984 (Nicholson, 2007). Today, about 300 lakes are commercially fished in all of Manitoba. Originally focused on sturgeon, northern Manitoba commercial fishing has now expanded to include walleye, northern pike, lake whitefish, sucker, trout, cisco, sauger, goldeye, carp and yellow perch (in declining order of value caught), along with lake whitefish roe (Manitoba Sustainable Development, 2013).

Manitoba Sustainable Development’s reports on Manitoba’s commercial fishery (2013) show that fish weight and value steadily declined from 2002–2012 (Figure 6). Across Manitoba, weight and value declined from a provincial total 10-year high of 15,093,750 kg of commercial fish valued at more than CAD 38 million in 2002–03 to a low of 10,324,089 kg valued at just over CAD 21 million in 2010–11; within those numbers, the total share for northern lakes has decreased. Northern Manitoba catches declined from 18 per cent of total commercial fish values in 2002–03 to 8 per cent in 2011–12. In addition, the number of people involved in commercial fishing in the region has declined, from a high of 873 in 2004–05 to 611 in 2011–12.

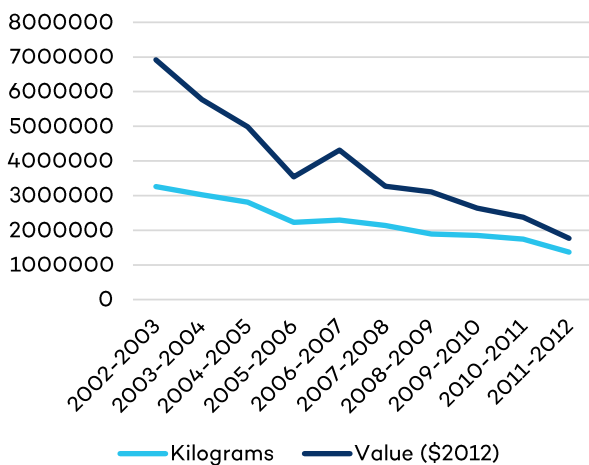


Figure 6. Weight and value of fish from northern Manitoba (2002–2012)

Source: Manitoba Sustainable Development (2013)

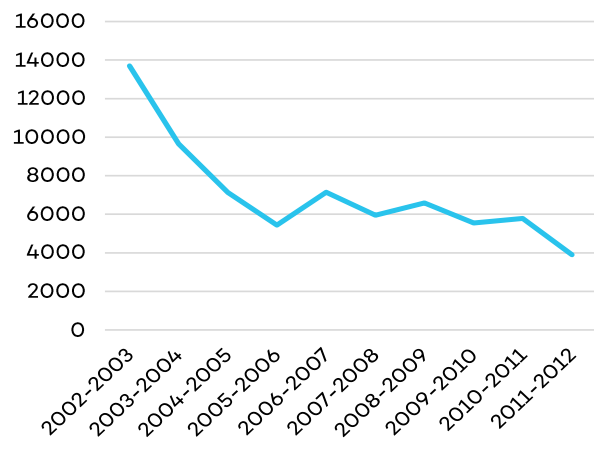


Figure 7. Average income for licensed fishers on northern lakes

Source: Manitoba Sustainable Development (2013)



Despite these trends, commercial fishing continues to be an important economic activity in northern Manitoba: “The importance of commercial fishing to local economies cannot be overstated. ... In Northern Manitoba, with the decline of the fur industry, commercial fishing is often one of the few economic opportunities available for many communities” (Manitoba Sustainable Development, 2013, p. 2–3).

2.5.5 Hydroelectric Development

Electrical connection started in the 19th century in Winnipeg with the connection of street lighting and the electrification of the street rail system (Manitoba Hydro, n.d.b). In order to move electrical infrastructure out of the city to connect small town and rural farmers, the government established the Manitoba Power Commission in 1919 (Know History, 2015).

By the mid-20th century, hydroelectric infrastructure expanded to the Nelson and Churchill rivers when demand exceeded what the Winnipeg River could generate. In 1961, with the establishment of Manitoba Hydro, the hydrologic potential of the Nelson River was harnessed to contribute to the national power grid (Know History, 2015). Today, Manitoba Hydro is the sole electricity power provider in the province, with total capacity of 5,701 MW (81 per cent from hydroelectric) providing electricity to more than 560,000 customers in 2015 (Manitoba Hydro, 2015a). It is also the largest employer of electrical, civil and mechanical engineers in the province, providing jobs to approximately 6,483 Manitobans. In addition, nearly 20 per cent of its employees are Indigenous (Manitoba Hydro, 2015a). Manitoba Hydro’s net consolidated income in 2014–2015 was CAD 114 million (Manitoba Hydro, 2015a).

Table 4. List of all hydroelectricity generating stations in the NCRB and their capabilities for the year ending March 31, 2015

Generating Stations	Year	Capacity (MW)	Location
Laurie River I & II	1952 and 1958	10	Laurie River
Kelsey	1961	287	Nelson River
Kettle	1974	1220	Nelson River
Jenpeg	1979	122	Nelson River
Long Spruce	1979	980	Nelson River
Limestone	1992	1350	Nelson River
Wuskwatim	2012	211	Burntwood River

2.5.6 Tourism

The Nelson–Churchill combined basins also have a significant tourism industry, much of it focused around ecosystems and the natural environment—which illustrates the socioeconomic importance of healthy ecosystems to the region. Northern Manitoba, which includes the Nelson–Churchill area, contributed 8 per cent—CAD 116 million—in tourism spending to the Manitoba economy in 2016 (Travel Manitoba, 2016). The roughly 530,000 visitors were primarily from Manitoba, Saskatchewan and Ontario, though the region also attracts a significant number of overseas visitors. Tourism creates almost 1,300 direct jobs related to attractions, accommodations, parks (e.g., campgrounds and RV parks), lodges, outfitters, festivals and events (Travel Manitoba, 2016).



The most well known tourism draw in the region is the Town of Churchill, which, since the 1980s, has drawn domestic and international visitors to see polar bears, beluga whales and birds, among other attractions. An estimated 10,000–12,000 tourists fly to Churchill each year, with another 6,500 arriving by railroad. So important is the tourism industry that it provides 40 per cent of jobs in town and, in 1996, contributed an estimated CAD 6.5 million to the local economy (Newton, 2000).

Tourists are also drawn to the many lodges and outfitters (e.g., fly-in fishing and hunting) throughout the region; provincial and national parks (e.g., Wapusk National Park, Grass River Provincial Park, Zed Lake Provincial Park, Paint Lake Provincial Park); other natural sites (e.g., Manitoba’s highest waterfall, Kwastichewan Falls); festivals (e.g., Northern Manitoba Trapper’s Festival; Hudson Bay Quest Dog Race from Churchill to Gillam; Thompson Winterfest); and historic sites (e.g., Lynn Lake Mining Town Museum; Historic Norway House; Prince of Wales Fort) (Tourism North Manitoba, 2015).

2.6 Hydrologic Regime

Understanding the hydrologic regime of a watershed is critical for the development and planning of a comprehensive watershed management strategy. As described in Battalia, Gomez, & Kondolf (2003, p. 1), aspects of the flow regime such as “total discharge, flood flows, baseflows, the shape of the seasonal and flood hydrographs, seasonal and interannual variability [control] many physical and ecological aspects of river form and processes, including sediment transport and nutrient exchange” (Poff et al., 1997). The natural flow regime can be affected by many man-made obstacles, such as damming, impounding, land-use and land-cover change, diversion and abstraction of water, and geomorphological change. On a larger scale, these human influences can lead to both climate change and changes in hydrologic regimes—such as magnitude, duration, timing, frequency and rate of change of flow—that have impacts on both water use and management (Worku et al., 2014). Therefore, “understanding the hydrology of a river and its historical flow characteristics is essential for water resources planning, understanding and quantifying ecosystem services, and carrying out environmental flow assessments” (Worku et. al., 2014).

For the purposes of this study, we prioritized basin governance within Manitoba to be able to analyze specific implications of policy and current process. For the purpose of describing the hydrology, we provide the context of the entire basin and its main features and then return to focusing on the lower NCRB in northern Manitoba.

The entire NCRB has four major sub-basins: “the Churchill River (which mainly drains territory in north-central Saskatchewan), the Saskatchewan River (southern Alberta and central Saskatchewan), the Red River (southern Manitoba, southeastern Saskatchewan and parts of Minnesota and the Dakotas) and the Winnipeg River (northwestern Ontario)” (St. George, 2007, p. 17), which drains into Lake Winnipeg where the Nelson River originates. The total flow in the system comes from four sources: the Winnipeg River (median annual flow: 988 m³/s); the Churchill River Diversion (up to 990 m³/s); the Saskatchewan River (up to 542 m³/s); and the Red River (up to 229 m³/s) (St. George, 2007).

The major hydraulic influences on the water regime of the Nelson–Churchill river system within the province of Manitoba are a result of (Manitoba Hydro, 2014b):

- Lake Winnipeg Regulation (LWR) increases the Lake Winnipeg outflow capacity by about 50 per cent and regulates the outflow for the lower Nelson River.
- Churchill River Diversion (CRD) diverts the water from Churchill to Nelson, which affects the water levels and flow patterns in Southern Indian Lake.



2.6.1 Lake Winnipeg

In order to expand the scope of attention received by the Lake Winnipeg basin to include the Nelson and Churchill systems in Manitoba, Lake Winnipeg and its role are described in this section. With a surface area of 24,500 km², Lake Winnipeg is the largest lake in Manitoba and third largest freshwater lake in Canada (Newbury, 1990). A dam at the northern end of Lake Winnipeg regulates its water levels. While the Saskatchewan, Red and Winnipeg rivers all discharge into Lake Winnipeg, only the Nelson River carries water out from Lake Winnipeg, draining at Hudson Bay. Lake Winnipeg stores “the equivalent of 60 per cent of the system’s mean annual energy” (Rangarajan et al., 1999).

Manitoba Hydro regulates the outflow from Lake Winnipeg at Jenpeg Generating Station on the west channel of the Nelson River near the outlet of the lake as required to produce power and reduce flooding. The Manitoba Water Power Act sets requirements for controlling Lake Winnipeg outflows. Figure 8 shows the history of Lake Winnipeg water levels with and without regulation (Manitoba Hydro, 2014b). Since regulation began in 1976, the lake level’s long-term average has been raised by 0.2 ft—from 713.4 ft to 713.6 ft; this change is much lower than the 0.65 ft that was predicted by the Lake Winnipeg, Churchill and Nelson Rivers Study Board (LWCNRSB, 1975). The typical seasonal pattern of the water levels has remained consistent, and regulation has reduced the occurrence of extreme highs and extreme lows (Figure 9). The historical maximum level of Lake Winnipeg—718.2 ft in 1974—was 1.3 ft higher than the highest level that occurred after regulation (Figure 10).

Manitoba Hydro (2014b) has modelled water levels that would have occurred in Lake Winnipeg under natural conditions (in the absence of LWR) and compared it to the actual levels after LWR to understand better the impacts of regulation under the same hydraulic and climatic conditions. Manitoba Hydro (2014b) concluded that regulation has:

- Lowered peak water levels and lowered average water levels by 0.1 to 0.9 ft
- Lowered water levels in the fall during wet years and raised water levels in the fall of dry years
- Not affected the seasonal water levels patterns
- Provided water residence times similar to natural conditions

These models and accumulated data have also helped Manitoba Hydro explain the impact of regulation on Lake Winnipeg to alleviate public concerns through public information sessions.

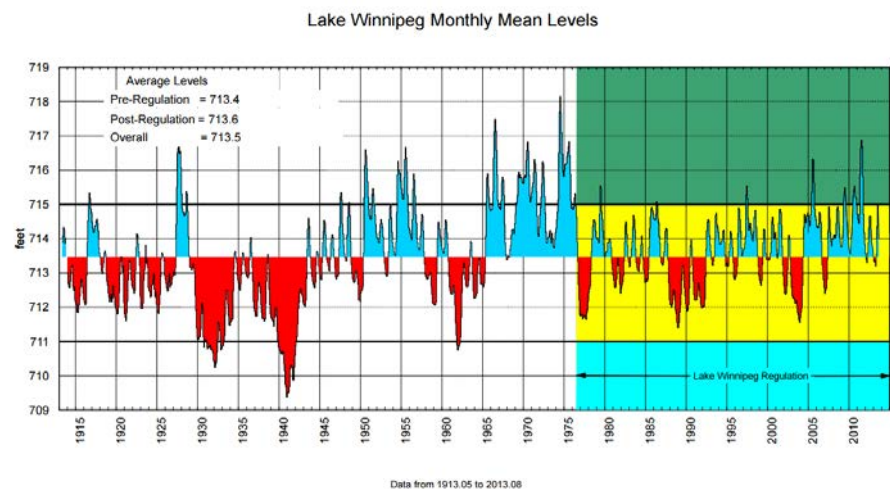


Figure 8. Water levels at Lake Winnipeg before and after the regulation.

Source: Manitoba Hydro (2014b); reprinted with permission.

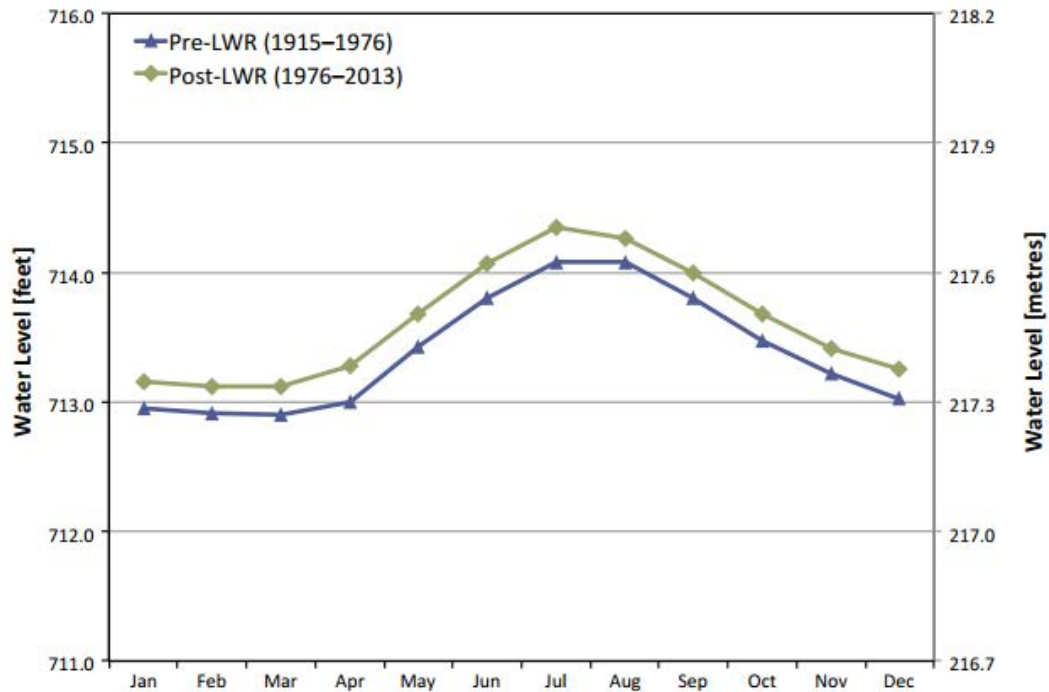


Figure 9. Pre- and post-LWR monthly average Lake Winnipeg water levels.

Source: Manitoba Hydro (2014b)

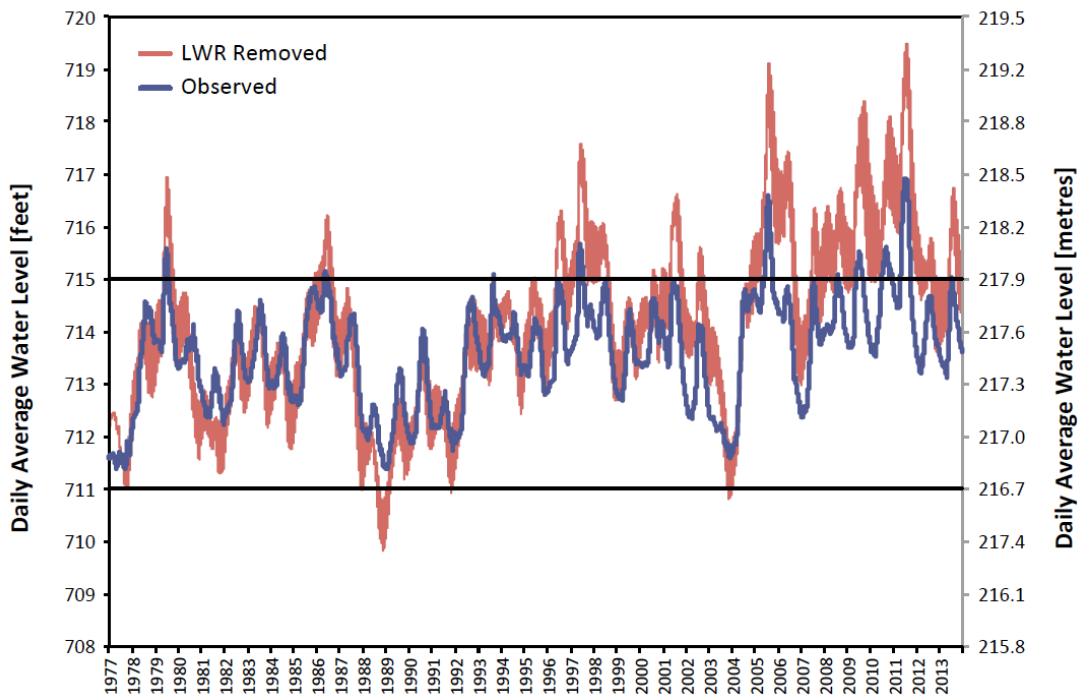


Figure 10. Lake Winnipeg water levels observed and simulated without regulation.

Source: Manitoba Hydro (2014b)

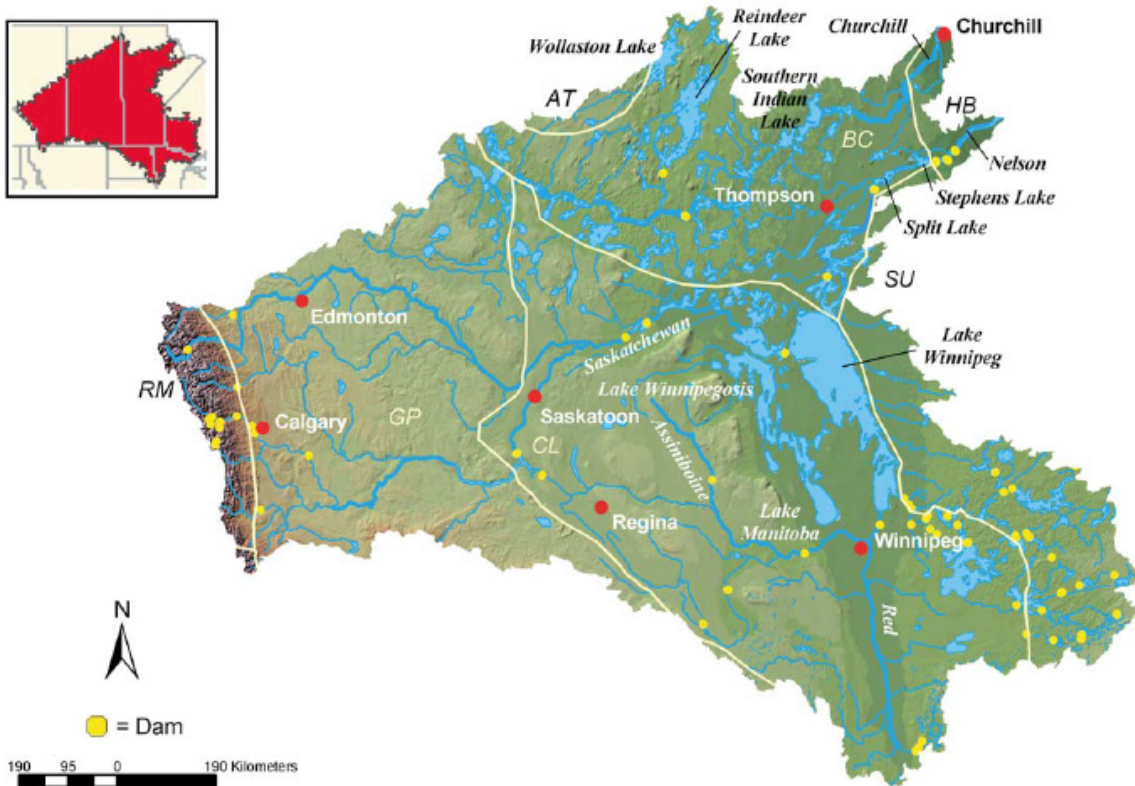
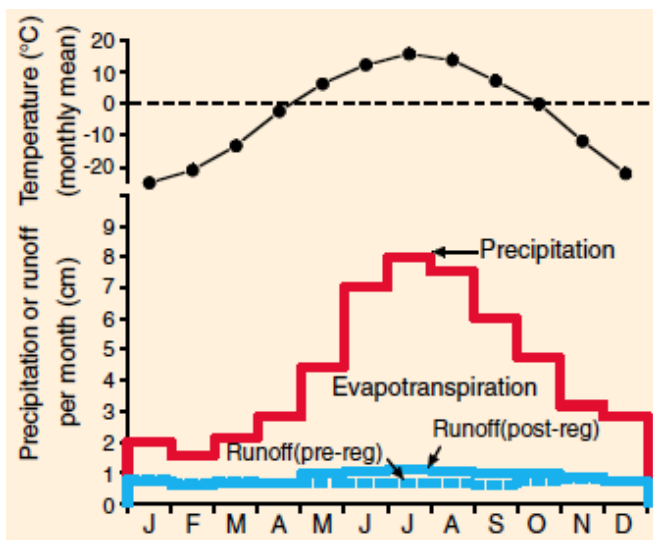


Figure 11. Map of the Nelson River basin.

Source: Rosenberg et al. (2005)⁴

2.6.2 Nelson River Main Stem



Nelson River’s main stem is the natural outflow of Lake Winnipeg. The upper Nelson (the first 350 km) flows to Split Lake through a complex series of lakes between bedrock-controlled lake basins, encountering two major dams. The Grass and Burntwood rivers join the Nelson from the west around Split Lake. The Nelson River hits three major dams before it runs to the mouth of Hudson Bay in a single channel. The upper Nelson channel travels through the rocky Canadian Shield over lacustrine deposits (LWCNRSB, 1975). The channel is “primarily bounded by Precambrian bedrock, with a shallow, coarse till cover” (Rosenberg et al., 2005). Between Lake Winnipeg and Split Lake, the average slope is 13cm/km.

Figure 12. Mean monthly air temperature, precipitation and runoff of the Nelson River basin

Source: Rosenberg et al. (2005)⁵

⁴ Reprinted from Rivers of North America, Rosenberg et al., Nelson and Churchill River Basins, pages 853–901, copyright. (2005), with permission from Elsevier.

⁵ Reprinted from Rivers of North America, Rosenberg et al., Nelson and Churchill River Basins, pages 853–901, Copyright (2005), with permission from Elsevier.



Before hydroelectric development, the mean annual natural discharge of the Nelson River main stem at Hudson Bay was 2,480 m³/s (Newbury et al., 1984). However, after the 1970s, the effects of Lake Winnipeg regulation and the addition of the 990 m³/s licensed diversion from the Churchill River has changed the hydrology of the Nelson main stem, increasing peak flows and altering seasonal discharge patterns. For example, the Lake Winnipeg storage dam at Jenpeg and the Churchill diversion have increased mean natural summer flows to Hudson Bay from 2,689.5 m³/s to 3,250.0 m³/s, while mean winter flows have increased from 1,885.5 m³/s to 2,859.3 m³/s (Déry et al., 2011). The reversal of the seasonal pattern on the lower Nelson River is obscured by the addition of Churchill River flows, but the alteration has shifted 7 per cent of the combined annual delivery from the open-water season to the ice-covered period from November to May (Déry et al., 2011).

2.6.3 Southern Indian Lake

In northern Manitoba, the Churchill River drains into Southern Indian Lake before draining into Hudson Bay. Prior to 1974, Southern Indian Lake was inaccessible by roads and was relatively untouched by human interference. However, in 1976 Manitoba Hydro built hydraulic control structures to increase the hydroelectric potential in the Nelson River. These diverted 75 per cent of the Churchill River flow, 958 m³/s⁻¹, which resulted in a significant change in the hydrological regime and biophysical characteristics in the Churchill River and Southern Indian Lake (Bodaly et al., 1984).

Southern Indian Lake lies in a shallow basin on the Churchill River lined with Precambrian shield bedrock (Newbury et al., 1984). The lake is 145 km long and up to 19 km wide. It has a long shoreline and many features of interest, including islands, peninsulas and bays. A dam was built across the lake outlet at Missi Falls in 1976 to increase the lake level by 3 metres. This facilitated the southward diversion of the Churchill River to hydroelectric generating stations on the Nelson River.

Impoundment increased the surface area of the lake by 20 per cent and its volume by 39 per cent over long-term mean values. This greater mean depth has diluted incoming heat and thus affected mean temperatures in the area. In addition, 80 per cent of eroded material in the lake was deposited near shore (Hecky & McCullough, 1984), while the remainder went into suspension, significantly increasing offshore sediment concentrations by two to five times. This increase in suspended elements in the water caused increased back-scattering of solar irradiance, adding to a general cooling effect. Due to less light and more nutrients from shorelines, seasonal mean chlorophyll concentrations rose in every region of the lake (Hecky & McCullough, 1984).

Figure 13 shows that the seasonal Southern Indian Lake water-level pattern before and after the Churchill River Diversion (pre-CRD and post-CRD) are similar, with highest water levels typically occurring during the summer. Water levels are still drawn down over the winter and typically lowest in the spring. In the pre-CRD data, we can also see the effects of the Island Falls Generating Station in Saskatchewan (completed in 1930), which causes higher winter flows than would occur under natural conditions (Manitoba Hydro, 2015b).

Hecky et al. (1984) compared pre- and post-impoundment observations to assess the predictive capability that had been applied to Southern Indian Lake in the pre-impact statements. They concluded that “predictions related to the physical environment, e.g. increased shoreline erosion, littoral sedimentation, higher turbidity, and decreased light penetration and visibility, were qualitatively correct; however, an unpredicted decrease in water temperature also occurred” (Hecky et al., 1984, p. 720).



They also posited that “increased phosphorus availability and light limitation of primary production were also correctly forecasted in a qualitative manner,” and that these studies contributed to quantitative predictions in future reservoirs (Hecky et al., 1984, p. 720).

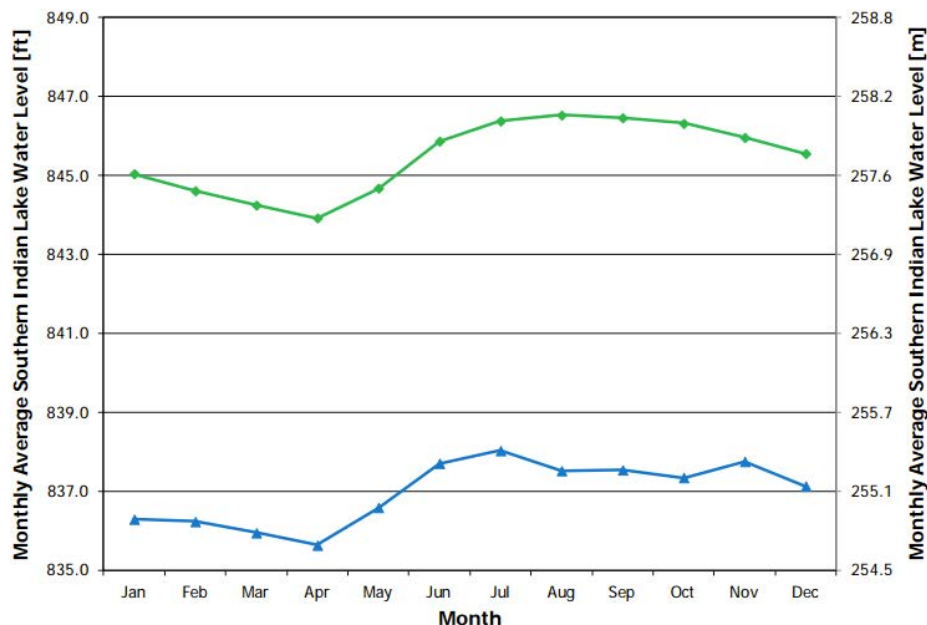


Figure 13. Monthly averages: Southern Indian Lake water levels

Source: Manitoba Hydro (2015b)

Table 5. Biophysical characteristics of South Indian Lake before and after the impoundment

	Zone 1		Zone 4	
	Pre	Post	Pre	Post
Inundation ratio	0	0.09	0	0.16
Mean depth (m)	8	10.1	12.1	13
Flushing time (yr)	0.12	0.17	0.23	1.4
Temperature change (°C)	0	-0.8	0	-1.3
Suspended sediment (mg. L ⁻¹)	3.2	8.1	1.2	6.3
I (mE.m ⁻² .min ⁻¹)	6.2	4	10	4.9
Erosive Input (g.m ⁻² .yr ⁻¹)	0	1,390	0	3,312
Primary production (mg.m ⁻² .d ⁻¹)	530	460	570	560

Source: Hecky et al. (1984)

2.7 Overview of Major Studies

The area of Manitoba Hydro development in the northern NCRB has been the focus of many studies, including, but not limited to, the LWCNRSB, the Federal Ecological Monitoring Program (FEMP), and Split Lake Cree–Manitoba Hydro Joint Studies and Environmental Impact Statement (EIS) studies for pre- and post-hydroelectric development in northern Manitoba. Most reports that have addressed the biophysical characteristics of the basin were detailed studies at smaller scales, as they were conducted as a part of or follow-up to the LWCNRSB, FEMP and Manitoba Ecological Monitoring Program



(MEMP) studies. These studies mostly addressed specific impacts related to hydro development in the northern NCRB. Therefore, there is a lack of biophysical knowledge in these studies describing the whole basin in general and providing overviews and conclusions that may help in drawing up a comprehensive watershed management strategy. Nevertheless, these major studies are the foundation for development of a comprehensive management strategy for the region. This section gives an overview of some of the major studies.

2.7.1 Lake Winnipeg, Churchill and Nelson Rivers Study Board (LWCNRSB)

The primary purpose of LWR is “to regulate Lake Winnipeg to provide increased winter outflows for power generation into the Nelson River” (Fisheries and Oceans Canada, 2005, p. 5). LWR also regulates Lake Winnipeg for flood control (LWCNRSB, 1975). The LWCNRSB was launched by the governments of Canada and Manitoba in 1971 with a budget of CAD 2 million. The study had multiple goals, including: determining the potential effects of regulation and diversion infrastructure on water resources; identifying beneficial projects; and recommending design and operational modifications. In the study, experts from federal and provincial governments, academic and research institutes, and consulting firms looked at the potentially negative impacts of the projects and recommended necessary mitigation measurements to decrease them.

2.7.2 Federal Ecological Monitoring Program (FEMP)

In order to address federal obligations under the Northern Flood Agreement (NFA), Environment and Climate Change Canada, and the Fisheries and Oceans Canada launched a five-year monitoring program in Northern Manitoba that started in 1986 and culminated in a series of ecological reports (FEMP, 1992; Manitoba Hydro, 2015b). The reports broke down areas of concern and monitoring recommendations by region. Phase II (Kellerhals Engineering Services Ltd., 1988) specifically quantified the morphologic changes in the lower Churchill River based on aerial photos and maps.

2.7.3 Split Lake Cree–Manitoba Hydro Joint Studies

The joint studies conducted by Manitoba Hydro and the Split Lake Cree in 1996 cover 48,500 km² around Split Lake. The area encompasses land and water stretching from the Churchill River to the north and Sipiwesk Lake to the south; and east to west from the CN rail line to Fiddler Lake. The first phase of the studies focused on creating an environmental baseline in order to evaluate the environmental impacts of hydroelectric projects and predict future impacts on the Split Lake Cree (Split Lake Cree–Manitoba Hydro Joint Studies Group, 1996). The studies were set up to monitor any evolving environmental conditions, including the effects of erosion and substrate changes on water quality parameters. It also identified knowledge and data gaps. The second phase of the project consisted of a conclusion and summary of the Phase 1 investigations.

2.7.4 Environmental Impact Assessment Studies

As set out in the Environment Act (1987), Manitoba Hydro is required to conduct Environmental Impacts Assessments (EIAs) in the preliminary planning of hydroelectric projects to identify the potential social and environmental effects of development. Manitoba Hydro has conducted EIAs for Limestone, Wuskwatim and Keeyask generating stations.



2.7.5 Coordinated Aquatic Monitoring Program (CAMP)

CAMP is a long-term monitoring program launched by Manitoba Hydro and the Province of Manitoba in 2008. The program tracks the environmental impacts of Manitoba Hydro development on aquatic ecosystem health (CAMP, 2014). The pilot segment of the program ran for three years to test and standardize protocols and methodologies. Data pertaining to impacts on hydrometrics, water quality, lower trophic levels, fish community, mercury levels in fish, phytoplankton (algae) and sediment quality are published every three years in technical reports.

These studies provide invaluable information relevant to the northern NCRB, and these can be used to start to connect the dots and characterize the relevant portions of the basin to create an ecosystem-based management plan.

2.7.6 Regional Cumulative Effects Assessment (RCEA), Phases I and II

Using the Clean Environment Commission’s Bipole III recommendations as a point of departure, Manitoba Hydro and the Government of Manitoba conducted the RCEA to contextualize socioeconomic and environmental impacts of hydroelectric development. The interim results from Phase I showed how the project would gather and report on cumulative impacts in the north, while Phase II provide quantitative and qualitative analysis of these cumulative social, economic and environmental systems (excluding the Grand Rapids and Winnipeg River stations) (Manitoba Hydro, 2015c, 2015d).

2.8 Ecosystem Services from the NCRB

2.8.1 Ecosystem Services: Benefits from Watersheds

Large river basins such as the NCRB provide the foundation for clean water, food, economic development, energy systems and much more. In order to ensure the continued flow of these varied and often interdependent ecosystem benefits, these watersheds must be maintained with some emphasis on their ecological systems. We approached management and governance of the northern NCRB from the perspective of ecosystem services, recognizing that the basin’s lands and waters are the lifeblood of its socioeconomic and environmental well-being. They are drivers of sector-based economic development (e.g., mining, forestry, hydro, tourism), but they also provide important value in less tangible ways, such as habitat provision, water purification and spiritual enrichment. Our synthesis of the climate, geography, ecology, land, water and socioeconomic features of the research region informed our ecosystem services analysis.

The Millennium Ecosystem Assessment (MA, 2005) popularized the idea that human well-being is inextricably interlinked with how ecosystems function and are managed (see the MA framework in Figure 14). The term ecosystem management has gained popularity as a way to identify, communicate, assign economic value, monitor and create scenarios to understand and manage natural systems better for sustainable development.

Generally, ecosystem services are categorized into four main services (Millennium Ecosystem Assessment, 2005a):

- **Provisioning services:** Food, raw materials such as wood fibre, fresh water, biological resources such as biochemicals with pharmaceutical uses, and materials such as metals and rock.



- **Regulating services:** Benefits obtained through regulating “ecosystem processes, including air quality maintenance, climate regulation, erosion control and water regulation” (Widmann et al., 2012)
- **Cultural services:** Non-material benefits obtained through spiritual, religious and cognitive experiences, recreation, ecotourism, education, values, cultural, heritage and aesthetic experiences.
- **Supporting services:** Benefits that are crucial to the production of other ecosystem services and can include processes such as photosynthesis, nutrient and water cycling, and soil formation. The impacts of these services on people are indirect or occur over long periods.

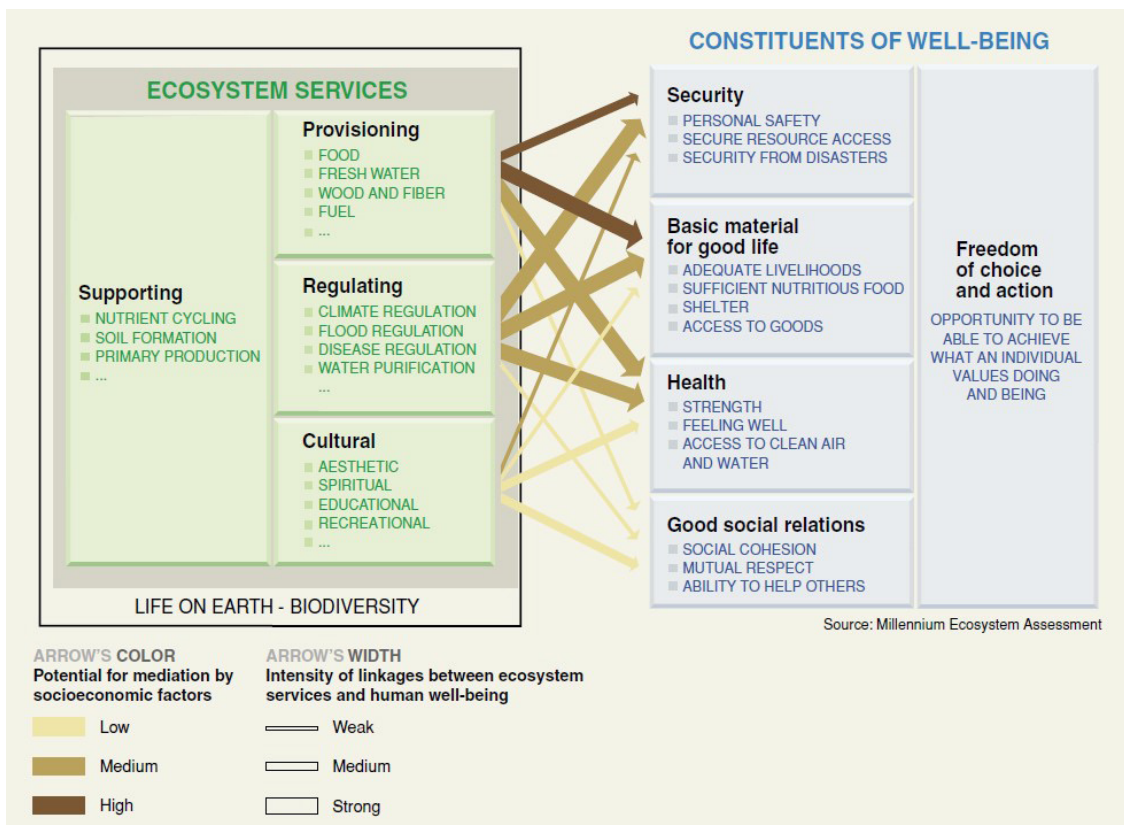


Figure 14. Schematic diagram shows the relationship between the different categories of the ecosystem services and the constituents of well-being

Source: Millennium Ecosystem Assessment (2005); reprinted with permission.

2.8.2 Ecosystem Services in the NCRB

As discussed in the previous sections, the northern NCRB’s wide range of ecosystem services contributes considerably to the region’s economy. The basin is a complex ecosystem that supplies numerous provisioning, regulating and cultural ecosystem services through its land, water, forests and other ecosystem components.



Specifically, the NCRB provides the following ecosystem benefits:

Provisioning services: The basin provides for a subsistence-based traditional food economy, and provides clean water, fisheries, hydroelectricity, minerals and metals from mining, etc. The value of commercial fisheries in northern Manitoba lakes was CAD 1.77 million in 2011–12 (down from CAD 6.9 million in 2002–03) (Manitoba Sustainable Development, 2013). In 2014, the value of mining in Manitoba was approximately CAD \$1.4 billion (metallic and industrial minerals) with five producing mines in or near the northern NCRB as well as significant ongoing exploration (Growth, Enterprise and Trade, 2016). In 2016 Manitoba Hydro produced hydroelectricity worth roughly CAD 1,800 million (Manitoba Hydro, 2016). In 2015, forestry in Manitoba (some of it in the northern NCRB) contributed CAD 387 million to provincial forestry exports (Natural Resources Canada, 2015).

Regulating services: The basin’s hydrology is a key component of flood and drought management in the region. Watersheds also regulate water quality, as they have the ability to filter sediments and discharge from human activities such as mining and natural events. Erosion control is a regulating service in which vegetative cover plays a vital role in soil retention while water infrastructure (e.g., dams, artificial drainage systems) may have adverse impacts. Water regulation affects the “timing and magnitude of runoff, and flooding,” which is strongly influenced by changes in land cover and any water infrastructure (Vymazal, 2011). Boreal forests cover approximately 570,000 km² of land in Manitoba and of that, an estimated 40 per cent is wetlands (Ducks Unlimited Canada, 2015; Wells, 2014;). According to Badiou (n.d.), the boreal is considered one of the “largest land-based carbon storehouses.” Globally it is estimated to store “more than 700 billion metric tonnes of carbon in its trees, wetlands and soils” (Badiou, n.d.).

Cultural services: The relatively large Indigenous population in the North relies on the region’s ecosystems for traditional use and subsistence economies, as described in Section 2.5.3. The watershed ecosystem supports traditional hunting and fishing, herbs and medicines, recreation and spiritual uses and more. In addition, the basin also supports a significant tourism industry that largely focuses on the natural environment and depends on the healthy functioning of ecosystems. The northern region of the province contributes CAD 116 million to the provincial economy from tourism per year, amounting to 8 per cent of tourism spending in Manitoba (Travel Manitoba, 2016). In 2012, tourism dollars amounted to CAD 41.9 million for transportation, CAD 26.4 million for food and CAD 15.9 million for accommodation (Travel Manitoba, 2012). The roughly 530,000 visitors in that year were primarily from Manitoba, Saskatchewan and Quebec, though the 25,000 visitors from the United States spent the most per person. These visitors helped support 816 tourism-related jobs in businesses related to attractions, accommodations, parks (including campgrounds and RV parks), lodges/outfitters, suppliers of outdoor experiences, festivals and events (Travel Manitoba, 2012).

Supporting services: The watershed’s large forest tracts, boreal wetlands and other ecological features provide habitat for a large variety of fish, waterfowl, wildlife and other species in a region of high biodiversity. For instance, the commercial fishery in Manitoba includes walleye, northern pike, lake whitefish, sucker, trout, cisco, sauger, goldeye, carp and yellow perch (in declining order of value caught), along with lake whitefish roe (Manitoba Sustainable Development, 2013).

A review of the ecology, land-use and socioeconomic systems in the basins emphasizes the ecosystem services provided by the basin. Quantifying the existing market values of these services provides a starting point to understanding the full economic value of this region, reinforcing the need for its



sustainable management. To maintain (or even enhance) these ecosystem services, we must address growing pressures on both their supply and demand, such as land-use changes in watersheds coupled with increasing human demand for water. Therefore, biophysical understanding and policy mechanisms are crucial in conserving the delivery of desired services. In their assessment of publications related to ecosystem goods and services (EGS), Wong et al. (2015, p. 108) find that, while a lot of attention has been placed on valuation and identification, there “has been minimal improvement on understanding the relationships between ecological mechanisms and ecosystem services to create the realistic end products that managers need.”

Ecosystem services, including in the northern NCRB, include “the benefits to people of terrestrial ecosystem effects on fresh water” (Brauman, 2007, 6.6). In order to understand “traditional hydrologic science into an ecosystem services context, it is useful to focus on four key attributes of each service: quantity, quality, location, and timing of flow” (Brauman, 2007, 6.23). In addition, external drivers such as climate change must also be considered, especially in determining anticipated and unanticipated future scenarios.

2.9 Summary

The NCRB is the third largest watershed in North America, conveying water from a drainage area of more than 1.4 million km². The Nelson River runs through a landscape that changes from the Great Plains and Prairies (Upper Nelson), to the Boreal Shield and Hudson Bay Lowlands (Lower Nelson). The Churchill River originates in the Boreal Plain and Boreal Shield ecozones, and runs through the Taiga Shield until it reaches the low-relief Hudson Plain. Flow of the Churchill River is strongly determined by the granite fissures and glacial morphology of the shield.

The region’s air temperature averages range from 16.4°C in summer to -12.0°C in winter with an annual mean of 2.3°C. Precipitation in the basin varies seasonally, and most of the precipitation occurs during the warm summer months. Climate change is predicted to have strong impact on temperatures in the basin, particularly the northern-most regions. Recent climate models show that the NCRB will experience warming primarily during the winter months (October to April), reducing snow cover and thus exposing permafrost to greater atmospheric heat fluxes. This loss, when coupled with predicted reduction in soil moisture due to increased temperatures, can increase carbon dioxide fluxes from the soil and participate in a climate feedback effect alongside much of the current ground ice-affected Arctic (Arctic Climate Impact Assessment, 2005).

According to the 2011 population census, the Nelson–Churchill basin is inhabited by 37,215 people, an increase of +2.32 per cent from the 2006 census, the majority of whom are Indigenous. Thus 3.08 per cent of Manitoba’s population lives in an area that covers about 31 per cent of the province’s land. Distribution of the population is discontinuous—issues surrounding transportation and remoteness from major centres preclude a smoother urban/rural distribution.

The Nelson–Churchill region is very rich with natural resources, with more than 65 per cent of the land cover in forested areas and wetlands. Forestry, mining, tourism, commercial fisheries, hydroelectric development and subsistence activities are major socioeconomic drivers in the region.

The hydrologic regime of the NCRB is very complex and is heavily influenced by hydroelectricity generation and related development in the region, as well as the impacts of climate change. Many studies



have been carried out to identify the specific impacts of the alteration on the regime to the ecosystem. However, most of these studies have been carried out at smaller scales without looking at implications for the whole basin as an integrated system, which is critical to developing basin-management strategies.

The northern NCRB provides a wide range of vital ecosystem services that contribute significant amounts to the region’s economy—and considerably to the provincial, national and global economies. The basin’s ecosystems supply numerous provisioning, regulating and cultural ecosystem services due to its various resources uses, which range from forests and mining to large-scale hydropower generation. Therefore, it is necessary to understand these ecosystem services as a function of integrated watershed management, which requires a good understanding of the biophysical characteristics of the basin and suitable policy mechanisms specifically tailored to the basin.



3.0 Toward an Integrated Management Framework for the Northern NCRB





3.0 Toward an Integrated Management Framework for the Northern NCRB

3.1 Toward an Integrated Management Framework for the Northern NCRB

Section 2 summarizes the state of the northern NCRB, focusing on describing the watershed ecosystem, highlighting some elements of ecological, economic and social importance, and finally summarizing some of these as ecosystem services that we benefit from—both regionally and globally. These help articulate the goals and aspects of integrated management efforts on the northern NCRB. In providing this summary, we make the case for managing this watershed ecosystem in its entirety to ensure that its interlinked aquatic and terrestrial systems continue to be healthy and provide the benefits that are the foundation for communities and economies in Manitoba. Our first attempt is in northern Manitoba, to develop something that can be adapted for the entire basin.

In this section, we discuss how to manage the ecosystem and who could be involved in these management efforts. A review of the literature focuses on key principles of ecosystem management with an emphasis on watershed ecosystems.

Researchers, policy-makers and managers have grappled with the complexities of ecosystem management and its issues for decades, having published hundreds of reports highlighting challenges and solutions around successful ecosystem management (Grumbine, 1994). With growing understanding of the links between ecosystem services and human well-being, there are examples of basins around the world where management is deliberately prioritizing certain benefits, while staying conscious of trade-offs that might occur as a result. These efforts gained momentum somewhat after the Millennium Ecosystem Assessment (MA, 2005) popularized these links further, and various management approaches have been developed to pursue this new paradigm. Some create frameworks and dialogues to manage competing land and water uses for interests within a watershed (e.g., industry, resource extraction, agriculture, energy production, urban areas, ecosystem needs, etc.).

Ecosystem management in the northern NCRB will require a clear understanding of current management systems being applied to specific aspects within the region. Section 3.2 presents principles for effective ecosystem governance based on lessons in literature from comparable efforts. These principles are then applied in the northern Manitoba portion of the NCRB in Sections 5.1 to 5.7 to provide the foundation for first steps in developing a specific framework with inputs from other interests.

3.2 Principles for Watershed Management Success

With increasing pressures on land and water, it is necessary to manage these resources to maximize environmental and socioeconomic benefits. When managing for multiple values, taking a watershed approach becomes quite compelling. Watersheds concentrate important elements of life such as nutrients and water and allow for landscape monitoring for clear indicators of management, such as water quality, flow, nutrient loads, etc. Watersheds naturally provide diverse benefits such as water filtration, soil formation and climate regulation. Society derives benefits from these services, including improved food security, employment security, flood protection and recreational opportunities.

While no one perfect watershed management model exists, and the specific context of each watershed is different, best practices can still be identified from experience thus far. This portion of the report focuses on identifying and articulating best management practices that are relevant in the setting of the northern NCRB.



3.2.1 Methods

In order to identify beneficial principles for watershed management success, we conducted a review of literature focused on place-based management, including natural resource and watershed management. By identifying recurring elements in the literature, we extracted principles necessary for good, adaptive management with some emphasis on relevance to the northern NCRB.

Our review yielded eight documents that focus on ingredients for good resource management. Several of these papers focus specifically on the Canadian context (Brandes & O’Riordan 2014; Government of Alberta, 2015; Sheelanere, Noble, & Patrick, 2013), while others look at single basins elsewhere (e.g., Bach et al. 2011 provides lessons from the Mekong basin) or compare multiple international examples (e.g. Blomquist, Dinar & Kemper, 2005; Lewtas, Gerrard, & Roy, 2015; Roy et al., 2011; Schmeier, 2012). While each study approached the topic of watershed management with a slightly different purpose and context (e.g., developed/developing countries; national/transboundary watersheds; academic analysis/“how to” guidance document), and thus each generated somewhat different factors, significant commonalities still arose.

Factors that were commonly identified as beneficial in watershed management approaches included:

- Basin planning
- Leadership
- Multi-party approaches
- Shared decision making with Indigenous Peoples
- Monitoring and reporting
- A role for legislation
- Consistent, long-term funding

These factors should not be viewed as totally discrete. Rather, they are interlinked—a fact that becomes clear when we discuss the principles in relation to Section 5 of this report which is focused on the northern NCRB. First, however, we examine each principle based on our identified literature.

Table 6 summarizes elements of successful resource management against their sources in the reviewed literature. The list of beneficial principles on which this section focuses is hardly exhaustive. The sources reviewed presented a rich array of factors that can benefit watershed management. For instance, Blomquist, Dinar and Kemper (2005) identify 19 factors they suggest play a role in basin management success. Schmeier (2012) presents an analytical framework for river basin organization effectiveness with 22 variables. In addition, the literature often reflects a more general concept of “good governance” that is not specific to watersheds or ecosystems. Governance principles expressed to varying degrees in Blomquist, Dinar and Kemper (2005), Brandes and O’Riordan (2014), Schmeier (2012) and Government of Alberta (2015) include the need for transparency, accountability, adaptability/flexibility, legitimacy and conflict resolution.

**Table 6. Beneficial principles for watershed management identified in the literature**

	Blomquist, Dinar & Kemper (2005)	Brandes & O’Riordan (2014)	Lewtas et al. (2015)	Sheelanere et al. (2013)	Schmeier (2012)	Government of Alberta (2015)	Bach et al. (2011)	Roy et al. (2011)
Basin planning	X	X	X	X	X	X	X	X
Leadership	X		X	X		X		X
Data, monitoring and reporting	X	X	X	X	X	X	X	X
Multi-party approaches	X	X		X	X	X	X	
Shared decision making with Indigenous Peoples		X	X			X		
Importance of/ role for legislation	X	X	X	X	X			
Consistent and long-term funding sources	X	X		X	X	X	X	X

3.2.2 Basin Planning

Recognition of the need for a watershed approach, along with development of a plan for implementation, is the foundation for watershed-based management. Basin planning compels a variety of measures, including defining the watershed area and the interests within it, and the creation of goals and objectives, along with consideration of many other factors.

Defining the basin: Before a basin plan can be created, its boundaries have to be identified and the need for basin-level governance recognized. This necessity can be viewed as a precondition for the rest of this discussion: for basin-level planning and management to occur, the basin must first be defined and the need for governance at the basin scale acknowledged (Blomquist, Dinar & Kemper, 2005; Government of Alberta, 2015). Defining hydrological boundaries is important so that the appropriate communities and interests are included in planning. Blomquist, Dinar and Kemper (2005) explain:

Ill-defined or poorly-fitted boundaries may include in collective decision making individuals or communities who are not actually in the basin, or exclude others who are ... Either mismatch detracts from the efficiency and efficacy of collective decision making arrangements—needed information is missing, extraneous information is included, arrangements for distributing costs and benefits cannot approach complete fairness, and some users can exploit others with impunity. (p. 15)

Goals/Targets: An overarching question related to watershed management is understanding what the overall goals are. Clearly agreed-upon goals and objectives, clear actions to meet objectives, monitoring systems to see what works and feedback into adaptive watershed management are components of good watershed plans (Brandes & O’Riordan, 2014; Government of Alberta, 2015; Roy et al., 2011). Often (but not always) there is a link between watershed management leadership and the development of a plan in that the lead entity might spearhead the creation of a plan (though they might produce it through consultation and collaboration with basin interests). Blomquist, Dinar and Kemper (2005) reported that, in all eight river basin organizations they studied, each had a lead entity responsible at least in part for “planning and/or coordination” in the basins.



Roy et al. (2011) give the example of the Danube River Basin Management Plan, which sets specific and time-bound targets for such considerations as surface water quality, river and habitat continuity, groundwater quantity and ecological status. Similarly, Brandes and O’Riordan (2014) also commend the European Union Water Framework Directive’s creation of clear goals and timelines to achieve water quality and ecological status targets.

Other considerations: The Government of Alberta’s Guide to Watershed Planning (2015), used in this review, provides “common elements essential for success” for watershed groups preparing management plans (ii). It offers practical advice on how to set up a watershed management process and plan framework. Embedded implicitly or explicitly in this guide are many of the principles that the present report recommends, such as the need for monitoring and reporting (3.2.6) and including Indigenous Peoples (3.2.5). Usefully, it also guides plan developers to ask key questions that, if not considered when developing a plan, could negatively affect success. For instance:

- Are interested parties signing off on terms of reference that clearly outline the issues to be addressed, scope, process, timelines and principles of engagement?
- Is there an education program for new interests joining the process?
- Are inventories of existing actions being compiled?
- Are necessary trade-offs being discussed?
- Are models available to explore alternative scenarios?
- Are proposed actions being tested for social acceptability?
- Are proposed actions being run through a cost-benefit analysis? (p. 44–45).

3.2.3 Leadership

A common theme in the review was that some form of leadership is critical to the success of watershed management initiatives. The establishment and recognition of a leader clarifies who is ultimately responsible for the initiative and gives interested parties someone to look to for information. In some ways, the leader can be seen as the “project manager” of the watershed—guiding the planning and execution of a watershed management plan, as well as managing interests, resources, relationships and scope.

While the nature of leadership needed varies across case studies reviewed (e.g., government, consortium, non-profit, multi-lateral organization, etc.), more useful is perhaps that the documents (Blomquist, Dinar & Kemper, 2005; Brandes & O’Riordan, 2014; Roy et al., 2011; Schmeier, 2012; Sheelanere et al., 2014) revealed a set of characteristics found in many entities that provide leadership for watershed management. These include the ability and widely accepted mandate to: provide strategic direction and vision to watershed planning; convene interested parties; coordinate planning and activities; make decisions; ensure implementation and compliance (through legislative authority or some other way); obtain or provide human and financial resources; secure social license/support from rightsholders and other stakeholders, including Indigenous Peoples; be able to meet expectations of accountability and transparency; have legitimacy in the eyes of interested parties; manage various interests; guide the initiative through challenges; work across provincial or international boundaries (in some cases); and help develop standardized methodologies and data.

In terms of structure, the eight case studies presented by Blomquist, Dinar and Kemper (2005) demonstrate that a range of leadership structures may be possible, from leadership by a central government agency (e.g., the Warta watershed in Poland), to an intergovernmental body (e.g., the Murray-Darling



basin in Australia), to a non-governmental organization (e.g., Fraser basin in Canada). Sheelanere et al. (2013) conclude that the provincial government is best placed to take the lead in the South Saskatchewan watershed context, though they allow for the possibility of a government-led consortium. They state: “effectively managing the cumulative effects to watersheds is a complex undertaking that requires leadership and coordination that is beyond the knowledge, capacity, and mandate of individual project proponents” (p. 73).

The level of authority that the entity providing leadership has is important. Through their case study of the Okavango River basin (in Angola, Botswana, Namibia and Zimbabwe), Roy et al. (2011) showcase the Okavango River Basin Water Commission as “strictly an advisory body” and claim that this reduces its ability to affect change. Actual water resource management and decision making remains with governments. In contrast, they give the example of the International Commission for the Protection of the Danube River (ICPDR), which has a mandate to implement the European Union Water Framework Directive in the basin. The ICPDR was created to help coordinate activities across the 19 countries in the Danube River Basin, implement the 1994 Danube River Protection Convention and lead some aspects of the Water Framework Directive. Both Roy et al. (2011) and Schmeier (2012) point to the ICPDR as an example of fairly effective leadership.

The existence of some form of leadership relates closely to many of the other principles presented here. For instance, the need for a lead entity is frequently discussed in the context of planning (Section 3.2.2) and monitoring (Section 3.2.6). A central coordinating body (sometimes the leader) is beneficial in developing standardized data, without which it is challenging to do basin-wide mapping, trend analyses and comparisons (Brandes & O’Riordan, 2014).

3.2.4 Multi-Party and Multi-scale Approaches

Everyone in a watershed has a role to play in its sustainable management. Securing significant involvement from rightsholders and other stakeholders throughout a watershed helps ensure broad support, incorporate different perspectives and, ultimately, increase the chance of management success.

Involving multiple interests in watershed planning is not a new concept. Blomquist, Dinar and Kemper (2005) write that it is one of the “most widely repeated recommendations in the water resources literature” (p. 4). Bach et al. (2011) define these parties as “the organizations and key individuals who make decisions and/or are affected by those decisions—those who manage and those who are being managed” (p. 28). More specifically, in watersheds these tend to include utilities, industry, civil society organizations, national and provincial governments (especially those departments with related interests, such as environment, public health, economic development, land use, natural resources etc.), local governments, landowners, Indigenous Peoples and the scientific community.

Roles of different parties: Several studies also indicate that roles vary between interested parties. Sheelanere et al. (2013) provide the following suggestions for roles in the context of cumulative assessment and management:

- The lead agency is “responsible for establishing watershed planning objectives, setting development thresholds, terms of reference for project environmental assessment and monitoring programs, and leading development of partnerships” (p. 71).
- The project/development proponents’ roles include fulfilling terms of reference, fulfilling monitoring and reporting requirements, and adopting mitigation measures.



- Watershed agencies contribute to watershed planning, monitoring programs and watershed reporting, as well as provide advice to the lead agency in terms of “changes in baseline conditions, public concerns, and suspected incidents of non-compliance with mitigation or thresholds” (p. 71).
- The science community can help develop indicators, modelling and linkages between river health and land use.

Multi-scale approaches: Some discussion in the literature about scale focuses on whether management should be top-down or bottom-up. Bach et al. (2011) and Sheelanere et al. (2014) suggest that both are necessary, along with vertical and horizontal coordination (i.e., information sharing, communication, harmonization of monitoring approaches, etc.) between levels of watershed management, across sectors and between interested parties. Other authors similarly emphasize the importance of these linkages when discussing concepts such as nested management, multi-scale approaches and the need for subsidiarity (Brandes & O’Riordan, 2014; Government of Alberta, 2015).

In their discussion of the multi-country Mekong basin, Bach et al. (2011) emphasize that different but linked structures and strategies are useful at different scales (see Figure 15). For instance, at the highest basin scale, an Integrated Water Resources Management-based (IWRM) Basin Development Strategy has been created. This strategy is supported by national- and sub-basin-level IWRM strategies, each involving somewhat different constellations of interests and partnering bodies.

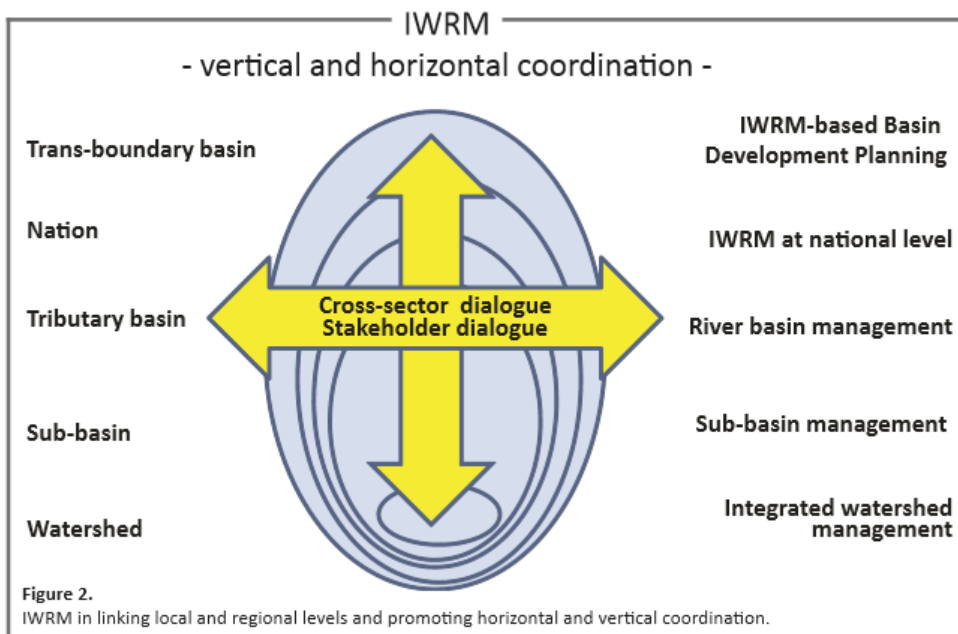


Figure 15. Vertical and horizontal linkages in watershed management

Source: Bach et al. (2011, p. 8); reprinted with permission from Hanne Bach.

3.2.5 Shared Decision Making with Indigenous Communities

In northern Canada in particular, where a large portion of the population is Indigenous, it is essential to involve the various Indigenous communities and groups in any regional planning. They are important interests with legal rights of their own, with knowledge and skills to offer—and also with a significant amount to lose if they do not have a say in planning and management. Brandes and O’Riordan (2014)



identify co-governance with Indigenous Peoples as one of their nine conditions for future watershed governance success in British Columbia, writing that Indigenous Peoples and their governments “must be properly acknowledged and hold an important place in any efforts to improve the governing of watersheds to ensure more ecological and socially sustainable outcomes” (p. 8). As in British Columbia, working with Indigenous Peoples is imperative in Manitoba.

Brandes and O’Riordan (2014) and Lewtas et al. (2015) document instances where shared decision making with Indigenous Peoples enjoyed some success. For instance, the Mackenzie Valley Land and Water Board decentralizes water management through the existence of four regional regulatory boards that emphasize co-management and are empowered to issue and manage land-use permits and water licenses. These boards, on which half of the members are nominated by Indigenous land-claim organizations, “give Aboriginal people of the Mackenzie Valley a greater say in resource development” (Brandes & O’Riordan, 2014, p. 28).

In the case of Quebec’s Plan Nord, institutional mechanisms are being created to ensure collaborative decision making with Indigenous Peoples. In particular, the 2014 Act Respecting the Société du Plan Nord created an entity “responsible for ensuring responsible development in a spirit of respect for local and First Nations communities” (Lewtas et al., 2015, p. 13). In addition, CAD 2 billion in infrastructure spending over the next five years is being designed with benefits for Indigenous Peoples in mind, including opportunities to improve living conditions; create employment; and enhance education, health and social services. While the 2011 version of Plan Nord was criticized by Indigenous Peoples, the revised version from 2014, which pays close attention to benefits for Indigenous Peoples and emphasizes social acceptability, is overcoming criticism and receiving sign-in by Indigenous communities.

Similarly, the Great Bear Rainforest Agreement in British Columbia has received approval by all Indigenous Peoples in the region. Involvement of Indigenous communities in decision making is one of the four key elements of the agreement (the other three being “rainforest protection, improved logging practices ... and conservation financing to enable economic diversification” [Lewtas et al., 2015, p. 34]). Indigenous Peoples are directly involved in land-use planning through the government Land and Resources Forum, with representation from Indigenous communities and the provincial government. The process also supports other benefits for Indigenous Peoples, including economic opportunities related to conservation and sustainable development and protection of culturally important areas. The groundbreaking ecosystem-based management approach is viewed as “among the most comprehensive conservation achievements in North American History” (p. 34), and has accomplished collaboration between Indigenous communities, industry, civil society and government in a context that, in the 1990s, was a source of major conflict.

Brandes and O’Riordan (2014) acknowledge that approaches to Indigenous co-governance may need to vary depending on context and location, but identify the following as likely elements:

- “A clear recognition of First Nations as constitutional rights holders;
- Some formal arrangement for consultation and accommodation processes, and perhaps shared decision-making and co-governance in traditional territories; and
- Agreement on the representation of First Nations on watershed entity boards and other structures to ensure appropriate representation across levels of decision-making” (p. 28).



3.2.6 Monitoring and Reporting

Conducting watershed planning and management involves the creation of goals, targets and objectives, as discussed in Section 3.2.2. Long-term monitoring can help in setting these goals and targets based on the natural conditions and trends within watersheds. Once targets are set, monitoring can also ascertain whether or not the state of the watershed is moving towards or away from those targets. Findings of monitoring programs should also be communicated broadly so that all interested parties are aware of progress, understand activities and can assist where possible.

3.2.6.1 Monitoring

Essential to watershed planning and management are knowledge of watershed processes and an understanding of trends over time, including an understanding of how implementing management processes are affecting these trends. One way of compiling this information is through ongoing data collection (monitoring), and often the creation of indicators using this data. All of the papers reviewed recognized the importance of data collection and monitoring. Brandes and O’Riordan (2014) explain: “Access to data on water supply, water use, water quality, and riparian condition is critical for successful governance” (p. 32).

The papers identify a number of sub-principles/activities that are important to monitoring (Bach et al., 2011; Blomquist, Dinar & Kemper, 2005; Brandes & O’Riordan, 2014; Sheelanere et al., 2013; Schmeier, 2012):

- Creating consistent data collection methods and protocols so that data collected by different interests can be integrated.
- Collecting data at multiple scales (i.e., “nested monitoring”), including at the local/project level (e.g., a single industrial development) and watershed scale.
- Incorporating traditional ecological knowledge into monitoring and indicator systems.
- Making the data accessible in common formats to governments, scientists, watershed organizations and other interested parties.
- Conducting cumulative effects monitoring so that interested parties can detect and address changes brought about by multiple activities in the watershed.
- Including both top-down (e.g., government) and bottom-up (e.g., community monitoring) data.
- Storing data in a central, comprehensive database that is accessible to all interests.
- Selecting indicators appropriate to each scale, as an indicator that works for a lower scale might not be as appropriate at a higher scale.

One much-discussed challenge is the need to bring data to one place and then make it available. For instance, Brandes and O’Riordan (2014) note that, in British Columbia, watersheds have “disaggregated data systems,” which make it difficult to organize data and create watershed plans (p. 22). They suggest that central storage would be helpful. Sheelanere et al. (2013) draw a similar conclusion for the South Saskatchewan basin, writing: “A common concern was that large amounts of valuable data are already stored in different databases ... and are not directly accessible for any type of watershed assessment. Ideally ... data needs to be gathered and accessed through a centralized process as this would provide opportunities to integrate future project information with watershed scale information” (p. 72).

Schmeier (2012) provides an example of basin-wide monitoring and data centralization for a complex, multi-country indicator framework. She suggests that the Danube River Basin has enjoyed fairly effective



basin governance in part because of their high level of data and information exchange, and the formalized centralization of data with one entity, the International Commission for the Protection of the Danube River (ICPDR). In the Danube Basin, the ICPDR coordinates and participates in a range of data collection activities, including the TransNational Monitoring Network, which monitors water quality and pollution loads and creates harmonized monitoring and assessment methods throughout the basin to facilitate data integration. Through this and other programs, the ICPDR collects, prepares and analyzes data about the basin on these and other topics (e.g., river flow levels, flood patterns etc.). Member states willingly share their data so the ICPDR can incorporate them into planning and activities. The data and outputs are then made available by the ICPDR to interested parties through databases, reports and websites. Schmeier (2012) reports that this level of data sharing and cooperation is viewed by experts as unusual, and adds:

The ICPDR data and information management can be regarded as one of the key prerequisites for effective river basin governance since it provides the river basin organization and member states, as well as basin populations, with data and information required for reaching joint decisions, developing river basin governance projects and activities, and monitoring outcomes. (p. 206)

3.2.6.2 Reporting

Even if data is stored in a central database, it must still be interpreted. This is why reporting is imperative; many interested parties do not necessarily have the expert knowledge or time to understand the data themselves, but can understand interpreted information so that they understand a situation and react accordingly. For example, government decision-makers such as elected politicians do not frequently analyze watershed data themselves, but they require synthesized reports in order to develop relevant and appropriate policies.

Brandes and O’Riordan (2014) emphasize the importance of reporting, not only to provide essential information but also to provide transparency and accountability: “The more often data is reported, and the more accurate the data is, the more responsive managers and local practitioners can be to shortages or changing local circumstances and ensuring effective adaptive management” (31). Additionally, they draw from international literature to recommend that not only should ecosystem data be reported, but also financial and organizational well-being: “International experience demonstrates the importance of establishing an independent oversight body and the benefit of public reporting on a range of issues, from financial management aspects and administrative functioning, to watershed conditions, to create institutional learning” (p. 40).

Both Roy et al. (2011) and Sheelanere et al. (2013) highlight the value of “state of the watershed/basin” reporting. Of the Mekong River Commission’s *State of the Basin Report*, Roy et al. (2011) explain that a wide range of valuable information is provided, such as “ecosystem-based economic valuation for wetlands, agricultural production, fisheries, flood mitigation, climate regulation, future patents and future recreation, as well as cultural significance and biodiversity” (p. 62).

Sheelanere et al. (2013) explain how the *State of the Watershed Report* by the Saskatchewan Watershed Authority provides an overall assessment of the watershed. Interviewees in their study emphasized the importance of reporting data widely so that it could inform decisions and be valuable to “end users, including project proponents, regulators, practitioners, and watershed agencies who report on the state of the watershed” (p. 72).

The BC Water Use Reporting Centre offers another Canadian example of public reporting. A website that allows utilities and large water users to report their surface and groundwater use, the system allows



for access to updated water-use data, comparisons between utilities and predictions of future water usage. According to Brandes and O’Riordan (2014), “this type of water-use reporting is about more than just meeting regulatory requirements. It has the potential to offer real-time and detailed understanding about water use in the watershed context” (p. 21).

3.2.7 A Role for Legislation

Commonly discussed in the literature is the function of legislation in watershed management (Blomquist et al., 2005; Brandes & O’Riordan, 2014; Lewtas et al., 2015; Schmeier, 2012; Sheelanere et al., 2013). Perspectives range from suggesting that minimal legislation is needed for this purpose, and that the main use of legal instruments for watershed management might be to create an entity and then allow it to advance water management through largely voluntarily means, to more extensive involvement of legislation, in which many actions and activities are regulated and enforced. More generally, some authors discussed the role of regulations in general to help protect the environment, whether or not the legislation was linked explicitly to watersheds (e.g., Bach et al., 2011).

The documents reviewed provided many examples in which legislation was fundamental to the creation of watershed-based groups. Examples include the creation of the Columbia Basin Trust through the Columbia Basin Trust Act (Brandes & O’Riordan, 2014); establishment of the Murray-Darling Basin Authority under the federal Water Act (2007) (Schmeier, 2012); and the creation of conservation districts in Manitoba and conservation authorities in Ontario through the Conservation Districts Act and the Conservation Authorities Act, respectively (Brandes & O’Riordan, 2014).

Legislation can help define the composition and mandates of organizations. The Mackenzie Valley Land and Water Board (MVLWB), created by the Mackenzie Valley Resources Management Act (MVRMA), provides an example of legislation providing some protection for a watershed organization. Part 4 of the MVRMA specifies composition of the MVLWB board, including a chairperson, members of regional panels, “two members appointed following consultation by the federal Minister with the First Nations and the Tlicho Government,” “one member appointed on the nomination of the territorial Minister;” and “one other member” (Government of Canada, 1998, p. 80). The mandates of the board and regional panels are also described. For instance, the mandate of the MVLWB is: “to provide for the conservation, development and utilization of land and water resources in a manner that will provide the optimum benefit generally for all Canadians and in particular for residents of the Mackenzie Valley” (p. 80).

Legislation can also be a tool for providing organizations with protection. Blomquist, Dinar and Kemper (2005) comment that watershed organizations can be vulnerable to changes in policy and government, including in terms of resources (financial and human) and structure (e.g., a new government’s support for decentralized management). They write: “Discontinuities in central government policy commitments can disrupt support, confuse the missions and operations of central government agencies involved in resource management, and undermine the confidence of stakeholders in the decentralization initiative” (p. 11). For instance, in 2014, the federal government attempted to amend the MVRMA and amalgamate the four regional boards into one centralized board in Yellowknife (Brandes & O’Riordan, 2014). The Tlicho government, one of the Indigenous Nations included in the MVRMA and with members on the board, took legal action against the changes using the original language of the MVRMA and Tlicho treaty rights. While the issue is not yet decided, the Northwest Territories Supreme Court granted an injunction in 2015 (Supreme Court of the Northwest Territories, 2015). That decision was appealed by the federal government in power, and the subsequent Canadian government elected in October 2015 put the appeal in abeyance.



This case illustrates how legislation can give organizations legal protection against changes, and also help uphold treaty rights and enable voices of multiple interests.

Legislation can also play an important role in creating environmental requirements. Lewtas et al. (2015) provide several examples of legislation creating effective natural resources management. For instance, in 1996 Costa Rica created a payment for ecosystem services program for which three laws form the framework: the 1995 Environment Law 7554, the 1996 Forestry Law 7575 and the 1998 Biodiversity Law. Together, these laws mandate “a balanced and ecologically driven environment,” require “rational use” of natural resources and biodiversity and prohibit land-cover change in forests (p. 49).

This example illustrates the role of legislation in establishing environmental standards and setting minimum requirements for resource protection (e.g., water quality standards). Even in the absence of a watershed-specific organization, regulations can achieve much. In fact, in its guide for watershed planning, the Government of Alberta (2015) recommends considering the “policy and legislative context” at the outset of creating a new watershed organization (p. 17); often, some groundwork will have already been laid related to resource management and environmental protection.

When interviewing interested parties in the South Saskatchewan Basin on the need for legislation in watershed cumulative effects assessment and management, Sheelanere et al. (2013) found that opinions varied. About half of interviewees suggested legislation needs to play an active and constant role, including through legislative instruments, enabling the enforcement of monitoring and reporting requirements and standards, setting terms of reference for environmental assessments, allowing for penalties where needed, and ensuring accountability of both developers and governments.

Conversely, some interviewees questioned if legislation is the most effective route, pondering if incentive-based approaches and multi-party collaboration might be more appropriate. Others pointed out that legislation must be enforced, and that environmental assessment legislation already existed in the watershed. Said one interviewee: “I don’t think legislation is a panacea, I don’t think it is going to solve the problems that we have.” Another interviewee, from a watershed organization explained that “new legislation is not going to change anything without willingness to enforce ... so I am not sure whether legislation is needed” (Sheelanere et al., 2013, p. 73). A middle-ground discussed was of “a delicate balance between legislation and cooperation” (p. 73). Sheelanere et al. (2013) ultimately conclude that, at the least, “enabling legislation” is required for effective watershed management. A discussion of the roles of various government and non-government entities and potential gaps in management that are relevant to ecosystem management is planned in the following stages of this research.

3.2.8 Consistent and Long-Term Funding

While the need for watershed management and planning is widely recognized, one common barrier to effective implementation is lack of sufficient and sustainable funding. The literature indicates that watershed management is underfunded in a large number of cases: “Decision makers tend to undervalue both the benefits of more sustainable water management and the costs of watershed degradation and loss” (Bach et al., 2011, p. 5). Funding is needed not only to create watershed plans, but also to then effectively implement them, conduct monitoring and periodically revise the plans for improvement. This process necessitates a range of sub-activities such as watershed modelling, data management, analysis, multi-party coordination and communications. The financial and human resources required are significant. Brandes and O’Riordan (2014) further suggest that the future of management should see watershed organizations taking on expanded roles, such as cumulative effects analysis, dispute resolution and facilitation of multi-party interaction—activities which will they recognize “will require significant additional funding” (p. 32).



The common recommendation of increased funding for watershed organizations naturally raises the following question: where should the funding come from? The literature identifies a range of options. In terms of cumulative environmental effects assessment and management, Sheelanere et al. (2013) found that interests in the South Saskatchewan Basin felt that government had the greatest responsibility to fund activities. However, they also recognized that government can finance the activities through innovative means such as cost recovery or user fees. Bach et al. (2011), Brandes and O’Riordan (2014) and Blomquist et al. (2005) recommend that watershed organizations be funded by a diversity of sources to increase sustainability, but also identify mechanisms such as user fees. In addition, Brandes and O’Riordan (2014) suggest that watershed organizations could be empowered to collect taxes and user fees, just as Canadian local governments are. There appears to be near consensus that non-traditional funding approaches can be used to ensure increased and more sustainable funding. This review identified the following potential funding sources:

- Licensing and permitting fees; water and resource user fees (Blomquist, 2005; Brandes & O’Riordan, 2014; Sheelanere et al., 2013)
- Senior (federal, provincial) government support (Blomquist, 2005; Brandes & O’Riordan, 2014; Sheelanere, 2013)
- Taxes (Brandes & O’Riordan, 2014; Sheelanere, 2013)
- Payment for ecosystem/watershed services (Bach et al., 2011; Brandes & O’Riordan, 2014; Roy et al., 2011)
- Water quantity and quality trading etc. (Brandes & O’Riordan, 2014; Roy et al., 2011)
- Project-based grants and programs from governments and foundations (Blomquist, 2005; Brandes & O’Riordan, 2014; Schmeier, 2012)
- Trust funds (Brandes & O’Riordan, 2014; Lewtas et al., 2015)
- Certificates of Environmental Services (Lewtas et al., 2015)
- Recreation fees (Brandes & O’Riordan, 2014)
- Community co-ops (Brandes & O’Riordan, 2014)
- Crowdsourcing; social/environmental impact bonds (Brandes & O’Riordan, 2014)

Table 7 provides examples of where some of these approaches have been used.

Some of these mechanisms have already been tested in watersheds around the world. For instance, payments for ecosystem services have been used considerably by in the Mekong basin. Similarly, the payment for ecosystem services program in Costa Rica provides payments to landowners for the provision of greenhouse gas mitigation, hydrological services, scenic beauty and biodiversity (Lewtas et al., 2015).

These payments are provided through three types of contracts:

1. “Forest conservation contracts that require owners of natural forests to protect the land for five years;
2. Restoration contracts that bound owners to plant trees on agricultural or abandoned land, and maintain the plantation for 15 years; and
3. Sustainable forest management contracts for landowners who prepared a sustainable logging plan for low-intensity logging for 15 years.” (Lewtas et al., 2015, p. 49)

Norwegian Government Pension Fund Global’s (GPF) management of revenues from Norway’s petroleum resources provides a valuable example of innovative and consistent long-term financing. Since



1990, GPFG has invested funds from the petroleum sector and uses the returns on public infrastructure and social programs (Lewtas et al., 2015). Through this approach, NOK 156.2 billion (CAD 25.5 billion) was used on public spending in 2014. Investing resource revenues to generate public funding, as well as generally aiming to share profits from resource development with a population, is a promising approach that can produce significant amounts of funding. Further examples provided in Table 7 illustrate the various ways in which benefits can be shared.

Brandes and O’Riordan (2014) point out that taxes, levies and fees can also successfully raise money for watershed management, and that there is a reasonable argument for doing so given that current fees generally do not cover the costs to operate water systems. “Even a modest increase in water rentals could go to the [water organizations in the] watershed to provide reliable base funding” (p. 34). For instance, the Okanagan Basin Water Board generates more than half of its annual funding through levies from member regional districts. Brandes and O’Riordan also propose that other resource royalties and fees can be collected in association with resource extraction, such as “water licenses, pollution permits, forestry ‘stumpage’ fees, or fishing licenses” (p. 33).

This example of local-level revenue collection by a watershed organization itself also demonstrates the value of providing organizations with some degree of financial autonomy. Decentralization of decision making, including how revenues are spent, contribute to good basin management. Bach et al. (2011) claim that, “while it is conceivable that central government officials could successfully design and alter institutional arrangements for each basin, as a practical matter the information requirements of such a task are extremely high” (p. 13). Thus, a decentralized approach with local and regional interests having significant influence on how funding is spent may be more successful for watershed management.

Table 7. Funding options for watershed management

Funding Source	Examples
Local taxation, levies, fees	<ul style="list-style-type: none"> • Okanagan Basin Water Board: levies on member regional districts • Regional District of Nanaimo: parcel levy to fund Drinking Water Protection Action Plan • Portland: manages stormwater runoff and water quality/quantity concerns using stormwater utility fees
Water license fees, resource royalties, pollution permits	<ul style="list-style-type: none"> • France: user-pay approach in relation to the Water Framework Directive
Philanthropy (e.g., foundations), charitable trusts, benefit-sharing agreements	<ul style="list-style-type: none"> • British Columbia: Columbia Basin Trust • Norway: Government Pension Fund Global (oil and gas context)
Recreation user fees	<ul style="list-style-type: none"> • Ontario: fees collected by conservation authorities at sites
Payment for ecosystem services (PES), watershed bonds, offsets (carbon and water quality trading), banking	<ul style="list-style-type: none"> • PES: Costa Rica’s PSA Program • Water quality trading: Chesapeake Bay Watershed Program (U.S.); Ohio River Basin Trading Project (U.S.); South Nation Total Phosphorus Management Program (Canada) • Carbon trading: Chicago Climate Exchange • New York: investment by NYC Authority in upstream ecosystem services in the Catskill/Delaware watershed to improve water quality
Community co-ops	<ul style="list-style-type: none"> • Social enterprise that creates a “self-sustaining revenue stream,” such as from turning waste by-products into bioenergy
Crowdsourcing, social/environmental impact bond	<ul style="list-style-type: none"> • South Dakota, United State: nearly USD 390,000 raised on the Indiegogo crowdfunding site by seven bands of the Oceti Sakowin (Great Sioux Nation) to buy land that includes the sacred site Pe’ Sla, and thus prevent development (Nienaber, 2012).

Sources: Brandes & O’Riordan (2014); Lewtas et al. (2015)



Box 1. Spotlight on benefit sharing: Giving back in resource-development contexts

Given the critical need for sustainable, long-term resources, without which watershed management and planning struggles, innovative approaches to providing consistent financing are beginning to emerge. Some of these fall under the concept of benefit sharing, which “refers to a commitment to channel returns of a project – either monetary or non-monetary – back to the range of designated participants, project-affected populations or populations living in the vicinity of a development” (Lewtas et al. 2015, p. 6).

Lewtas, Gerrard and Roy (2015) give examples of benefit sharing from a wide range of geographies, from watersheds (e.g., Columbia Basin Trust in British Columbia), to regions (e.g., Quebec’s Plan Nord), to country-based benefit-sharing approaches (e.g., Norway’s GPF, discussed in the previous section) and a diversity of natural resource contexts (forestry, mining, oil and gas and hydroelectric developments).

On a basin basis, the Columbia Basin Trust (CBT) in British Columbia is viewed as an example of effective benefit sharing. Created by the Columbia Basin Trust Act in 1995, it creates a framework to share the benefits of hydropower generation with citizens in the basin. With a fund of CAD 321 million, the trust earned CAD 29 million in revenues in 2014–15. As a result, it distributed nearly CAD 22 million that year to programs and initiatives related to the environment, economic development, social areas, education and training, youth, arts, culture and heritage (2016). Due to ongoing success, program and initiative delivery are forecast to increase in future years (e.g., to CAD 47 million in 2016–17) (CBT, 2015). The American side of the basin has also developed a form of benefit sharing specifically to fund conservation activities. The interstate Northwest Power and Conservation Council is in charge of planning and policy-making in relation to both fish and wildlife and power generation, with the expectation that it considers these competing uses. Conservation activities, including habitat improvements and riparian restoration, are funded by power revenues amounting to USD 289.9 million in 2012 (Zubrycki et al., 2015).

British Columbia is also home to other trusts, including the Nechako-Kitamaat Development Fund Society, Northern Development Initiative Trust and Island Coastal Economic Trust, all tailored to their own particular natural resource and socioeconomic circumstances. Brandes and O’Riordan (2014) also point to the Habitat Conservation Trust Fund in BC, which is funded largely (70 per cent) by surcharges on hunting, angling, guiding and trapping licenses, as well as donations and court awards. Created in 1981, the fund has invested CAD 155 million in conservation projects related to ecosystem enhancement, conservation and restoration; land acquisition; and education (Habitat Conservation Trust Fund, 2015).

Not all benefit-sharing approaches are trusts. Quebec’s Plan Nord is a development strategy that aims to generate benefits, including employment, economic diversification, capacity building and infrastructure (e.g., improved transportation, telecommunications) for the region’s citizens. The Plan Nord region, which covers 72 per cent of the province’s area, has strong potential for mining, hydro, wind, solar, forestry and tourism development. Accordingly, Plan Nord plans for investments in energy, natural resource, infrastructure and social development by the province (CAD 2.7 billion), Hydro-Québec (CAD 20 billion) and the private sector (CAD 17 billion) over the next 20 years. It also sets environmental goals, including dedicating 50 per cent of the area to non-industrial activities by 2035. This balanced approach is reflected in Plan Nord’s vision statement: “The overall vision for 2015–2035 is to have enabled the development of this rich resources area, for the benefit of its populations and of the whole of Québec, through an exemplary form of sustainable development based on a comprehensive, integrated, consistent and responsible approach” (Government of Quebec, 2015; as cited in Lewtas et al., 2015).

3.2.9 Additional Considerations for Governance

The principles discussed above emerged repeatedly in our reviewed literature. Documents also revealed additional beneficial approaches to watershed management. Those listed here illustrate other issues highlighted.

3.2.9.1 Contextual Factors

Several of the publications explored not only beneficial management principles, but also the situations in which watershed management occurs (i.e., context). While context is largely out of the control of those



involved with watershed management, it is helpful to consider in order to understand what situational factors might help or hinder watershed planning.

Contextual factors listed by Blomquist, Dinar and Kemper (2005) include the level of economic development in the nation and in the river basin; distribution of resources among basin parties; social and cultural distinctions among different parties; and local experience with self-governance and service provision.

Schmeier (2012) discusses “problem structure” and “situation structure” variables including the complexity of problems being faced; whether disagreements are related to means or values; the complexity of the game structure; power structure and distribution; and whether or not cooperation exists on issues other than water.

3.2.9.2 Institutional and Governance Factors

The literature reviewed highlighted a number of governance issues (Blomquist, Dinar & Kemper, 2005; Government of Alberta, 2015; Schmeier, 2012). These include:

- Accountability, such as through public reporting (Brandes & O’Riordan, 2014; Government of Alberta, 2015)
- Transparency (Brandes & O’Riordan, 2014; Government of Alberta, 2015)
- Local-level support and partnership, including of existing local governance arrangements, which can increase legitimacy (Brandes & O’Riordan, 2014; Blomquist et al., 2005)
- Peer-to-peer learning and capacity building (Brandes & O’Riordan, 2014)
- Characteristics of water rights and water laws (Blomquist et al., 2005; Schmeier, 2012)
- Provision of dispute/conflict resolution methods and forums

3.2.9.3 Plan and Process Design

Similarly, the nature of a watershed management plan, and the processes for plan development and implementation, can be managed. Additional considerations provided included:

- The value of conducting cumulative impact assessments (Brandes & O’Riordan, 2014; Sheelanere et al., 2013)
- The importance of having strong scientific understanding and basing decisions in science (Bach et al., 2011; Lewtas et al., 2015; Sheelanere et al., 2013)
- The importance of providing adequate time for implementation and adaptation (Blomquist et al., 2005; Government of Alberta, 2015)
- Risk management (including economic risk) and long-term thinking (Lewtas et al., 2015).

The Government of Alberta (2015) provides an effective two-page checklist of key questions to assist with watershed management planning, including questions relevant to: plan initiation (e.g., “sufficient information to support the planning process”) (p. 46), plan development (e.g., “inventories of existing actions being compiled”), plan implementation (e.g., “social networks being utilized to help adoption of actions”), plan evaluation (e.g., “indicators designed to measure short, medium and long-term progress towards outcomes”) and adaptive management (e.g., “timeframe for updating the plan”) (p. 47).

4.0 Ecosystem Governance Case Studies





4.0 Ecosystem Governance Case Studies

This section comprises three case studies to illustrate the use of the principles for effective ecosystem or resource management identified in published literature. The cases of the Fraser basin in Canada, Mekong River basin over a number of countries in Asia and the Pan Nord Regional Development Plan were selected, as they demonstrate a variety of ways in which complex ecosystems are managed using a range of governance institutions with support from diverse policy mechanisms. The cases highlight a range of funding sources and participation from a variety of interest parties, including Indigenous communities. A mix of Canadian and international cases was deliberately selected to provide broad lessons.

4.1 Fraser Basin Council

4.1.1 Watershed Description

The Fraser River Basin is located in British Columbia, Canada and as the province's largest watershed, supports a wide diversity of flora, fauna and natural resources. The watershed also contains two thirds of the province's population (2.7 million people) and a diverse economy. The Fraser River is 1,399 km in length, flowing through varied terrain, in which its basin is the fifth largest river basin in Canada and extends across an area of 240,000 km² (Fraser Basin Council [FBC], 2011).

The Fraser River Basin's watershed includes 13 main sub-watersheds: Upper Fraser, Stuart-Takla, Neckako, Quesnel, West Road-Blackwater, Chilcotin Middle Fraser, North Thompson, South Thompson, Thompson-Nocola, Bridge-Secton, Lillooet-Harrison and Lower Fraser and Estuary (Figure 16). The current use of the Fraser River varies along its length, with forestry, pulp and paper, fishing and recreational uses dominating the sparsely populated upstream region and industrial, trade and municipal uses more dominant in the more densely populated downstream region of Greater Vancouver. The Fraser River Basin is one of the world's most productive salmon habitats, supporting seven salmon species (Chinook, Sockeye, Coho, Chum, Pink, Steelhead and Cutthroat Trout), which has prompted the need for stronger resource and watershed governance.

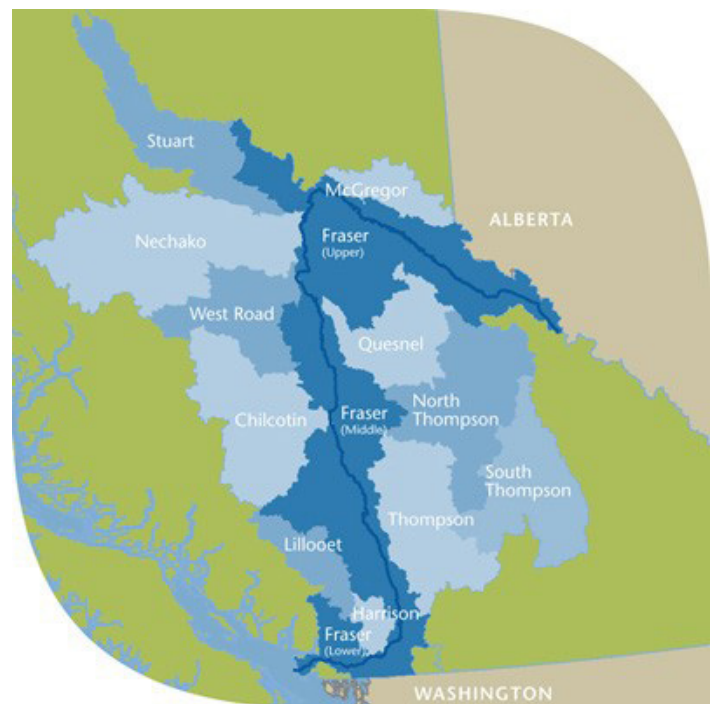


Figure 16. The major watersheds of the Fraser Basin, represented by blue polygons, within the province of British Columbia.

Source: FBC (n.d.b)

**Table 8. Fraser River Basin characteristics**

Location	British Columbia, Canada
Watershed Area	240,000 km ²
River Length	1,399 km
Ecosystems and Watershed Characteristics	The Fraser Basin includes 11 of the 14 biogeochemical zones of BC, which makes it one of the most diversified basins in Canada: Coastal Western Hemlock, Interior Cedar Hemlock, Interior Douglas Fir, Ponderosa Pine, Bunchgrass, Mountain Spruce, Engelmann Spruce-Sub-Alpine Fir, Mountain Hemlock, Sub-Boreal Spruce, Sub-Boreal Pine Spruce and Alpine Tundra (Savard, 1991).
Climate	The region experiences heavy precipitation during autumn and winter. Mean annual precipitation can exceed 2,000 mm in some regions (Coast Mountains). Interior Plateau mean annual precipitation ranges from approx. 400 to 800 mm.
Natural Resources	Forestry (pulp and paper), hydroelectric development (Kemano project on the Neckako River, McGregor River and the Fraser River at the Moran Gorge), irrigation and flood control, agriculture, fishing and recreation, and cattle ranching.
Population	2.7 million people
Management Institution	Fraser River Basin Commission

Source: Calbick et al. (2004); FBC (2011)

Multiple social, economic and environmental challenges confront the watershed, some of which include climate change impacts, water quality and allocation, flood protection, multiple demands on natural resources, strains on ecosystems, habitat loss downturns in local economics, changing demographics, improving Indigenous relations and a growing demand for public services (FBC, 2011).

4.1.2 Integrated Management

Various legislation and regulatory frameworks have guided the management of water resources in British Columbia, as well as specifically in the Fraser River Basin. The original water rights system for the Fraser River Basin was designed in response to the conflicts in its tributary streams that arose during the early gold rush. The first attempt occurred in the early 1950s by the Dominion Provincial Board and was a response to the flood of 1948 (Calbick et al., 2004). The second attempt occurred in the 1970s, as a response to the increasing conflicts in watersheds and the weakness of the earlier federal-provincial comprehensive river basin studies (Barrons, 1989; Calbick et al., 2004). The Fraser River Estuary Management Program (FREMP) was established in 1985 to manage water resources as an integrated system “to protect and improve environmental quality, provide economic development opportunities and sustain the quality of life in and around the Fraser River Estuary” (Fraser River Estuary Management Program, 2003). However, following the implementation of the FREMP, no other comprehensive plan to address water resource management was explored in the Fraser Basin.

The Fraser River has been degraded by a wide variety of pollutants, including toxic chemicals from saw mills, pulp and paper production, mining and other industries, municipal sewage, agricultural waste and urban runoff (Calbick et al., 2004). Due to concerns of ecosystem health, in 1990 the Government of Canada identified the Fraser River Basin as a major freshwater system that required priority action. In 1991, UBC’s Westwater Research Centre completed a comprehensive assessment of the Fraser River Basin’s sustainability, and then the Fraser River Action Plan was announced as part of Canada’s Green Plan in 1992. As part of Canada’s Green Plan, the Fraser River Action Plan was modelled on the original interagency FREMP. A five-year Fraser Basin Management Program, funded by all levels of government,



focused on integrated ecosystem management and encouraged collective stewardship and co-operative partnerships. Through its associated board, public involvement, industry and Indigenous communities, a public-private partnership was achieved and dedicated to realizing sustainable development in the Fraser River. The Fraser Basin Management Program's strategic plan for the sustainability of the entire Fraser River Basin in turn became the Charter for Sustainability.

The implementation of the strategic plan is carried out by the FBC, which is a non-governmental organization (NGO) focused on collaborative watershed governance to advance sustainability in the Fraser River Basin and across British Columbia. Established in 1997, FBC is a collaboration of four orders of government—federal, provincial, local and Indigenous—and multiple private sector and civil society organizations. The FBC aims to create collaborative, sustainable solutions to social, economic and environmental issues, and encourages resilience within the watershed and community. The FBC plays multiple roles, including:

- Secretariat: providing leadership, administrative, organizational and management support to multi-interest committees dealing with sustainability issues
- Monitoring and reporting: measuring the progress of sustainability initiatives and sharing information
- Institutional coordinator
- Conflict and interjurisdictional resolution agent
- Research and analysis: undertaking research and analysis, ensuring access to information and that data is reviewed in usable forms

Collaborative watershed governance involves legislation and regulation to guide water resource management, as well as numerous agencies, organizations and orders of governments. At the federal level, Environment and Climate Change Canada and the Department of Fisheries and Oceans are the primary agencies responsible for water resource governance in British Columbia. Additionally, the Department of Canadian Heritage coordinates the federal-provincial cooperative program for the Canadian Heritage River System. Rivers possessing a significant feature receive heritage status through developing a management plan or heritage strategy that ensures the river will be managed to conserve its outstanding natural, cultural or recreational values (Calbick et al., 2004; Government of British Columbia, n.d.).



Table 9. Summary of institutions and legislation involved in the governance of the Fraser River Basin

Level of Government	Main Agencies	Primary Responsibility	Authorizing Legislation
Federal	Environment and Climate Change Canada	Manages water contaminants	Canadian Environmental Protection Act, Canadian Environmental Assessment Act, Canada Water Act
	Fisheries and Oceans Canada	Manages fisheries and stocks, such as salmon, and their habitats	Fisheries Act
	Natural Resources Canada	Manages natural resources and development, includes the sectors of energy, forests and minerals and metals. Develops policies and programs to enhance the contribution of the natural resources sector to the economy, as well as lead science and technology in these sectors.	Department of Natural Resources Act, Forestry Act
	Agriculture and Agri-Foods Canada	Manages the agriculture sector and food economy in Canada.	Department of Agriculture and Agri-Foods Canada
	Infrastructure Canada	Funds water and waste treatment systems	Waste Management Act
	Canadian Heritage	Administers the Canadian Heritage River System	Department of Canadian Heritage Act
Provincial	Ministry of Environment	Protection, management and conservation of the province's water, land, air and living resources.	Water Sustainability Act, Waste Management Act,
	River Forecasting Centre	Forecasts water quantity conditions, for example flooding or drought	Water Sustainability Act, Waste Management Act
	Ministry of Sustainable Resource Management (former ministry)	Develops water resources, provides corporate leadership on water resource policy, planning and integration	Water Protection Act, Environmental Management Act
	Land and Water Basin Columbia Inc.	Manages the allocation of surface water resources by issuing licences	Canada Water Act
	Ministry of Health	Regulates drinking water quality	Environmental Management Act, Drinking Water Protection Act, Water Sustainability Act
	B.C. Hydro and Power Authority	Hydropower generation	Hydro and Power Authority Act
	Ministry of Forest, Lands and Natural Resource Operations	Responsible for stewardship of provincial Crown land and natural resources, and protection of heritage resources.	Land Act, Forest Act, Wildlife Act
Ministry of Agriculture	Responsible for the production, marketing, processing and merchandizing of agricultural products and food	Ministry of Agriculture and Food Act, Ministry of Forests and Range Act, Fisheries Act (licensing of aquaculture), Farming and Fishing Industries Act, Agriculture Land Commission Act	
Local	Municipalities	Provides civil society with services such as potable water and waste treatment	Local Government Act
	Regional Districts		
	Improvement Districts		
Indigenous	Indian & Northern Affairs Canada	Administers potable water supplies on reserves	Indian Act

Source: Modified from Calbick et al. (2004); Government of British Columbia (n.d.)



4.1.3 Watershed Principles and Lessons Learned

The FBC illustrates several elements of sustainable basin management, incorporating social, economic and environmental aspects of development. These elements provide insight into best practice for integrated watershed management, which include: leadership; meaningful engagement of all interests; co-governance and shared decision making; the inclusion of Indigenous Peoples in engagement; and strong science through watershed baselines, indicators, thresholds, and data management and coordination.

The FBC presents an example of a non-governmental overarching agency with the authority, mandate and capacity to develop a management strategy, monitor programs and influence decisions on project development. The FBC acts as a secretariat and enables coordination between governments, research institutes, Indigenous communities, the public and industry within the watershed. The roles and interests of watershed stakeholders and rightsholders are well defined within the FBC, and strategic representation from interested groups is established in the Fraser River Basin Strategic Plan framework.

Blomquist, Calbick and Dinar (2005) remark that this structure has facilitated working across jurisdictional boundaries and with different levels of government, and has contributed to the FBC as being viewed as relatively objective, unbiased and apolitical. “It has allowed the integration of Indigenous communities and private stakeholders in ways that more traditional governmental programs have found difficult or impossible” (p. 25). It has successfully encouraged information sharing and promoted the idea of stakeholder interdependency. While drawbacks to this approach include reliance on others for the implementation of many activities, and the sometimes slow nature of the consensus-oriented methods used, Blomquist, Calbick and Dinar (2005) suggest that “on balance ... the approach represented by the Fraser Basin Council has worked well” p. (25).

The FBC also measures the progress of sustainability initiatives and completes a regular assessment of the state of the watershed through multiple project reports and yearly indicator reports (FBC, n.d.c). State of the Fraser Basin and Sustainability Indicator Reports have been useful tools to track progress towards sustainability goals and report on key social, economic, environmental and decision-making trends. The report assesses science-based indicators for impact assessment and monitoring through implementation of data-monitoring programs and reporting, which are required at both the project and watershed scales. For example, the Nechako Watershed Health Atlas and Report assess multiple indicators such as water quality and quantity, fish and wildlife, resource use and development. The assessment and understanding of watershed cumulative effects are available to interest parties in common data formats and can be used for other purposes by end users. The implementation of watershed initiatives, monitoring programs and compliance ensure influence over development decisions taken at the individual project level.

Consistent funding is available in some part through various levels of government to implement and sustain management programs (monitoring, modelling, reporting, communications, etc.) and project grants within the basin. However, there is a growing need to diversify these financial mechanisms to support long-term program implementation and monitoring. The BC Living Rivers Trust Fund has helped to build strong, cooperative networks of public, private and non-profit sector groups with expertise and experience in regional development relevant to watershed goals, including community groups, educational institutions, agricultural organization, industry and fisheries (FBC, n.d.a). The FBC has emphasized the use of financial management mechanisms and fiscal policy, such as reserve or endowment funds, to strengthen stability and flexibility over the long term and across multiple initiatives. For example, the BC Living River’s Trust Fund has been used to fund research in the Fraser River Basin (Box 3).



Box 3. BC Living Rivers Trust Fund

The BC Living Rivers Trust Fund, which was created in 2002, is a provincial legacy fund to invest in the health and sustainability of British Columbia's watershed. Between 2006 and 2012, the fund invested CAD 21 million in 450 priority watershed projects (FBC, n.d.a).

Investments were focused in the Fraser River Basin, specifically the Fraser Salmon and Watershed Program, Georgia Basin–Vancouver Island and Skeena Basin. Overall, the fund has invested capital in work that is focused on:

- Watershed planning and management
- Stewardship and restoration of freshwater/estuary habitat
- Sustainable fisheries management
- Education and engagement of the public

The Fraser Basin Council integrated watershed management approach has allowed for effective management, which has been capable of directing individual project-based development, as well as operating at the watershed scale.

4.2 Mekong River Basin and Mekong River Commission

4.2.1 Watershed Description

The Mekong River is the 10th largest river in the world and flows 4,090 km through six countries: China, Myanmar, Thailand, Lao PDR, Cambodia and Vietnam. The Mekong River Basin encompasses a diverse range of geographic and climatic zones, and the region is endowed with diverse and abundant natural resources. On average, approximately 15,000 m³ of water flows into the Mekong mainstream from the surrounding watershed every second, and this water irrigates large tracts of forest and wetlands that support local economies, such as building materials, medicines and agriculture, and serve as habitats for a large diversity of species (Mekong River Commission [MRC], n.d.).



Figure 17. Mekong River Basin and riparian countries

Source: MRC (2011); reprinted with permission from the Mekong River Commission Secretariat.

**Table 10. Mekong River Basin characteristics**

Location	Asia
Watershed Area	795,000 km ²
Watershed Characteristics	The Mekong River Basin consists of seven physiographic regions featuring diverse topography, drainage patterns and geomorphology. The Tibetan Plateau, Three Rivers Area and Lancang Basin form the Upper Mekong Basin. The Northern Highlands, Khorat Plateau, Tonle Sap Basin and Mekong Delta comprise the Lower Mekong Basin.
Major Ecosystems and Regions	The basin encompasses 16 distinct World Wildlife Fund (WWF) ecoregions. Himalayan mountains, Siphandone (4,000 islands and wetland area is Lao PDR), Lower Songkhram River floodplains in Thailand, Tonle Sap Great Lake (vast inland wetland in Cambodia), Mekong Delta (River of Nine Dragon).
Climate	The Mekong River Basin ranges from the glaciatic highlands of the Tibet Plateau to the hot and humid lowlands of Southeast Asia. Seasonal monsoon rain events; average annual precipitation ranges between 1,000 and 3,000 mm, dependent on region
Natural Resources	Contains a diverse wealth of natural resources, including one of the world's largest inland fisheries.
Countries	China, Myanmar, Thailand, Laos, Cambodia and Vietnam
Population	70 million
Management Institution	Mekong River Commission (MRC)

Source: MRC (2003); Phillips et al. (2006); Roy et al. (2011)

The Mekong River Basin countries form a large section of the Indo-Burma biodiversity hotspot. A broad range of ecosystems is represented in the region, including mixed wet evergreen, dry evergreen, deciduous forests, shrub lands, woodlands and mangroves. The non-timber forest products provide an important source of income to rural communities in the region. The basin comprises wetlands that perform a wide-range of ecosystem functions and sustain key social, economic and cultural values. Wetlands also support the livelihoods of local communities, providing a productive environment for agriculture, aquaculture, fisheries and tourism (MRC, n.d.). The basin's biodiversity is fundamental to the viability of natural resource-based rural livelihoods of a population of approximately 60 million people living in the Lower Mekong basin (MRC, n.d.). The wetlands also provide indirect benefits including: sequestering excessive nutrients and toxins from agricultural, industrial and municipal wastewater; absorbing potentially disastrous floodwaters during wet seasons; and preventing erosion via the mangroves in the delta's coastal areas.

Current water resource development and management priorities include: water resource withdrawal (irrigation for agriculture, industrial use and consumption) and water-related sectors such as fisheries and aquaculture. More recent economic development in the region has been focused and driven by hydropower dam development projects on the both Upper and Lower Mekong River, and its tributaries, which can impose entirely changed flow regimes with implications for habitat and other regional benefits. Other potentially damaging effects of the mainstream dams in China and those planned in Lao PDR and Cambodia include the trapping of nutrient-rich sediment behind the dams—potentially affecting ecosystem productivity in the Delta and the blockage of fish migration routes essential for sustaining fish productivity and biodiversity (MRC, 2010; Roy et al., 2011). Fish catches have declined significantly in tributaries that have been dammed, and harvests have been affected by pollution and increased drawing of river water for



irrigation and aquaculture, specifically in the Mekong Delta. In Thailand, fish catches in the Mun River, above and below the Pak Mun Dam, have declined by as much as 70 per cent (Osborne, 2000; Roy et al., 2011).

In the past decade, the basin's population, comprising mainly rural communities, has increased by approximately 12 per cent (MRC, 2011). Food security and malnutrition continue to pose challenges to development in the region: about half of all households do not have access to a safe drinking water supply and half of all communities are inaccessible by all-weather roads (MRC, 2011). Since the livelihoods and food security of the approximately 60 million people living in the Lower Mekong Basin are thoroughly linked to the Mekong River and its watershed, inclusive and integrated management based on strong science and clear assessments of its components is crucial as the rural population continues to grow.

4.2.2 Sustainable Watershed Management

The Mekong Committee (MC) was established in 1957 by the United Nations (UN) through coordination with Cambodia, Laos PDR, Thailand and South Vietnam. The MC advanced scientific monitoring of the basin by creating hydrological and meteorological stations, aerial mapping, surveying and improved navigation, and increase integration of the partnered countries. In the 1990s, the MC transboundary water cooperation shifted focus onto both hydropower development and irrigation projects (Roy et al., 2011; Wolf & Newton, 2008). With cooperation among the riparian countries, the MC then became the MRC in 1995 among the countries in the Lower Mekong Basin (without China and Myanmar). The 1995 Mekong Agreement established the MRC, an innovative approach to watershed management, moving the responsibility of the management directly under the commission and its four member countries: Cambodia, Lao PDR, Thailand and Vietnam. The 1995 Mekong Agreement provides the legal mandate of the MRC, and defines the scope of work and cooperation related to coordinated planning for economic and social development in the Mekong River Basin, while protecting the environment. The agreement established a framework for the achievement of the strategic objectives of watershed scale management and acknowledged that development decisions by agencies in the sovereign riparian countries of the Mekong River Basin may have transboundary consequences.

As an intergovernmental river basin organization, the MRC relies the endorsement of its approaches by its member countries. The cooperation among member countries is to promote inclusive and balanced development of the basin while ensuring the equitable sharing of benefits among all users of the basin water and related resources (MRC, 2011). Since its establishment, its purpose has been to develop work programs and strategies that effectively support sustainable management and development of the watershed and related resources (MRC, n.d.). The strategic plan encompasses economic growth, while encouraging social and environmental sustainability and regional cooperation in basin-wide planning.

The most recent Strategic Plan (2011–2015) outlines the fundamental objectives and principles in the 1995 Mekong Agreement:

- Protection of the environment and ecological balance
- Sovereign equality and territorial integrity
- Equitable utilization
- Maintenance of flows on the mainstream
- Prevention and reduction of harmful effects
- State responsibility for damages



- Freedom of navigation
- Response to emergency situations

In addition to the MRC's Strategic Plan, the MRC's IWRM plan prioritized eight areas:

- Economic development and poverty alleviation
- Environmental protection
- Social development and equity
- Dealing with climate variability
- Information based planning and management
- Regional cooperation
- Governance
- Integration through basin planning

In addition to the MRC, governance includes multiple international and regional conventions, treaties, protocols and declarations respecting water and land management, as well as the involvement of international organizations, NGOs and academia (Roy et al., 2011). The MRC has achieved strong cooperation in water resource issues among the riparian countries, in part through the involvement of multiple partnerships and increasing regional capacity (MRC, 2011).

4.2.3 Watershed Principles and Lessons Learned

The MRC illustrates several principles related to best practices of integrated watershed management by incorporating co-governance and shared decision making into transboundary management.

In terms of leadership, the MRC has a clearly defined mandate to direct management strategy, monitoring programs and influence decisions on project development. The long-term vision of the MRC defines its role as promoting the coordination of benefit sharing among member countries, monitoring environmental health, and undertaking environmental and social impact assessments. The roles and interests of watershed interests are well defined and appropriate representation from interested groups is established in the MRB Strategic Plan framework. While the MRC has included a range of parties in its consultation processes, its focus on harnessing the Mekong River's economic potential has raised concerns about the likelihood of actually implementing consultative goals (Mehtonen, Keskinen, & Varis, 2008; Roy et al., 2011). As well, despite the transboundary management perspective of the framework, official commitment from all riparian nations has not occurred and the lack of political commitment has repercussions for long-term sustainable management of resources within the basin. The lack of basin-wide commitment to the MRC and its processes poses a significant challenge to integrated watershed, resource management efforts in the Mekong River watershed (Roy et al., 2011)

Bach et al. (2011) describe various ways in which engagement of multiple watershed interests has been achieved in parts of the Mekong Basin. In the context of seeking ways to sustainably develop hydroelectric power in the Mekong River Basin, the example of the Rapid Sustainability Assessment Tool, developed by the Asian Development Bank, the World Wildlife Fund and the MRC, is informative. Designed as a “framework for a multi-interest groups dialogue process and for scoping of the cumulative impact of potential multiple hydropower dam developments,” the approach has been used to discuss how best to sustainably develop hydro in the Mekong region with minimal adverse social and environmental impacts



while still producing profitable and renewable energy (p. 30). Aims include facilitating dialogue and communication on hydropower between interest groups, prioritizing opportunities and risks, identifying capacity-building needs, and considering the “dynamic nature of hydropower” in which several projects may be in development in a basin at once, and might be at different stages (e.g., proposed, committed, under design, under construction, operating).

In regards to long-term monitoring, data collection and reporting, the *State of the Basin Report* (MRC, 2010) includes ecosystem-based economic valuation for wetlands, agricultural production, fisheries, flood mitigation, climate regulation, future patents, as well as cultural significance and biodiversity (Roy et al., 2011). The state of the watershed needs to be known and agreed-upon science-based indicators for impact assessment and monitoring are required at both the project and watershed scales. Targets and baseline indicators have been agreed upon by Member Countries and outlined in the IWRM-based Basin Development Strategy 2011–2015 (MRC, 2011); however, although the MRC member countries have signed on to IWRM, downstream impacts have not been taken into consideration.

The MRC’s management functions, as detailed in the Basin Development Strategy (2011–2015) emphasizes long-term programs, monitoring and modelling. The strategy has categorized the MRC’s management functions as the following:

1. Secretariat Administrative and Management Functions
2. River Basin Management Functions
 - a. Data acquisition, exchange and monitoring
 - b. Analysis, modelling and assessment
 - c. Planning support
 - d. Forecasting, warning and emergency response
 - e. Implementing MRC procedures
 - f. Promoting communication
 - g. Reporting
3. Capacity Building and Tools Development Functions
4. Consulting and Advisory

A past Strategic Plan (2001–2005) involved efforts to integrate and strengthen cooperation between the MRC and China on data sharing, particularly during flood seasons. Over the last decade, both China and Myanmar have demonstrated an increasing commitment to cooperation, including the exchange of data and information on the status of upstream developments and joint capacity-building projects (MRC, 2011). Furthermore, the most recent Strategic Plan (2011–2015) aimed to improve implementation of these management functions, as well as their integration with national systems (MRC, 2011).

The role of the MRC is to implement watershed initiatives, enforce monitoring programs and compliance, and influence development decisions taken at the individual project level. Institutionally, water and natural resource authorities have relatively weak capacities (Roy et al., 2011). However, as of October 2010, hydropower development projects in the basin go through proposal submissions with the MRC for the prior consultation process, as established under the MRC Procedures for Notification, Prior Consultation and Agreement. Through this mechanism, the MRC is able to influence the overall objectives of basin management by providing policy and strategic advice.



The MRC is funded predominantly by donors, for example the World Bank and the Asian Development Bank (Mehtonen et al., 2008; Roy et al., 2011). Financing and financial autonomy are outlined in the current Strategic Plan (2011–2015) and MRC core functions are designed to be fully financed by member countries by 2030. Innovative funding mechanisms based on ecosystem services are also being used to generate resources. In Vietnam and Laos PDR, upstream residents are paid by hydroelectric and water supply companies to manage the land to protect water quality (Bach et al., 2011).

The MRC’s achievements have demonstrated the extent to which a river-based intergovernmental organization can affect a region through strengthening cooperative governance and building national capacity. Further improvement is needed for meaningful interest-group engagement and to ensure benefit sharing throughout the region.

4.3 Plan Nord: Quebec, Canada

Plan Nord is an integrated development strategy, led by the Government of Quebec, to ensure that resource development in northern Quebec is beneficial to the population living in the area. While not a watershed-based approach, this regional planning effort exemplifies some of the principles of watershed management reviewed and demonstrates ways to implement for maximizing sustainable development. The strategy emphasizes multiple policy directions, including: sustainable and diversified economic development; inclusive economic growth and development of local communities, improved living conditions and well-being of these communities; and protection of the environment. Quebec’s Plan Nord illustrates progress towards a collaborative and balanced approach to conservation and development.



Figure 18. Area in Quebec covered by Plan Nord.

Source: Government of Quebec (2015); reprinted with permission from Société du Plan Nord.



4.3.1 Description

Quebec's boreal forest covers an area of 1.2 million km², accounting for 21 per cent of Canada's boreal region (Carlson, Wells, & Jacobson, 2015). The Canadian boreal forest supports globally significant ecological value including storage of 31 billion tonnes of biotic carbon, 25 per cent of North America's most pristine rivers, breeding grounds for hundreds of bird species, and is among the world's most significant herds of barren ground caribou (International Boreal Conservation Campaign, 2010).

The region covered under Plan Nord is rich in natural resources, including minerals, hydroelectric potential and timber, and development is expected to increase. Plan Nord is driven by mining development and private investment; however, hydropower development in the region continues to be an integral component of the region's economic and resource development prosperity. Specifically, the region holds 75 per cent of Quebec hydroelectric capacity, over 200,000 km² of forests and over half of all the productive forest land in Quebec, and also contains numerous mineral deposits, currently accounting for all the nickel, cobalt, platinum group elements, zinc, iron ore and ilmenite produced in Quebec (Table 11).

Table 11. Regional characteristics covered under Plan Nord

Location	Quebec, Canada
Geographical Area	The region covered under Plan Nord is located in northern Quebec, north of the 49th parallel and north of the St. Lawrence River, and encompasses an area of 1.2 million km ² (72 per cent of Quebec total land mass).
Regional Characteristics	The Canadian Shield covers almost 90 per cent of the area of Quebec. The area covered under Plan Nord is rich in natural resources (mineral deposits, forestry and hydroelectric generation).
Major Ecosystems	Boreal forest, St. Lawrence River and the St. Lawrence Platform.
Climate	Subarctic climate, typical of areas located between the 50th and 58th parallels, is characterized by a very cold and long winter and a short and cool summer. Precipitation is infrequent.
Natural Resources	Mineral deposits, hydroelectric generation and forestry
Population	120,000 – one-third are Indigenous People from four nations (Inuit, Cree, Innu and Naskapi)
Management Institution	Government of Quebec Management and supervision of various components of Plan Nord will be carried out by Société du Plan Nord, which is state owned.

Source: Carlson et al. (2015); Government of Quebec (2016)

The region covered under Plan Nord has seen several years of major economic growth, mainly due to investments made in the mineral resource sectors to meet strong international demand for metals. GDP in this region has grown more rapidly than anywhere else in Quebec, estimated at CAD 11 billion in 2013 (Government of Quebec, 2015). Furthermore, between 2007 and 2012, private investments in northern Quebec more than tripled at CAD 4.5 billion. In comparison, private investments for the rest of Quebec increased by 15 per cent during the same time period (Government of Quebec, 2015). Despite a recent decrease in private investments due to weak global demand for certain metals, the level of investments is mainly attributed to the mineral resource sectors and hydroelectric facilities. Furthermore, forestry, tourism and the bio-food industries also play roles in the economic activity of some communities covered under Plan Nord (Government of Quebec, 2015).



The area covered by Plan Nord presents a range of challenges created by its geography, demographics, and social and environmental features. The main challenges identified by the Government of Quebec (2015) include:

- Abundant, diversified natural resources that are hard to access and are located in a distinctive, often fragile environment.
- A sparsely populated area with small, scattered communities, many of which are Indigenous communities, and have fallen behind in terms of service provisions and living conditions.
- Occupation of the area is diverse and individuals employed play an active role in the socioeconomic development of their community.
- The gathering of knowledge and commissioning of research to ensure environmentally responsible planning.

Achievement of this development strategy depends on fostering cooperative planning processes to guide a balance between protection and development. Plan Nord attempts to provide inclusive development with meaningful interest parties' engagement and co-governance, while the provincial government provides leadership for the strategy's implementation and management.

4.3.2 Integrated Resource Management

Plan Nord is a development strategy led by the Government of Quebec and aimed at developing and diversifying the economic potential of northern Quebec, which benefits both the population living there and Quebec as a whole. The plan aims to support development of all communities in the Plan Nord region, as well as to protect the environment and preserve the distinctive biodiversity of northern Quebec by ensuring that mechanisms are established to dedicate 50 per cent of the area, by 2035, to non-industrial purposes (such as recreation or conservation), protection of the environment and the safeguarding of biodiversity (Government of Quebec, 2015).

Under the Plan Nord Action Plan framework, to promote northern Quebec's economic potential, natural resource development has been prioritized as follows (Government of Quebec, 2016):

- Re-establish a context conducive to mineral development based on a wide range of resources.
- Diversify and promote forestry products and implement integrated forestry management methods.
- Continue to develop the energy potential of northern Quebec.
- Increase the socioeconomic benefits of wildlife activities while ensuring the long-term viability of the resource.
- Increase tourism development by promoting the region's distinctive geography and culture.
- Design and implement a sustainable northern bio-food model based on potential in the region.
- Promote private investment.
- Increase the processing of resources from the North within Quebec.
- Promote the diversification of the local and regional economies.

Despite Plan Nord's strong economic focus, the Government of Quebec recently updated its social and environmental components with a new policy direction and updated governance structure in a 5-year action plan for 2015–2020. Four basic principles have been established, on the basis of shared values and



maximized economic benefit to the region, to guide the government’s development strategy (Government of Quebec, 2016):

- A planned, coordinated project based on partnership, private sector investment and support for communities, in particular through the creation of the Société du Plan Nord.
- A focus on sustainable development that integrates the economic, social and environmental dimensions.
- Government actions adapted to the realities of local and Indigenous communities and to northern areas in general.
- A harmonious and ethical approach to development that remains respectful of Indigenous and non-Indigenous communities and is consistent with equality between men and women.

Priorities under the Action Plan are driven by the need to develop the area’s natural resources responsibly and to protect the integrity of the region by long-term, inclusive development and management. To encourage private investment and diversify of the local economy, the provincial government created the Institute National des Mines in 2009 to support local procurements and coordinate training and education requirements, specifically in the mining sector (Government of Quebec, 2016). Furthermore, Geologie Quebec has planned to acquire, process and distribute geo-scientific knowledge through Quebec. Another institute, Fonds du Plan Nord, was created to accelerate the acquisition, processing and distribution of geo-scientific information, specifically to help attain the objective set for 2035 of designating 50 per cent of the territory covered by Plan Nord for non-industrial purpose and the protection of the environment (Government of Quebec, 2016).

4.3.3 Development Principles and Lessons Learned

Two principles of Plan Nord are protection, focusing on minimizing risk to ecosystems, and sustainable management, emphasizing economic development. Plan Nord as a regional, economic development-focused strategy, nevertheless, embodies principles similar to those of successful integrated watershed management, particularly in regions of potential resource and northern development.

Plan Nord presents a plan with discrete objectives to operationalize sustainable development while deriving northern Quebec’s economic potential. The plan also outlines the development and well-being of local and Indigenous communities, and aims at enhancing partnerships with these communities by engaging relevant interest parties, including Indigenous communities. In addition to creating the conditions needed for resource development, Plan Nord identified the need to focus on the living conditions of the people living in the area and to respond to these northern communities’ needs. Plan Nord also encourages an agreement between the Government of Quebec and the Crees of the Eeyou Istchee James Bay territory. The agreement supports an inclusive planning process and provides the Cree with decision-making powers with respect to land use. In terms of policy and legislation, most of the area under Plan Nord is governed by the Baie-James and Northern Quebec Agreement and the Northeastern Quebec Agreement, two treaties that establish Indigenous rights (Government of Quebec, 2015).

Funding for Plan Nord is allocated from the provincial budget and managed by the Société du Plan Nord, but plans for benefit sharing from existing and potential resource-based economic development in the region can contribute to much-needed long-term funding support for Plan Nord. The Ministère de l’Énergie et des Ressources (MERN) contributes to two Indigenous mining funds: the Cree Mineral Exploration Board (Crees) and the Nunavik Mineral Exploration Fund (Inuit). One of the mandates



of these funds is to introduce residence in the communities to mining activities through awareness campaigns, initiation activities and contact meetings concerning geology and activities related to mineral exploration (Government of Quebec, 2015). Furthermore, the Northern Plan Fund is allocated to Plan Nord from the provincial budget and will be partially financed by the reinvestment of tax benefits resulting from economic development north of the 49th parallel, which amounts to CAD 63 million for the 2014/15 budget year (Amyot, Paradis, & Gagnon, 2014)

The boreal forest is one of the main ecosystems in the area covered by the Plan Nord, and since the enactment of the Sustainable Forest Development Act in 2013, Quebec and Plan Nord has implemented a forestry management strategy that supports large-scale sustainable development, diversifying forestry products and implementing integrated forest management strategies. Plan Nord has committed to dedicating 50 per cent of northern Quebec to biodiversity protection; specifically, it will designate 20 per cent of the region as protected area by 2020 and will disallow industry in 30 per cent of the region by 2035 (Berteaux, 2013). The plan also aims to increase knowledge of the region's physical and ecological environment in order to identify the most appropriate conservation measures, recognize the potential for development and ensure efficient processes for environmental assessment.

While the provincial government has taken a leadership role in Plan Nord, there are partnerships and roles for other regional organizations. For instance, the government plans to create the Institute Nordique du Quebec, as a response to the research objective and to ensure a balance among the social, economic and environment components of development for the region in response to the need for efficiencies.

To coordinate and enforce actions needed to implement Plan Nord, the Government of Quebec chose to create a governance structure adapted to the specific characteristics of the North and the needs of local and Indigenous communities. In response, under legislation Bill 65 (December 4, 2014), the Société du Plan Nord became the main authority for the deployment of the various components of Plan Nord. The bill was introduced to guide conservation and sustainable development under Plan Nord (National Assembly, 2012). Ecological planning is intended to explicitly incorporate conservation objectives in the land-use planning process and to provide a strong approach to addressing the challenge of proactive and balance planning (Carlson et al., 2015).

Plan Nord offers an example of a multi-interest parties strategy, inclusive of research institutes, governments (Indigenous, federal and provincial) and industry, to develop a cooperative and coordinated model that balances protection and sustainable management (Carlson et al., 2015). However, Plan Nord has yet to be fully implemented and realized, and the strategy has been considered controversial and promoting an industrial development agenda. The challenges encountered have been associated with the implementation of the framework, specifically the large-scale expansion of northern resource development (Carlson et al., 2015; Nisichawayasihk Trust Office, 2012). Plan Nord includes 3,000 MW of hydroelectric development, numerous mines and investments surpassing CAD 80 billion (Government of Quebec, 2012).

Plan Nord reflects a balance of development and conservation, recognizing the importance of the large area of intact boreal forest remaining in northern Quebec and the rest of Canada's boreal region. The plan has been identified as perhaps the best opportunity globally for maintaining the full range of ecological, economic and cultural values supported by forest ecosystems in perpetuity (Carlson et al., 2015). It recognizes the importance of maintaining these ecosystem values as critical to sustainable development of the region and, most importantly, the people of northern Quebec.

5.0 Ecosystem Governance in the Northern NCRB





5.0 Ecosystem Governance in the Northern NCRB

Taking lessons from the previous two sections on principles for effective governance, gathered from a review of case studies illustrating how these principles have played out in practical resource management contexts, this section provides an analysis of how these apply in the northern NCRB.

5.1 Basin-Level Planning Approaches

Our review of the literature showed how global recognition of the value of basin-level thinking has been growing for decades. Considering water and land management at a basin scale brings out new perspectives that are not as apparent at other scales. Natural benefits, known as ecosystem services, provided by watershed ecosystems, such as water purification, flood regulation, food production and livelihood support, can all be linked to basin management. A healthy and well-managed basin produces these services in a more sustainable manner. Basin-level thinking can also bring diverse interests together to consider management of the entire area in a comprehensive and integrated way, thus producing an understanding of how each party's desires and needs are interlinked with those of others. This type of common understanding can help create a framework that considers trade-offs, optimization and the three pillars of sustainable development. The logic of watershed or basin-level management is reinforced by the fact that these units of natural water flow enable measurement of water, nutrients and other important aspects that are the foundation for many ecosystem services that we depend upon.

Critically, the literature review also identified the importance of setting goals, objectives and targets within basin plans, and then tracking movement towards or away from these targets. For instance, a target could be set for a certain water quality parameter, with monitoring determining whether or not conditions are improving to reach that parameter. While this type of approach likely occurs at a project-specific level, a more comprehensive approach is important for basin-wide planning.

5.1.1 Current Efforts

There is currently very little consideration of the northern NCRB as an integrated system for basin-level planning. While basin-level planning and management for many other watersheds in Manitoba exist, such as for the Red, Saskatchewan and Assiniboine Rivers (and efforts on the Lake Winnipeg watershed are growing), there is little evidence of this type of planning in the northern NCRB. This fact is reflected in the boundaries used when discussing the area.

5.1.2 Prominent Current Boundaries

Environment and Climate Change Canada's Canadian Environmental Sustainability Indicators (CESI), which reports on freshwater quality in rivers across Canada, including the Nelson and Churchill, acknowledges the usefulness of considering the Nelson–Churchill as a watershed (Environment and Climate Change Canada, 2016c). However, this information is very high level, includes very few data points and does not constitute watershed-level management and planning. WWF-Canada is also in the process of considering the environmental well-being of the Churchill and Nelson basins through its watershed report cards, for which it is aiming to analyze the health and threat levels of 25 major watersheds in the country by 2017 (WWF, n.d.). While valuable, this analysis using pre-existing data will not necessarily lead to basin-level planning and implementation. It will contribute knowledge on the watershed relevant to monitoring and reporting (see Section 3.2.6), but it does not actively engage parties in the basin to think at the basin scale.



Waterways affected by hydroelectric development are a prevalent boundary used in the region related to water flows, and were the focus area for the 2015 Regional Cumulative Effects Assessment (RCEA), described in Section 2.7.6. This area, shown in Figure 19, includes the portion of the Churchill, Burntwood and Nelson River watersheds affected by Manitoba Hydro developments in northern Manitoba. The report (Manitoba Hydro, 2015b) states that these areas “were primarily determined by the boundaries of Resource Management Areas [discussed in the next paragraph] and Registered Trapline Zones” (p. 1.3–2). This delineation is logical for understanding the impacts of hydroelectricity development, but does not include the entire northern NCRB – an inclusion necessary for full watershed planning

The Resource Management Areas were set up through agreements between the province and Indigenous nations as part of settlement agreements. These areas are managed for land and resource use, water, harvesting activities, mineral development, forestry and wildlife management (Indigenous and Municipal Relations n.d.). While quite useful from a natural resources management perspective, and hence quite relevant to our study, they still do not consider the watershed scale. Rather, they are usually created along registered traplines.

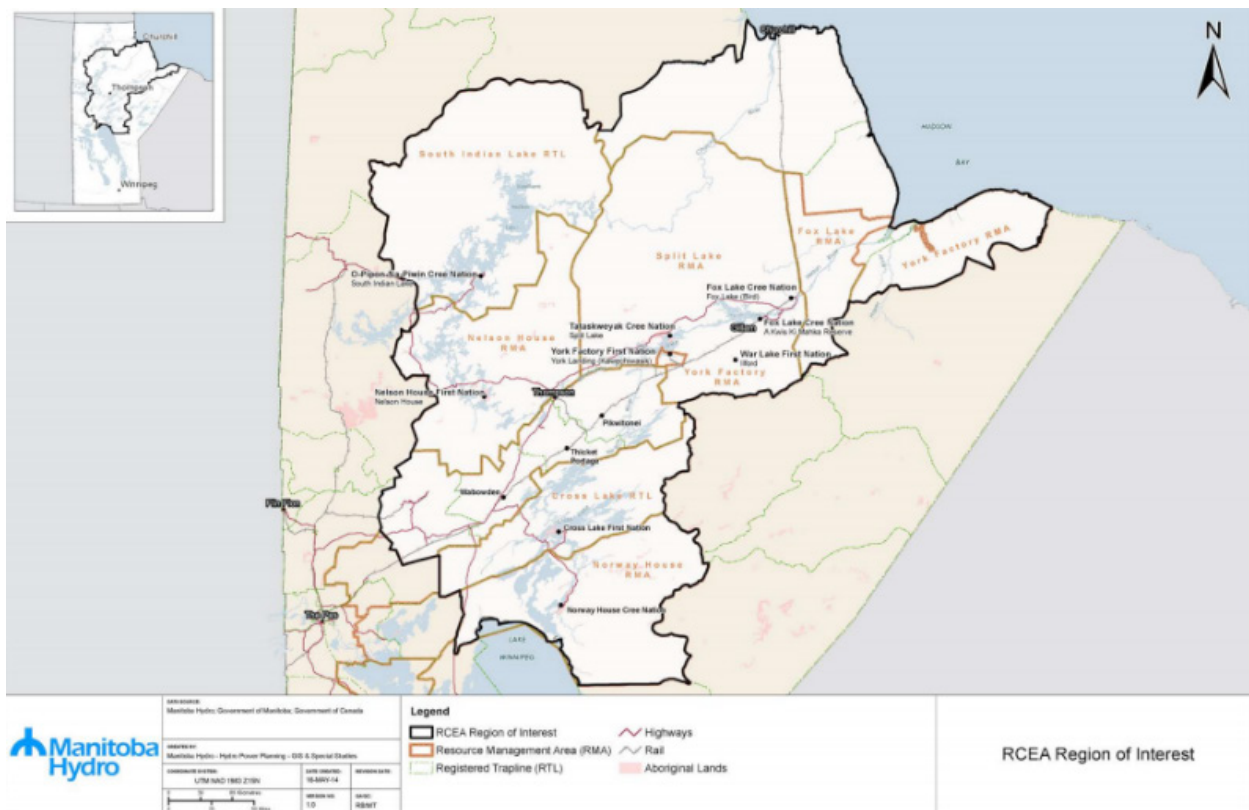


Figure 19. Hydro-affected areas

Source: Manitoba Hydro (2015b); reprinted with permission.

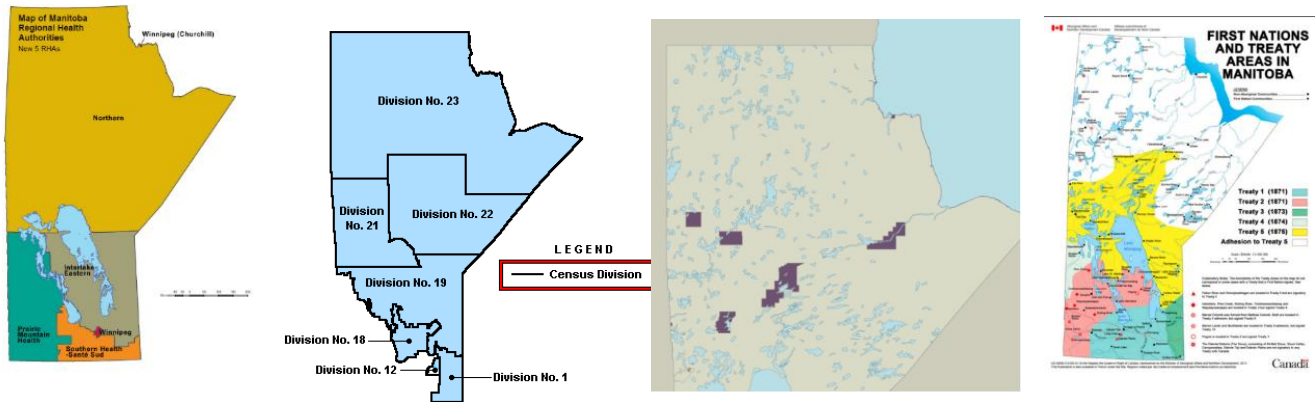


Figure 20. (L to R): Treaty areas of Manitoba; health authorities of Manitoba (Manitoba Health, Healthy Living and Seniors, n.d.); census divisions in Manitoba (Government of Canada, n.d.); and municipalities in northern Manitoba (Association of Manitoba Municipalities, 2014).

More commonly considered boundaries in the basin are political or institutional, such as rural municipalities, census divisions, regional health authorities or treaty lands (see Figure 20). While these boundaries are useful and appropriate for the purposes they were designed for, they are not particularly helpful in watershed management.

5.1.3 Governance Approaches

In its review of Lake Winnipeg Regulation, Manitoba’s Clean Environment Commission (2015) urged more integrated thinking in the region. While not focused on the entire watershed, the 2015 CEC report recommended to the Province of Manitoba that the relicensing of hydroelectric projects be done in geographical groupings—for instance, that those on the Lower Nelson (Kettle, Long Spruce and Limestone) be considered together. The report states: “In addition to allowing for licensing efficiency, this process would assist in assessment of effects, especially the cumulative effects of hydro development in a particular area” (Manitoba Clean Environment Commission, 2015, p. 143). It also recommended that an independent body be created by the Government of Manitoba to “review policies, statutes, goals, objectives and outcomes of the various water-related environmental policies and strategies to ensure there is consistency between them and that they meet the desired result of watershed and/or ecosystem-wide approaches” (p. 145). As such, it is evident the CEC supports broader, potentially basin-scale thinking.

While moving towards basin-level planning, other planning initiatives occurring at different scales in the region provide useful insights. At the broad scale, the planned development of a northern economic development strategy (Government of Manitoba, 2016d) illustrates that there is recognition that coordination and planning are needed. This initiative is discussed further in Section 5.2. The Thompson Economic Diversification Plan also takes a broad view, considering approaches to the area’s future that would benefit residents and other interested groups. The multi-party group that worked on the plan identified the boundaries of what it calls the “Thompson Region.” Shown in Figure 21, it includes most of the population of the Manitoba portion of the northern NCRB, the rationale of the group being that Thompson provides services to northern residents and serves as the economic hub for the region (Thompson Economic Diversification Working Group, 2012a).

A government-related component to build upon are the Manitoba conservation districts, organizations set up to manage land and water through integrated watershed management plans (IWMPs) and their



implementation. Currently, a number of these exist, but they are limited to southern Manitoba. While the planning institutions provide some guidance, so do the plans themselves. IWMPs often comprise clear goals, implementation guidance and evaluation plans to see what is working (e.g., in the La Salle Redboine Conservation District; Seine-Rat River Conservation District; East Interlake Conservation District; etc.). Manitoba Sustainable Development’s guidance on IWMP recommends including diverse parties to “identify how land and water management programming will be cooperatively carried out throughout the watershed” (Water Stewardship Division, Government of Manitoba, n.d.).

Finally, the 1999 Report of the Consultation on Sustainable Development Implementation (COSDI) warrants recognition for asserting that “large area level” planning was needed in Manitoba, and strongly recommending that these areas “maximize the use of natural boundaries such as watersheds for defining the large planning areas” (Government of Manitoba 1999). COSDI was a multi-party consultation initiative meant to guide government in how to integrate sustainable development principles into decision making. The COSDI vision statement, “Manitobans working together to develop an integrated framework for large area and municipal planning, significant resource allocations and environmental management decisions to ensure sustainable development in Manitoba,” further reinforces this focus on planning.

5.1.4 Industry and Resource Company Approaches

The major industry and natural resource use companies in the area also conduct planning, though they are generally focused on goals, objectives and ecosystem services closely related to the industry in question. For instance, Tolko Industries operates based on a Sustainable Forest Management (SFM) plan in Manitoba, part of the certification from the Canadian Standards Association.⁶ Included in the standard certification are expectations for high public involvement, third-party audits, continual improvement and adaptive management. The requirements and guidance document for creating an SFM plan describes its goals: “In this Standard, the organization is required to work closely with the public to identify local values, objectives, indicators, and targets that reflect the national criteria and to incorporate them into forest management planning and practices. Decisions are made together with the public during this process” (CSA Group, 2003, p. 2). Tolko’s SFM plan (Tolko Industries Ltd., 2014b) describes the planning process, identifies 68 indicators that are used to measure progress and also outlines six criteria for sustainability:

- 1) Conservation of Biological Diversity
- 2) Maintenance and Enhancement of Forest Ecosystem Condition and Productivity
- 3) Conservation of Soil and Water Resources
- 4) Forest Ecosystem Contributions to Global Ecological Cycles
- 5) Multiple Benefits to Society
- 6) Accepting Society’s Responsibility for Sustainable Development

Tolko also incorporates the SFM Plan when creating its annual operating plans, which set out its harvesting and renewal activities on a three-year basis (Tolko Industries Ltd., 2015a). The geographic extent of Tolko’s planned activities can also be viewed on a detailed map available on the company’s website (Tolko Industries Ltd., 2015b).

⁶ In November 2016 Tolko Industries Ltd.’s Manitoba operations and assets were sold to American Industrial Acquisition/Canadian Kraft Industries Limited (Government of Manitoba, 2016e). Tolko’s approach to planning and operations in the region are discussed here under the assumption that there will be some similarities in the approach of any new organization.



With its significant activities in the north, it is unsurprising that Manitoba Hydro also has a multitude of plans related both to specific projects and to general hydroelectric development in the region. For instance, numerous plans have been developed for the Bipole III project in relation to environmental protection and socioeconomic elements, including:

- 1) Bipole III Transmission Project Environmental Protection Plan
- 2) Bipole III Culture and Heritage Resources Protection Plan
- 3) Biophysical Monitoring Plan (pending approval from province)
- 4) Socio-economic Monitoring Plan (pending approval from province)

At a broader scale, Manitoba Hydro also conducts planning in terms of future development in the region and future domestic and export energy needs, including through its Preferred Development Plan, supported in part by Manitoba’s Public Utility Board but altered in 2014 to request that Manitoba Hydro delay the development of the Conawapa development (Manitoba Hydro, 2013).

5.1.5 NGO Approaches

The Canadian Boreal Forest Agreement also recognizes of the value of managing for ecosystem well-being by bringing together forestry companies and environmental NGOs to allow for forestry in Canada’s boreal while also creating a protected spaces network, protecting critical habitat and species, implementing sustainable forest management practice and supporting climate change mitigation and adaptation.⁷

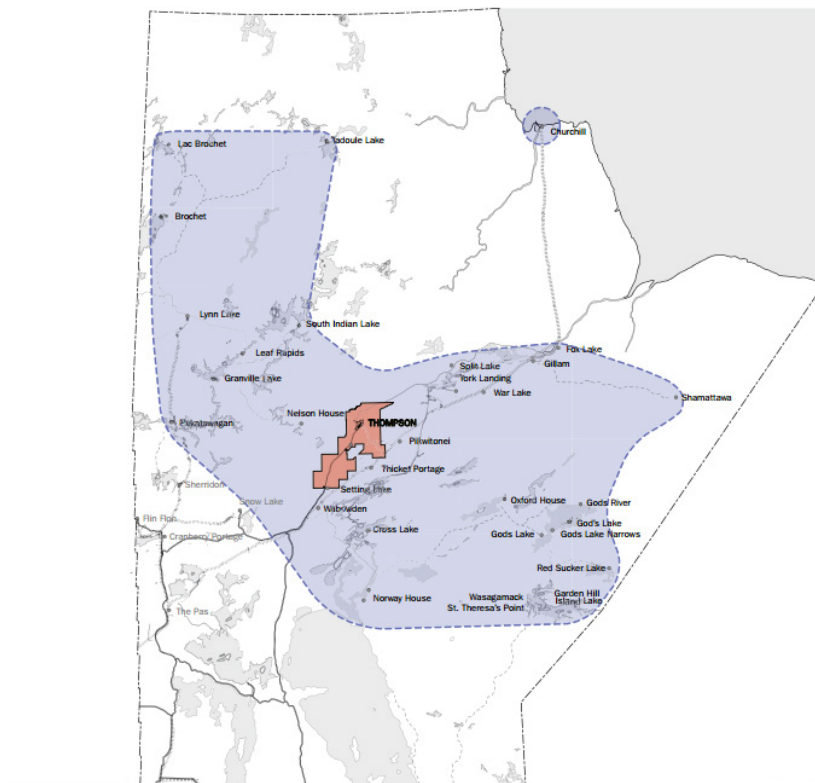


Figure 21. Thompson Region (as identified by the Thompson Economic Diversification Working Group (2012)

Reprinted with permission from City of Thompson

⁷ See the agreement at <http://cbfa-efbc.ca/agreement/>



5.1.6 Discussion

Basin-level thinking is nascent in the northern NCRB, with only some high-level consideration (e.g., through CESI and WWF-Canada). No entity is creating a plan for the entire basin, or even the Manitoban portion of it. However, there are other large-scale planning initiatives, such as a recently announced provincial task force on northern economic development, and the former Thompson Economic Diversification Working Group’s regional planning initiative. Had COSDI’s recommendation for large-area planning based on watersheds been implemented, it could have led to watershed-level planning in the northern NCRB in the early 2000s. Today, it still provides useful comments on the value of regional planning in Manitoba and also articulates other principles identified in this paper (e.g. multi-party initiatives; adequate resourcing; transparency and reporting; Indigenous engagement), as highlighted in the following sections.

While some watersheds in Manitoba have also only recently developed this level of understanding—for example, the Assiniboine River Basin Initiative was not formed until 2014—others have existed for decades. The Red River Basin Commission has existed since 2002 (Red River Basin Commission, n.d.b) and the Partners FOR the Saskatchewan River Basin since 1993. In addition, Manitoba’s first conservation district, the Whitemud Watershed Conservation District, was formed in 1972. There are now 18 conservation districts in the province, formed under the Conservation Districts Act (Government of Manitoba, 2016f). However, none exist in the northern NCRB on which this report focuses; the nearest is the Kelsey Conservation District, which lies in the Saskatchewan Watershed just outside the main area in question, though it is part of the larger Nelson River Basin. Its Carrot-Saskatchewan River Integrated Watershed Management Plan includes watershed-level thinking.

The Red River Basin Commission’s natural resources framework plan emphasizes integrated and basin-level management and provides goals and objectives in a few categories, including: basin-wide objectives (such as integration across national borders); flood damage reduction; drainage; water quality; water supply; soil conservation; and fish, wildlife and outdoor recreation (Red River Basin Commission, 2005).

5.1.7 Summary

The creation of a basin-level plan is one of the first steps in sustainably managing a watershed with its many components. Additionally, one of the values of watershed approaches is that they bring together parties to work together on watershed management, planning and solutions—including setting goals and targets and designing ways to meet them. Implicit in this approach is the need to find ways to resolve conflicts or trade-offs through multi-party deliberation and relevant analyses to optimize different priorities. With high socioeconomic reliance on natural resources, the development of a planning approach would be logical and beneficial in the northern NCRB; however, no such plan yet exists. Ideally, basin planning in the area would involve multiple scales, from a sub-watershed level (e.g., Burntwood River) through to the basin-level (i.e., the NCRB).

Manitoba began to recognize the value of watershed- and basin-level thinking more than four decades ago. With increasing resource development in the north, it would be prudent to finally initiate a basin-planning process in northern NCRB. The following sections will elaborate on additional elements and considerations that may be considered in basin planning and management.



5.2 Leadership

One clear finding from the literature review was that some form of leadership and a clear strategy are essential to successful watershed management. While there is currently no entity leading watershed-focused management in the entire northern NCRB, there are numerous examples of regional planning efforts that consider sustainable natural resource management.

5.2.1 Current Strategies and Leadership Potential

In 2000, the Province of Manitoba created the Northern Development Strategy (NDS), which focuses on the priorities of transportation, health, employment and training, housing and economic development.

In November 2016, the provincial government announced the creation of a task force, co-chaired by Onekanew (Chief) Christian Sinclair of the Opaskwayak Cree Nation and Chuck Davidson, president and CEO of the Manitoba Chambers of Commerce, “to lead the process of implementing the Manitoba government’s Northern Economic Development Strategy” (Government of Canada, 2016). In addition, the Communities Economic Development Fund (CEDF) issued a request for proposals to help develop this strategy, a task that would involve working with the task force and other interests (MERX, 2016).

Federally, Canada’s Northern Strategy focuses on Yukon, the Northwest Territories and Nunavut (Government of Canada, 2009), with only mention of Churchill.

Significant regional thinking has also developed around the boreal forests of Manitoba and Canada as a whole. In 2015 the Province of Manitoba conducted consultations on the development of a boreal strategy (Government of Manitoba, 2015a). In addition, non-governmental entities have formed initiatives around the boreal forest including the Canadian Boreal Conservation Framework, led by the multi-party Boreal Leadership Council (NGOs, indigenous communities and groups, resource industry, private companies) and aiming for the protection of 50 per cent of the boreal in Canada (Boreal Leadership Council, n.d.). Other entities and initiatives have formed around specific boreal species, such as the Boreal Songbird Initiative and the Canadian Parks and Wilderness Society’s “Caribou and You” campaign. Additionally, the Province of Manitoba created a Boreal Woodland Caribou Recovery Strategy in 2015, which includes a large portion of the northern NCRB (Government of Manitoba, 2015b) (see Figure 22), and in 2012 the federal government created a national recovery strategy for boreal caribou (Government of Canada, 2012). While not structured around watersheds, these initiatives show that large-scale sustainability thinking is already present in the region in various forms and involving many parties.

Therefore, while there is presently no structured and systematic watershed leadership in the region, there are numerous examples of regional sustainability initiatives.

5.2.2 Discussion and Summary

Currently, no entity is leading watershed management in the northern NCRB. However, it is promising that numerous initiatives exist or are in development that could provide leadership for and structure to natural resources management, the most integrated of which being the Province of Manitoba’s Northern Development Strategy and its new process for a northern economic development strategy.

The literature review that identified leadership as a desired watershed management principle also uncovered a set of characteristics common to leading entities. These include the ability and mandate



to: provide strategic direction and set goals; convene, coordinate and manage watershed interests; provide or facilitate resources; secure social license or support; work across provincial or international boundaries; and guide the initiative over time to meet objectives.

These characteristics reveal that mandate, resources and relationships with the range of interests in the region are all important for leadership. As discussed in Section 5.3, different interests will have different roles in watershed planning and management. Some might provide leadership in a sub-area of work.

Role for governments: Several federal and provincial government departments appear to have the ability and mandate for watershed management. Provincially, Manitoba Sustainable Development is responsible for numerous matters relevant to land, water and watershed management including the creation of conservation districts, pollution prevention, drinking water safety, forestry, fisheries, sustainable development, compliance with environmental laws, provincial parks and the environment in general. Accordingly, it derives abilities and responsibilities under such legislation as the Water Protection Act; the Environment Act; the Forest Act; the Drinking Water Safety Act; the Conservation Districts Act; the Sustainable Development Act; the Water Power Act, etc. (see Section 5.6 for further discussion of legislation) (Government of Manitoba, 2015d). Given that control of natural resources is generally in the hands of the provinces, the provincial government appears to be a contender for watershed leadership in the northern NCRB, where natural resource development is significant. An additional department to consider would be Indigenous and Municipal Relations. However, it has no explicit mandate for watershed-level land use and planning. As such, it can be viewed as a possible supporting entity in a watershed initiative.

The federal government also has authority related to water. In their analysis of the role of the federal government in water security, Zubrycki et al. (2011) wrote: “Federal leadership is necessary to create consistency across all provinces and territories, build cross-boundary collaboration and help save money by providing strong guidance that could reduce duplication of efforts and point to best management practices for Canadian water resources” (p. 1). The Canadian Constitution gives it jurisdiction over fisheries and fish habitat, and navigation and federal lands, including Indigenous reserves and national parks. The Constitution also states that the federal government is responsible for “peace, order and good

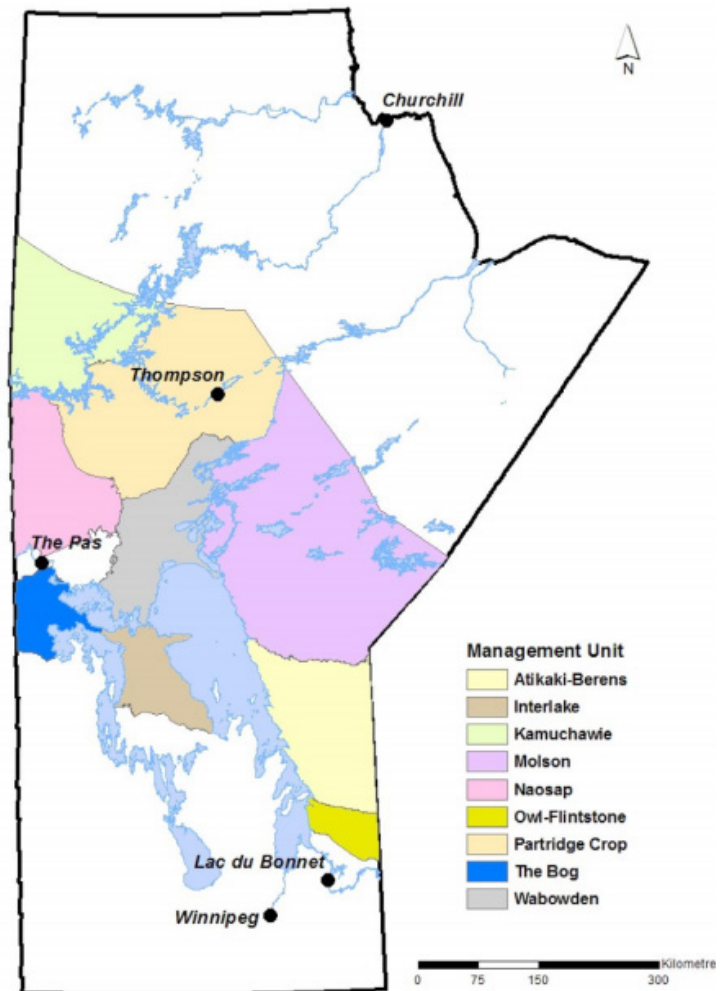


Figure 22. Boreal Woodland Caribou Recovery Strategy area

Source: Government of Manitoba (2015b); reprinted with permission.



government”—a provision that Bailey (2008) describes as used “most readily” in relation to natural resources, including water (Centre for Constitutional Studies, 2013). Based on other laws, the federal government also has shared responsibility with provinces on monitoring (see Section 3.2.6), pollution control and interprovincial waters. More information on legislation related to water management is provided in Section 3.2.7. The ministry most responsible for waterways is Environment and Climate Change, as the Department of the Environment Act assigns Parliamentary responsibility for water to this ministry along with “the preservation and enhancement of the quality of the natural environment” and “renewable resources, including migratory birds and other non-domestic flora and fauna” (Government of Canada, 1985b, p. 2).

Role for Indigenous Peoples: While it is possible to identify several entities with the mandate and resources for leading watershed management, it is less clear which entity might best be able to secure social license and support from everyone in the area. Indigenous communities have historically been disadvantaged by past resource developments, and often continue to experience conflict over natural resource developments in northern Manitoba (Canadian Press, 2014; Graham, 2014). In addition, reconciliation with Indigenous Peoples is ongoing. Both the Canadian and Manitoban governments issued apologies in recent years for past treatment of Indigenous Peoples, including through the Indian Residential School system and the “’60s scoop,” which involved removing Indigenous children from their homes and placing them for adoption in non-Indigenous homes (Government of Manitoba, 2015e). Given that watershed leadership would be expected to convene affected communities and groups and secure broad support for watershed management, existing relationships should be considered when determining leadership. As elaborated on in Section 3.2.5, meaningful involvement of Indigenous Peoples—including shared decision making and co-governance—is important to success in the northern NCRB.

Role for industry, resource development and Manitoba Hydro: It is clear from Section 2.5 that industry and resource developers, including mining, forestry, hydroelectric development and tourism have significant stakes in the northern NCRB. As major employers in the region, they will doubtless be quite involved in the development of a new northern strategy. The environmental well-being of the region also affects them. For instance, the forest industry relies on a healthy boreal ecosystem. Water flows are of obvious importance to Manitoba Hydro. A comprehensive plan for land and water management cannot be developed without significant involvement from these parties. While they lack the jurisdictional authority to develop a basin-wide approach, and some have been in conflict with communities in the region—resulting in some loss of trust—they are essential in any initiative going forward. They have the potential to be progressive and engaged leaders in their own areas of expertise. They also have some leadership characteristics, such as human and financial resources (e.g., Manitoba Hydro already provides some relevant support), as well as the ability to convene (e.g., Tolko holds annual public information meetings and hosts numerous Forest Resource Advisory Committees) (Tolko Industries Ltd., n.d.). While none of these entities is capable of leading alone, they should be viewed as participants that have much to contribute in creating regional approaches.

Collaborative leadership structures: While provincial and federal governments have the clearest mandates and are most likely to have resources for watershed management in the northern NCRB, they need support of other regional interest groups. However, given that there are significant legacy issues with Indigenous communities, it is unclear who can build the necessary strong relationships and social capital. Therefore, in determining potential leadership, it might be useful to consider collaborative



leadership structures identified in the literature review, including NGOs, central government agencies and intergovernmental bodies.

5.3 Multi-Party Approaches

As watershed management involves managing seemingly conflictual uses of land and water, one of the most common recommendations in watershed management literature is that all parties should be meaningfully engaged in order to bring multiple viewpoints, prioritize opportunities, manage risks and ensure broad buy-in. Often a watershed includes diverse groups that hold significantly different perspectives on how best to develop the watershed. Creating a framework for discussion allows for the discovery of shared interests, negotiation of problem areas and the creation of plans that have wide-ranging support.

5.3.1 Multi-Party Approaches in the northern NCRB

Based on a desktop review of interests in the northern NCRB, we have identified categories of parties that might be included in an integrated approach to watershed governance. These include:

- The federal government (and relevant departments)
- The provincial government (and relevant departments)
- Municipalities (communities, towns, cities and local government districts)
- Indigenous governments and Peoples
- Multi-government organizations
- Tribal councils
- Indigenous organizations
- Industry and business
- Resource management boards
- NGOs
- Other

Lists of identified parties in each category are available in Appendices 1.

At a watershed level, there have not been any multi-party initiatives in the northern NCRB. However, there have been multi-party approaches in the region that may provide some foundation and guidance for a watershed approach.

Provincially, the prospect of a new northern economic development strategy presents one opportunity for multi-party engagement at a regional level.

At a more local scale, the former Thompson Economic Diversification Working Group (TEDWG) offers an example of a cooperative planning approach involving many interests. The TEDWG formed after Vale announced in 2010 that it was decommissioning its smelter and refinery in Thompson. The TEDWG process was created to “identify and advance initiatives to broaden and strengthen the economic base of the City of Thompson and the broader region” (TEDWG, n.d., p. 1). Members represented different interests including: the City of Thompson, Vale, Manitoba Keewatinowi Okimakanak, Keewatin Tribal Council, Manitoba Metis Federation, Northern Association of Community Councils, Nisichawayasihk



Cree Nation (NCN), Thompson Unlimited, the Thompson Chamber of Commerce and the Province of Manitoba. TEDWG used a consensus-based approach to developing plans to guide development in the Thompson region. In addition to traditional economic development considerations, TEDWG members identified restorative justice, housing, education and training, economic development, and local and regional identity as priority areas, and developed action plans in several of these areas (TEDWG, 2012). As described in Section 3.2.5, partnerships between Manitoba Hydro and various Indigenous communities to develop and benefit from hydroelectric facilities, such as Wuskwatim and Keeyask, are also examples of multi-party approaches where common interests and differences must be negotiated.

From a resource perspective, the resource management boards of northern Manitoba involve at least two key interests: one or more Indigenous communities and the province (Indigenous and Municipal Relations). Each board includes 8–10 people, with half from the province and half from the community (Indigenous and Municipal Relations, n.d.).

In terms of a water-focused approach, the Manitoba Water Council, established in 2007 under the Water Protection Act, is one example of a multi-party group that could guide water management in the North. According to the act, the council’s responsibilities are “to monitor the development and implementation of watershed management plans in the province” (Government of Manitoba, 2005). A variety of parties are appointed by the Lieutenant Governor in Council with the goal of representing regional diversity, local government, agriculture and environmental perspectives (Manitoba Water Council, 2015). Only one member listed is from the northern NCRB (Loretta Mowatt from Norway House Cree Nation) (Manitoba Water Council, n.d.). In 2012–2013, the consideration of northern water issues was included in the council’s work plan, with the group concluding that there was a “need for continuous knowledge building on water issues in the North” and that the following issues were important to water planning in the region: water power licensing; co-management agreements with Indigenous Peoples on resources; Section 35 consultation and engagement processes (Manitoba Water Council, 2013); and boreal peat and wetlands (Manitoba Water Council, 2013, p. 7). The council also stated that: “a greater comprehension of northern water issues will foster future policy contributions on how watershed planning could better evolve in the North” (2013, p. 1). However, the 2013–2014 and 2014–2015 reports on council activities did not refer to northern considerations (Manitoba Water Council, 2014).

When considering potential multi-party watershed approaches in the northern NCRB, it is valuable to consider how other watershed-level entities in Manitoba bring together parties. The Red River Basin Commission engages a wide range of parties, with Manitoban board members from various rural municipalities, cities, provincial/state departments, water cooperatives and environmental organizations. There are also mechanisms for engagement, such as an annual conference, committees focused on topics of interest (e.g., long-term flood solutions; regional transboundary waters; plan implementation) and staff who conduct outreach and engagement throughout the area (Red River Basin Commission, n.d.a). Conservation districts, in comparison, have boards consisting of members from their sub-districts, which supports geographic representation in decision making.

Other existing multi-party initiatives are more specific to certain topics or groups. Various Indigenous groups, such as the Swampy Cree Tribal Council and Keewatin Tribal Council, represent some Indigenous communities in the region. However, their membership is specific, and so they alone do not offer the comprehensive multi-party membership needed for watershed management. The Prairie Provinces Water Board is valuable in that it considers interprovincial waters, including the Churchill



River flows from Saskatchewan and Alberta. However, its members are solely governmental (federal and provincial) and, as such, it is not a broad multi-party initiative (Prairie Provinces Water Board, 2014). Finally, the Northern Manitoba Sector Council represents mining, forestry and energy sectors in the region and also has ex-officio members from government and academia. However, again, its membership is not inclusive of all interests in the region.

5.3.2 Discussion

Achieving multi-party approaches in any watershed can be a challenge, but the northern NCRB watershed faces an additional geographic challenge not experienced by most other watersheds: a highly dispersed population with sometimes limited connectivity. In the Manitoban portion of the watershed, roughly 36,150 people (2011 census) are spread over 200,803 km². The abilities of some of these communities to participate in multi-party engagements may be limited by travel options (some communities are only accessible by winter road, plane or rail) and Internet access.

To build a watershed-based multi-party engagement process for the northern NCRB based on precedents in the region, there needs to be a clearly articulated plan that brings watershed interests together. As identified in the literature review, it is crucial to establish a framework for dialogue that includes those who “make decisions and/or are affected by decisions—those who manage and those who are being managed” (Bach et al., 2011, p. 28). Appendix 1 lists many of those parties in the northern NCRB. Given the length of the list, it would be important to consider a range of options in involving parties; while it would be unwieldy to have all parties directly involved in planning and decision making, less intensive options should be open to all. Methods should be used to ensure all interests have a voice in the direction the watershed takes; roundtables, forums, consultations, written/phone submissions and mutually agreed-upon methods for representation of interests are some options. The examples of existing multi-party initiatives in the region, such as the former TEDWG, incorporate some of these options. Some of these approaches could contribute to initial discussions and/or evolve into watershed-focused engagement. Given its mandate to monitor watershed management plans in Manitoba, the Manitoba Water Council is another existing group that could help catalyze multi-party discussions for watershed management in the northern NCRB. The COSDI report, mentioned earlier in this document, could also play a role in providing guidance for such an initiative. The COSDI recommendations themselves were created through a multi-party process that included both an 18-member “core group” and an advisory committee with 60 members (Government of Manitoba 1999). The resulting report recommended that multi-party advisory committees develop large-area—ideally watershed-based—sustainable development plans. Were such a committee formed for the northern NCRB, it could result in a roadmap that integrates perspectives from all interests and has broad buy-in.

In initiating such multi-party processes in the northern NCRB, it is also useful to consider the roles of different parties, as each role has different responsibilities and expectations. Roles for a multi-party partnership in the northern NCRB could include:

- **A lead agency**, potentially responsible for overall guidance of an initiative, providing resources, and/or conducting reporting and monitoring on key components.
- **Government entities** at all levels to provide necessary policy and legislative strength and the ability to link watershed processes with other priorities and processes, and also to help lead and provide guidance as necessary.



- **Industry and those involved in resource development** would represent economic interests, potentially help with technical capacity and other resources to manage the watershed, and contribute to reporting and monitoring.
- **The science community** would help identify key components of the ecosystem, help determine vulnerable areas, help review projects in the region and help develop monitoring systems.
- **Indigenous communities and civil society groups** would provide valuable local-level inputs.

In governance and democracy literature, civil society has been called a “mediating third realm” between government and the private sector that can temper short-term profit-based perspectives with longer-term, sustainability-based perspectives (Barber, 1998; Zubrycki, 2010). In the northern NCRB context, civil society can work with other parties to ensure that any planning also considers socioeconomic benefits for those who live in the watershed and takes into account spiritual, cultural and historical connections to the land. It could be argued that one role for these groups is to provide checks and balances for development activities. Partners in a multi-party process can represent larger populations, but also smaller groups with a specific perspective or a minority view.

5.3.3 Summary

In summary, a multi-party framework for dialogue is fundamental to good watershed planning. With the multitude of parties with varying views in the northern NCRB, finding mutually acceptable and beneficial paths forward for watershed management is important to achieving carefully considered sustainable development in the region. In order to create this dialogue in the watershed, a framework would need to be created that addresses the relatively low connectivity by transport and information infrastructure of many parties in the region.

5.4 Shared Decision Making with Indigenous Peoples

The land in the northern NCRB falls under Treaty 5 (Manitoba⁸) and Treaty 10 (Saskatchewan⁹). An estimated 65 per cent of people in northern Manitoba are Indigenous (Government of Manitoba, n.d.a). Many of these residents participate in traditional activities such as hunting, fishing and gathering; for instance, Campbell et al. (1997) surveyed residents in Nelson House and South Indian Lake and found that 66 per cent of households in South Indian Lake included an active hunter (48 per cent for Nelson House), 33 per cent had an active fisherman (34 per cent for Nelson House) and 58 per cent had an active trapper (40 per cent for Nelson House). With Indigenous Peoples having by far the longest history on the land of any population in the region, high reliance on a healthy watershed for their well-being, and traditional knowledge that can strengthen planning, their involvement in creating a sustainable path forwards is essential.

Section 5.3 emphasized the importance of meaningful engagement with all interests when planning for watershed and natural resources management. In the northern NCRB, it is particularly important to work with the Indigenous communities if sustainable development—balancing social, economic and environmental priorities—is to be achieved. The literature review indicated that co-governance with Indigenous Peoples, including shared decision making and benefit sharing, have emerged as a beneficial way to pursue this goal. While this type of co-governance is not yet a norm, there appears to be some movement towards this approach within the northern NCRB.

⁸ For a map of the Treaty 5 area, see <https://www.aadnc-aandc.gc.ca/eng/1100100020576/1100100020578>

⁹ For a map of the Treaty 10 area, see <http://www.otc.ca/education/we-are-all-treaty-people/treaty-map>



In terms of natural resource management, northern Manitoba's resource management boards (RMBs), established between 1992 and 2010, present one approach to co-management. The management area consists of "a mutually agreed geographical area, usually the Registered Trapline District, that includes both Crown and/or Reserve and/or community lands," (Government of Manitoba n.d.c.) and is managed for such things as "land and resources use planning; water management; commercial and domestic harvesting activities; mineral development activities; forestry; and wildlife management" (Government of Manitoba n.d.d.). Each RMB and its plans are different, allowing them to manage the area's specific priorities and context.

There are several fairly recent and promising developments in the area. In January 2016, the Province of Manitoba announced it would "share up to 25 per cent of mining taxes on new mines with indigenous communities" (Government of Manitoba, 2016b). A result of the minister's Mining Advisory Council, which includes representation from northern Indigenous nations, this is an example of revenue sharing, one of the tools outlined in our literature review.

Collaborations between Manitoba Hydro and various Indigenous communities also indicate increased meaningful engagement. In 2006, Nisichawayasihk Cree Nation (NCN) ratified a Project Development Agreement with Manitoba Hydro regarding the development of the 200-megawatt Wuskwatim Generation Project on the Burntwood River. This equity partnership allows NCN to own up to 33 per cent through the Taskinigahp Power Corporation, owned by NCN, and receive a share of project revenues (Nisichawayasihk Cree Nation, n.d.a). In 2015, revenues from the trust were used for a variety of community benefits, including resource and land-use planning, social development, a justice program, an Aboriginal Heritage Program and public works (Nisichawayasihk Trust Office, 2015). In addition to a share of revenues, NCN also has first preference on contracts (e.g., road construction, catering, security), and first preference to its citizens for jobs and training related to project development. The total benefits to NCN are estimated at CAD 216.5 million over 25 years (Nisichawayasihk Cree Nation, n.d.a).

Similarly, the Keeyask Project is an equity partnership that shares benefits with Fox Lake Cree Nation, War Lake First Nation, Tataskweyak Cree Nation and York Factory First Nation. Signed in 2009, the Joint Keeyask Development Agreement (JKDA) allows the four communities, referred to as the Keeyask Cree Nations, to hold up to 25 per cent of the partnership, with the remaining 75 per cent owned by Manitoba Hydro. Both Manitoba Hydro and Keeyask Cree Nations are limited partners in the Keeyask Hydro Limited Partnership, which owns the generating station. The JKDA also outlines expectations related to "income opportunities, training, employment, business opportunities, and other related matters" (Keeyask Hydropower Limited Partnership, 2016a). The Keeyask Hydro Limited Partnership website states: "Ultimately, as evidenced by approving the Agreements, CNP [Cree Nation Partners] Members believe that the proposed Keeyask Project provides a variety of opportunities to strengthen their Cree identity while modernizing their economies. This will ensure that the current CNP youth, as well as future generations, can take advantage of the social and economic opportunities provided by the sustainable and responsible development of Keeyask" (Keeyask Hydropower Limited Partnership, 2016b).

On a regional scale, the Province of Manitoba's recently announced process for a new Northern Economic Development Strategy could provide opportunities for increased shared decision making in the region. Additionally, text from the 1999 COSDI report still rings true today. It acknowledged the critical importance of including Manitoba's Indigenous Peoples in watershed-based sustainable development planning, stating: "The COSDI Core Group considers that the success of the initiatives and



recommendations contained in this document will be, to a large extent, dependent upon the existence of open communication between the Government of Manitoba and Aboriginal peoples” (Government of Manitoba, 1999)

When considering the important role of Indigenous Peoples in the northern NCRB, examples of Indigenous leadership in resource and service development also warrant recognition. In early 2016, it was formally announced that a group of Indigenous communities were hoping to purchase the Hudson Bay Railway line, which runs to the Port of Churchill. Mathias Colomb Cree Nation offered to buy the line from the Denver-based company, OmniTrax, and invited other northern Indigenous communities to join a consortium. Mathias Colomb Cree Nation already operates the Keewatin Railway Company, also located in the northern NCRB, with Tataskweyak Cree Nation and War Lake First Nation. In 2006 the communities purchased the Sherridon Rail Line from OmniTrax with financial support from the Government of Canada (Keewatin Railway Company, 2016). While the future of the Hudson Bay Railway line is still uncertain—in part because of a legal case between OmniTrax and the Province of Manitoba (Annable, 2016) and also due to the July 2016 closure of the Port of Churchill by Omnitrax (Redekop, 2016)—it is still a good example of how Indigenous communities have a leading role in regional infrastructure.

The co-governance, shared decision making and benefit-sharing approaches discussed above are still recent, and the levels of success for all are not yet evident. Nevertheless, they appear to be encouraging movements towards mutually beneficial collaboration.

5.4.1 Discussion

Co-governance and shared decision making with Indigenous Peoples is a growing, if still fairly nascent, trend throughout Canada. The literature review identified several examples in this vein, including Quebec’s Plan Nord, the Mackenzie Valley Land and Water Board, and the Great Bear Rainforest Agreement.

None of the current examples in the northern NCRB are watershed-focused, though there are obvious relationships between the hydroelectric partnerships and water management. For instance, the Keeyask project includes an Aboriginal Traditional Knowledge Monitoring Program; traditional knowledge was used for site planning to protect resources and sacred places, environmental and social impact assessments, and will be used to monitor effects (Keeyask Generation Project, 2013; Nisichawayasihk Cree Nation, n.d.b, n.d.c). As such, traditional knowledge is being used with Western science to make decisions about land and water management, a positive development that supports this principle identified in the literature review.

The existence of RMBs for co-management, as well as their ability to develop resource management plans and land-use plans with Indigenous communities and the Province of Manitoba equally represented on the board, also supports this principle. However, RMBs do not exist on a watershed basis.

Should watershed-level co-governance be a specific goal in the northern NCRB, insights on best practices could likely be gained from other such approaches from comparable areas. For instance, the Mackenzie Valley Land and Water Board is firmly grounded in co-management and clearly gives decision-making power to its four decentralized boards, each of which includes members appointed by Indigenous groups. Its website states: “The *Mackenzie Valley Resources Management Act (MVRMA)* has created and provided authorities to co-management boards to carry out land use planning, regulate the use of land and water and, if required conduct environmental assessments and reviews of large or complex projects. It also



provides for the creation of a Cumulative Impact Monitoring Program ... and an environmental audit to be conducted once every five years” (Mackenzie Valley Land and Water Board, 2016).

The Great Bear Rainforest Agreement is instructive in many ways, including its success in creating collaboration between groups with long-standing conflicts, receiving support from all Indigenous nations in the region and developing a groundbreaking ecosystem management approach. A similar consensus-based approach could be useful for co-management in the northern NCRB and perhaps go far in reconciling relationships while supporting socioeconomic benefits and responsible environmental planning in the region.

One way in which to incorporate lessons from these Canadian examples into the region would be to consider them during the planned development of a new Northern Economic Development Strategy. There is opportunity to encourage co-governance, recognize Indigenous rights and include Indigenous members in any decision-making structures (e.g., boards, planning entities) created compatible to or on a watershed basis. The inclusion of Opaskwayak Cree Nation Onekanew (Chief) Christian Sinclair as a co-chair on the task force for the development of this strategy seems a positive step (Government of Manitoba, 2016e). We recommend that this process and the resulting strategy be viewed as one possible way to integrate and implement the principles discussed in this paper—and that it could be deliberately designed to further watershed thinking, Indigenous empowerment and sustainable development.

5.4.2 Summary

In summary, the demographics of the northern Manitoba portions of the NCRB make it necessary to actively involve Indigenous communities, and the foundations of such engagement are at least partially present. Existing co-management and benefit-sharing approaches can be seen in industry (e.g., hydro, mining), services (e.g., rail lines) and regional planning (e.g., potentially the new Northern Economic Development Strategy). It is possible that the growing collaboration and shared decision making with Indigenous people in the region could provide springboards for watershed-level collaboration.

5.5 Monitoring and Reporting

In order to conduct watershed management, you need baseline information on the watershed, as well as ongoing monitoring to track how measurements are changing (e.g., Is the water quality improving? Are fish populations changing? Have there been changes in land use?). Once this information is available, good watershed management practice would have it communicated appropriately to different audiences—for instance, in a more technical and detailed form to specialist audiences (potentially including a centralized database), and in plain language and perhaps abbreviated form (highlighting key findings and trends) for general audiences. Ideally, this data and reporting would include both the environmental and socioeconomic aspects, though the present section focuses primarily on the environmental.

Below we discuss two key aspects of information in watershed management: monitoring (i.e., data collection) and reporting. Each exists to some degree in the northern NCRB, but they are not done in an integrated or complementary manner, making it challenging to understand the “big picture” in the basin.

5.5.1 Current State

There are a number of entities collecting water quality/quantity and other biophysical data in the Manitoba portion of the northern NCRB. These include Manitoba Hydro, the Government of Manitoba,



the Government of Canada, North/South Consultants, mining companies (Vale and Hudbay), forestry (Tolko) and, on smaller scales, various communities. Data and analysis are reported on to varying degrees.

Perhaps the broadest monitoring program is the **Coordinated Aquatic Monitoring Program (CAMP)**, developed in partnership with Manitoba Hydro and Manitoba Sustainable Development to “monitor the health of water bodies (rivers and lakes) effected by Manitoba Hydro’s generating system” (CAMP, 2016a). In addition to Manitoba Sustainable Development and Manitoba Hydro, knowledge is contributed to CAMP by Fisheries and Oceans Canada, Environment and Climate Change Canada, North/South Consultants and local parties, including RMBs and Indigenous communities (CAMP, 2016b). CAMP monitors for both biotic (e.g., phytoplankton, fish communities, benthic invertebrates) and abiotic (e.g., water quality, hydrometrics, sediment quality) components, thereby measuring ecosystem health of the waterways. CAMP also includes three levels of reporting: annual activity reporting (to the Minister of Sustainable Development and Manitoba Hydro); annual data reporting (reported on CAMP’s website); and three-year technical reports (CAMP, 2016b, 2016c).

Both Manitoba Hydro and Manitoba Sustainable Development conduct additional monitoring in the region. For instance, Manitoba Hydro established the **Lake Sturgeon Stewardship and Enhancement Program** to monitor sturgeon populations (Manitoba Hydro, 2014a) and also monitors hydrological and atmospheric data at other locations (Manitoba Hydro, n.d.a). Other monitoring and reporting efforts related to hydro previously mentioned in this report (see Section 2.7) include the large-scale 1975 report by the **Lake Winnipeg, Churchill and Nelson Rivers Study Board**, the 1986–1992 **Federal Ecological Monitoring Program** and 1996 joint studies conducted by the Split Lake Cree and Manitoba Hydro. In addition, Manitoba Hydro conducts ongoing site-specific monitoring programs, including the **Churchill River Weir Assessment and Monitoring Studies, South Indian Lake Environmental Monitoring Program** and **Wuskwatim Aquatic Effects Monitoring Program** (Manitoba Hydro, 2005). Finally, Manitoba Hydro and the Government of Manitoba recently completed a **regional cumulative effects assessment (RCEA)**, fulfilling a 2013 Clean Environment Commission Bipole III Report recommendation.

Manitoba Sustainable Development monitors precipitation through stations owned by its **Manitoba Fire Program** (Manitoba Sustainable Development, n.d.b). It also monitors water quality through the **Ambient Water Quality Monitoring Network**, though information on specific monitoring locations could not be found (Government of Manitoba, n.d.b). In addition, Manitoba contributes to the National Hydrometric Program, discussed in the next paragraph.

Federally, water monitoring and reporting is somewhat limited. Environment and Climate Change Canada’s hydrometric data map for its **National Hydrometric Program** is jointly administered with the provinces and territories. Information is available on a single, searchable online portal, and includes the most data points of any federal reporting found (see Figure 23) (Government of Canada, 2014). Other monitoring datasets have sparse information on the northern NCRB. Canada’s **long-term freshwater quality monitoring network** includes only one Manitoban site at the Manitoba-Saskatchewan border, run by the Prairie Provinces Water Board, and only a small number of federal-provincial monitoring sites in Saskatchewan (see Figure 24) (Environment and Climate Change Canada, 2015). Similarly, only a few of the federal government’s **Canadian Aquatic Biomonitoring Network** sites are located in the northern NCRB and none are in northern Manitoba (Environment and Climate Change Canada, 2015).

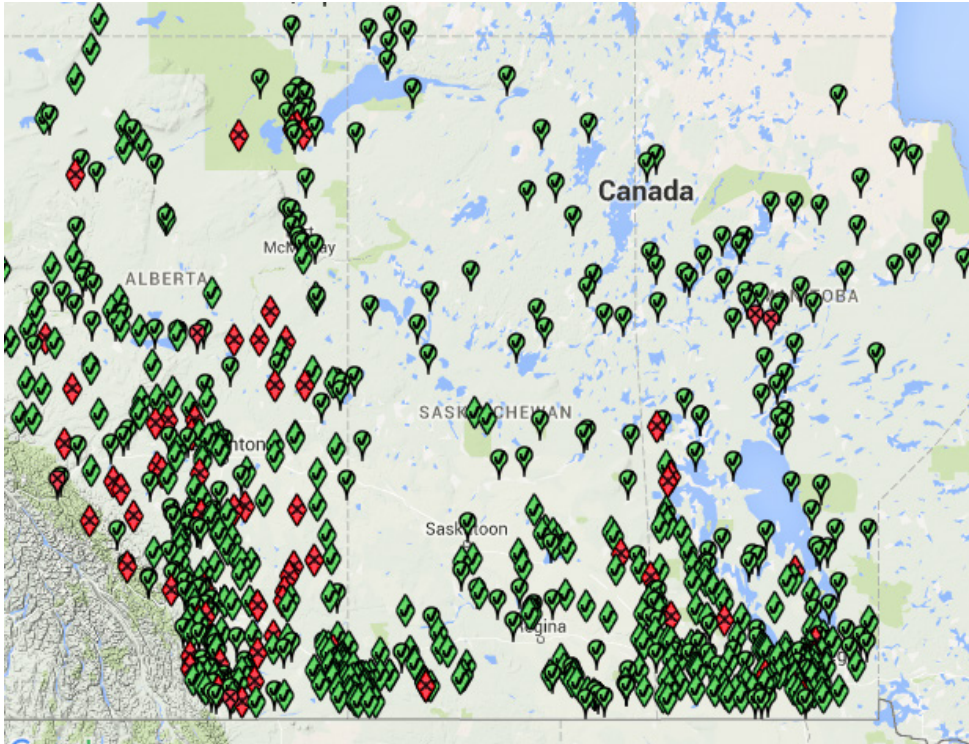
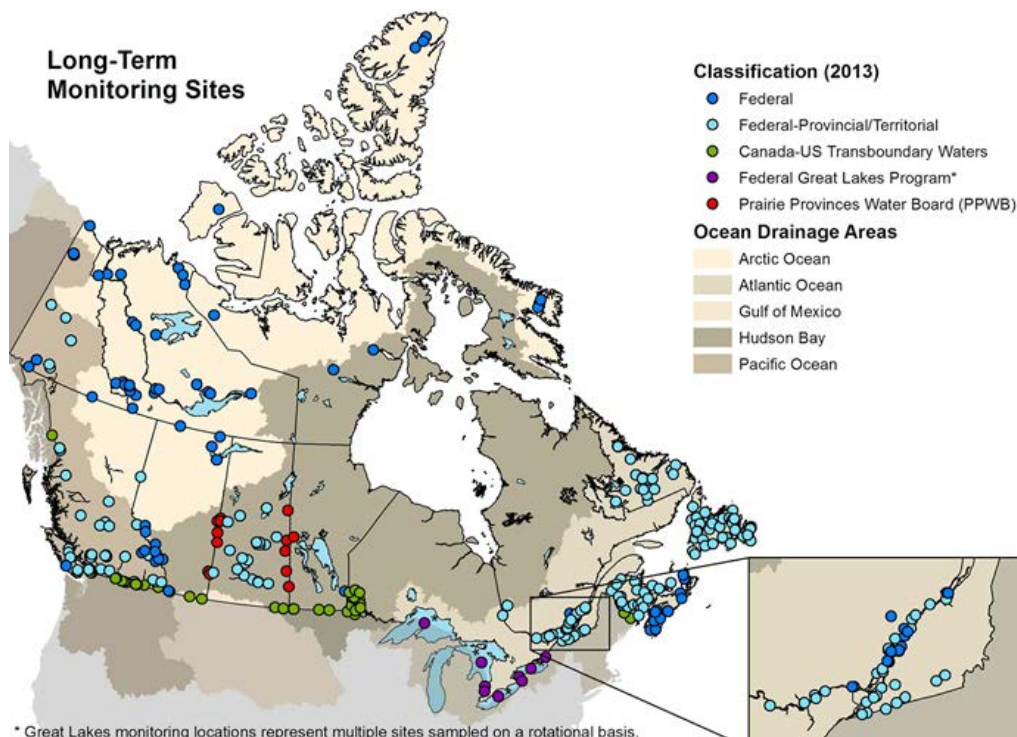


Figure 23. Hydrometric data

Source: Government of Canada (2014)¹⁰



* Great Lakes monitoring locations represent multiple sites sampled on a rotational basis.

Figure 24. Long-term monitoring sites

Source: Environment and Climate Change Canada (2015)¹¹

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In terms of federal reporting, **CESI**, part of Environment and Climate Change Canada, reports on data in a fairly user-friendly way, providing maps, graphs and charts that are useful in understanding the indicators it reports on. For water, these indicators include a rating of ambient water quality on the Nelson River (but not the Churchill River) (Environment and Climate Change Canada, 2016d); freshwater quality at monitoring sites (five on the Churchill River and one on the Nelson River) (Environment and Climate Change Canada, 2016c); and interactive maps on releases of mercury, lead and cadmium to waterways by several large facilities in the watershed, such as by mining facilities in Snow Lake and Thompson (Environment and Climate Change Canada, 2016b). Additionally, it provides maps on annual emissions of various air pollutants (e.g., mercury, respirable particulate matter, sulphur oxides, nitrogen oxides) from different sources (e.g., mining facilities, the Manitoba Hydro facility at Brochet), some of which are in the watershed and are relevant to watershed management due to possible effects on ecosystems and health. Ambient conditions of some of these substances are also provided.

Monitoring and reporting by forestry and mining in the northern NCRB appear to relate primarily to government requirements. For instance, Tolko conducts monitoring, produces site assessments and publishes reports related to its Forest Management License with the Province of Manitoba, as well as in relation to federal considerations, particularly through the Navigable Waters Protection Act, altered in 2012 and renamed the Navigation Protection Act (Department of Fisheries and Oceans and Transport Canada).¹² Tolko’s sustainable forest management plan report identifies indicators, with most environmental ones being land based (e.g., forest cover composition in reforested areas; woodland caribou habitat) and only a few water-related ones (e.g., condition of stream crossings and roadways in relation to erosion) (Tolko Industries Ltd. 2012, 2014a). An indicator on “proportion of watershed or water management areas with recent stand-replacing disturbance” exists but is incomplete, as Tolko states it could not access data for the watershed outside of its operational area (Tolko Industries Ltd., 2014a, p. 12).

As with forestry, monitoring by mining companies in Manitoba appears to be driven by government requirements. Hudbay writes that its water stewardship in Manitoba relates to environmental effects monitoring requirements in the Metal Mining Effluent Regulations (Hudbay, 2015b). These include quarterly reporting of effluent monitoring for such considerations as deleterious substances, pH of effluent and volume (Government of Canada Justice Laws, 2016a).

Other monitoring in the watershed is at a very localized level. For instance, the City of Thompson tests untreated water from the Burntwood River and treated drinking water as required by Manitoba law (Drinking Water Safety Regulation 40/2007; Drinking Water Quality Standards Regulation 41/2007; Government of Manitoba, 2007). Results are summarized on the city’s website and available on request (City of Thompson, 2014a, 2014b).

5.5.2 Discussion

In order for monitoring in the northern NCRB to inform decision making, it needs to include monitoring of all the relevant components. These could include key environmental components, including land, water, forestry, etc.; key social components including components of community health and well-being and traditional knowledge; and economic components including employment and overall economic returns. In order to be usable, data needs to be informative about the state of the system; help determine trends, vulnerabilities and gaps; and help determine which management actions are working and which are not.

¹² Changes to the act resulted in it applying to far fewer water bodies.



While monitoring is carried out in the northern NCRB and some reporting is available, the findings of this scan indicate that current activities are fragmented and do not produce a robust picture of the status of the watershed, nor do they inform trends or decisions adequately.

5.5.2.1 Data Centralization

The literature review identified several components important to data that are not found in the northern NCRB context. First, data collected is not stored in a central, comprehensive database accessible to all parties, nor is there a strong centralized reporting approach. The federal government’s CESI website is perhaps the nearest thing, as it incorporates data from several sources (e.g., data used for “Local Freshwater Quality” are from the Government of Manitoba and Prairie Provinces Water Board) and reports on it in a user-friendly way. However, this site only provides a very high-level overview of the watershed, with very few data points in the northern NCRB. More detailed information would be desirable. The Manitoba Hydro-Manitoba Government CAMP program appears to collect more data, but the raw data is not readily accessible, and only some data is displayed in a user-friendly manner.

5.5.2.2 Standardization of and Consistency in Data Collection and Reporting

It does not appear that data collection and reporting methods are standardized between many of the entities collecting data. Although the federal and provincial governments share some hydrometric and water quality data, there does not appear to be a systematic way of ensuring data collected by all entities are consistent and comparable on a watershed basis. For instance, in terms of reporting, CESI reports on freshwater quality using the Canadian Council of Ministers of the Environment’s Water Quality Index (Environment and Climate Change Canada, 2016b). However, CAMP discusses water quality in the context of the Manitoba Water Quality Standards, Objectives, and Guidelines.

In terms of reporting consistency, both Zubrycki and Bizikova (2015) and the Government of Alberta (2012) comment on the challenge of reporting consistency in watershed reporting. The situation in Alberta is described as follows:

In a state of watershed report, does one report on nutrient concentrations in relation to Alberta’s Surface Water Quality Guidelines, according to Canadian Council for the Ministers of the Environment (CCME) Water Quality Guidelines, or according to local objectives? Or perhaps, simply as a numeric value with no reference to any existing guidelines or objectives? Does one report on each parameter (or metric) individually, or within a multimetric index? If the latter, which index should be used? Alberta Environment and Sustainable Resource Development’s overarching Surface Water Quality Index, the Nutrient Sub-index, or perhaps Alberta Agriculture & Rural Development’s Water Quality Index for Agricultural Streams? Each differs and the subsequent values generated within each index are not comparable. (p. 6)

Based on the different approaches to reporting observed in the northern NCRB context, it appears that a similar conundrum may be faced in Manitoba.

5.5.2.3 Multi-Scale Monitoring

Other traits of data collection and reporting found in the literature review do exist to some degree in the northern NCRB. For instance, there is data collected at multiple scales, including local and project scales (e.g., mining sites, communities, Manitoba Hydro sites) and larger scales (e.g., by Manitoba Hydro, the



Province of Manitoba and the federal government). Although this data is not centralized, and it is unclear if consistency exists in collection and protocol, it is still worth noting that multi-scale collection occurs.

5.5.2.4 *Traditional Knowledge*

There are some instances of traditional knowledge being used in assessing and reporting on portions of the watershed, though it does not appear to be done regularly or in a systematic way. Traditional knowledge has been used in understanding and reporting on species in the area, such as caribou and the Nelson River sturgeon (Hannibal-Paci, 2000; MacDonnell, 1997; York Factory First Nation, 2013). Traditional knowledge has also been used in the context of hydro developments, such as the Bipole III transmission line (Larcombe, 2012; Manitoba Hydro, 2011) and in the EIA of the Keeyask Project (Keeyask Hydropower Limited Partnership, 2016c). In addition, the Manitoba Clean Environment Commission has heard and reported on traditional knowledge in its reports on developments in northern Manitoba, and it appears that observations have bearing on recommendations (Manitoba Clean Environment Commission, 2015). However, this information does not appear to be well integrated with other data and reporting and is, instead, often presented in separate documents.

5.5.2.5 *Cumulative Impact Assessments*

The literature review also identified cumulative effects monitoring as an aspect important to watershed data and reporting. It is promising that a regional cumulative effects assessment (RCEA) was conducted in hydro-affected areas upon a 2013 Clean Environment Commission Bipole III Report recommendation. However, a watershed-wide assessment considering the cumulative effects of all activities would be even more valuable.

5.5.2.6 *Roles and Mandates*

It appears that Manitoba Hydro, often in cooperation with the Government of Manitoba (primarily Manitoba Sustainable Development), conducts the greatest amount of monitoring and reporting in the northern NCRB. The broadest and most comprehensive program it runs is CAMP, which collects information about hydro-affected rivers and lakes. These two entities also conducted the recent RCEA study, which reports on socioeconomic information in addition to environmental. While CAMP and RCEA reports provide important data on the state of the ecosystem, there are numerous limitations for the purposes of this study, including:

1. They are both limited to waterways affected by hydro operations, and thus leave out large portions of the combined watersheds.
2. They are designed to collect data related to a specific industry and, therefore, may not include components related to other activities or consider cumulative effects from other activities.
3. CAMP has only existed since 2008, resulting in datasets not capturing changes prior to that period.

Section 6.2 on leadership indicated that one important consideration in watershed management is the question of who has the mandate and responsibility for an activity. The significant drawback that Manitoba Hydro does not monitor and report on the entire northern NCRB stems from the fact that its responsibility is limited to the region it studies. Similarly, the other entities discussed that conduct some monitoring—for example, mining, forestry and communities—do not have this mandate; quite reasonably, they are only expected to monitor smaller areas, not the entire watershed.



The government mandate for monitoring is shared between the Canadian and Manitoban governments. The Canada Water Act enables the federal government to “collect, process and provide data on the quality, quantity, distribution and use,” as well as enter into agreements with provinces to share monitoring (Government of Canada, 1985a). To “collect, process and provide data” could be interpreted as “to co-ordinate and report on data physically connected by others.” Section 44 of the Canadian Environmental Protection Act (CEPA) 1999 requires the Minister of Environment and Climate Change to “establish, operate and maintain a system for monitoring environmental quality” and “collect, process, correlate, interpret, create an inventory of and publish on a periodic basis data on environmental quality in Canada from monitoring systems, research, studies and any other sources” (Government of Canada Justice Laws, 1999).

By the federal government’s own admission, this requirement is not being adequately met. In 2010 an Environment Canada (now Environment and Climate Change Canada) audit of its National Hydrometric Program found that monitoring in much of northern Canada was deficient, including in vast areas of the northern NCRB. Only small portions along the main rivers were found to have sufficient coverage (see Figure 25) (Environment and Climate Change Canada, 2010). Also in 2010, the Canadian Commissioner of the Environment and Sustainable Development found water quality and quantity monitoring in Canada to be lacking. Vaughan (2010) concluded that “Environment Canada is not adequately monitoring the quality and quantity of Canada’s surface water resources” (p. 2). Specific concerns included that it did not monitor on most federal lands (e.g., Indigenous reserves and national parks) and did not locate monitoring stations based on an assessment of water risks (Office of the Auditor General of Canada, 2010).

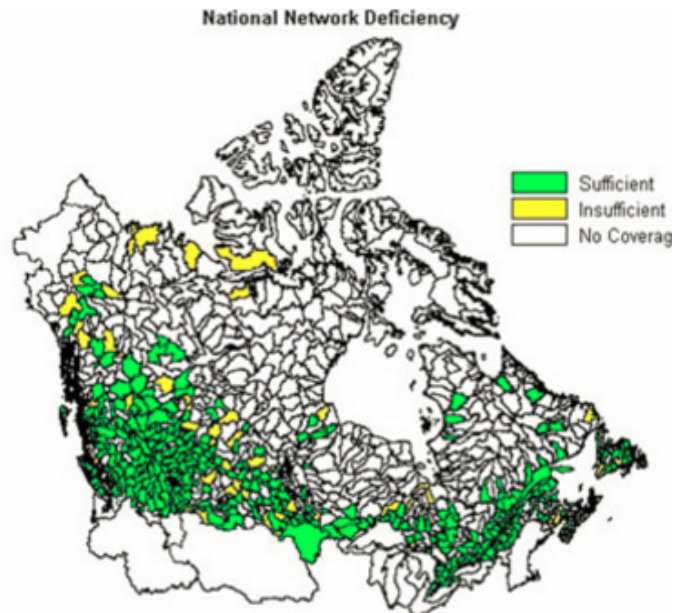


Figure 25. National Hydrometric Program deficiency

Environment and Climate Change Canada (2010)¹³

5.5.3 Summary

While some monitoring and reporting is carried out in the northern NCRB, significant improvements could still be made that could go far in increasing broader understanding and available information on the region. Key elements to consider include:

- Increasing coordination between entities collecting data
- Centralizing data and reporting, where logical
- Examining the role of government, industry and others in monitoring, compiling information and reporting
- Creating new data collection sites where existing data points are inadequate to accurately assess the watershed

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- Enhancing interpretation of data, including trends and issues, and making findings publicly available
- Incorporating traditional knowledge with other data
- Expanding cumulative assessments to include the entire watershed and all activities
- Considering social and economic data alongside environmental data to help guide the region towards sustainable development

There are a variety of examples that can help inform these improvements. For instance, the ICPDR in the Danube River Basin provides a commendable example of data coordination, sharing and centralization for effective planning. The FBC reports on social and economic considerations, in addition to environmental health ones, and also identifies trends (Fraser Basin Council, 2010). The Mackenzie Valley Environmental Impact Review Board has published *Guidelines for Incorporating Traditional Knowledge in Environmental Impact Assessment*, which provides information that is also useful outside of the EIA context (Mackenzie Valley Review Board, 2005). These examples, along with others, are likely to be informative in any future efforts to create more consistent and comprehensive monitoring and reporting in the northern NCRB.

5.6 Importance of Legislation

In several of the case studies discussed (e.g., Plan Nord), legislation played a significant role in incenting or implementing land and water management. However, there is some debate in the literature about the degree to which legislation is beneficial to watershed management, with some suggesting that minimal legislation is better (i.e., using it only to create a watershed entity) and others suggesting that legislation is important for enforcement and accountability purposes. This section describes the current role of legislation in the northern NCRB, as well as a spectrum of possibilities of how else it could be used—from fairly minimal involvement to more active use.

While the literature review identified legislation as potentially important in enabling the existence and creating the mandate and structure of a watershed entity, no such entity has been created in the northern NCRB. Section 3.2.3 includes a discussion on the potential for government agencies and other regional institutions to take the lead. It also discusses the possibility of collaborative watershed leadership including relevant interest groups, such as Indigenous communities and groups, governments, NGOs and industry groups. In the case of the creation of a new entity or the coming together of existing entities, the role of legislation in the creation of such an entity is heightened. The second role for legislation highlighted in the literature is in providing legal goals or mechanisms for overall watershed or regional management. Existing legislation is used to a significant extent in the region for water and environmental protection and management. Both the provincial and federal governments have a variety of regulations through which they are involved in the northern NCRB from an environmental perspective.

It is important to note that jurisdiction over water is shared between the federal and provincial levels of government. The Canadian Constitution gives the provincial governments control over non-renewable natural resources, forestry resources and electrical energy, and the federal government control over ocean and inland fisheries, as well as navigation and shipping (Government of Canada Justice Laws, 2016b). However, no such clear delineation exists for water in general. While additional responsibilities for the provinces generally include “water supply, pollution control ... authorization of water use and flow development” and the federal government for “water on federal lands [including reserves and national parks] and transboundary waters,” there are significant areas of overlap (Zubrycki et al., 2011, p. 17). As a result of this shared jurisdiction, both levels of government have legislation in active use in the northern NCRB.



Federally, some of the most relevant legislation includes:

- The Fisheries Act (under which regulations such as the Metal Mining Effluent Regulations, Manitoba Fishery Regulations, Wastewater Systems Effluent Regulations and Pulp and Paper Effluent Regulations are enabled)
- The Canadian Environmental Protection Act, 1999
- The Canadian Environmental Assessment Act
- The Canada Water Act, which “contains provisions for formal consultation and agreements with the provinces” (Environment and Climate Change Canada, 2016a)
- The Department of the Environment Act, which “assigns the national leadership for water management to the Minister of the Environment” (Environment and Climate Change Canada, 2016a)

Before the Navigable Waters Act was renamed the Navigation Protection Act in 2012 and altered to apply to fewer waterways, many rivers and lakes in the northern NCRB would have fallen under this legislation. As a result of federal constitutional responsibility for navigable waters, the federal government was responsible for protecting the public right to navigate on these waters, at times triggering environmental assessments (Zubrycki et al., 2011). However, under the new act, the only water in the northern NCRB that falls under this regulation is the Hudson Bay, which is actually outside the watershed (Government of Canada, 1985c). (The Fisheries Act and Canadian Environmental Assessment Act were also altered in 2012, but still have applicability in the region.)

5.6.1 Federal Legislation

While a more comprehensive review of the federal acts and their roles will inform an understanding of the role of legislation in achieving goals of ecosystem management in the northern NCRB, a few examples have been explored here. Environment and Climate Change Canada produced a *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations*, a document that explains which mines in Manitoba are subject to the regulations and how they performed, including information on effluent compliance. For instance, Bucko Lake Mine near Wabowden is identified as one of a few “problematic facilities” in the country, chronically exceeding total suspended solids in its effluents. The report notes that: “Enforcement actions are being taken and appropriate remediation measures are being examined/implemented in order to fix the problems” (Environment and Climate Change Canada, 2014, p. 3).

The Canadian Environmental Assessment Act has also been applied to projects of different sizes, including the Keeyask Generation Project (which was approved with conditions) (Canadian Environmental Assessment Agency, 2014), the Lalor Concentrator Project in Snow Lake (it was determined an assessment was not required) (Canadian Environmental Assessment Agency, 2013) and, on a smaller scale, a proposal by the Town of Churchill to convert an existing building into a waste transfer and storage station (the project was allowed with monitoring for and mitigation of environmental effects) (Canadian Environmental Assessment Agency, 2012).

Federal legislation, such as the Canadian Wildlife Act, Migratory Bird Convention Act and Species at Risk Act, also relates to species in the region. Lake sturgeon (*Acipenser fulvescens*), caribou (*Rangifer tarandus*) and polar bear (*Ursus maritimus*) are listed as endangered, threatened or special concern under the Species at Risk Act (Species at Risk Public Registry, 2016).



5.6.2 Provincial Legislation

The Province of Manitoba also has significant powers and responsibilities in the northern NCRB. In 1930, the federal government transferred control over natural resources to the province through the Manitoba Natural Resources Transfer Act. As a result, it has many regulations related to land and water management, many of which are the responsibility of the Manitoba Sustainable Development department. Key acts currently involved in management in the northern NCRB:

- The Forest Act, under which Tolko has its Forest Management License
- The Water Power Act, under which hydroelectric developments are licensed
- The Sustainable Development Act
- Drinking Water Safety Act, which sets requirements for drinking water systems within provincial jurisdiction
- The Contaminated Sites Remediation Act, through which numerous sites in the watershed have been designated as impacted (Government of Manitoba, 2016c)
- The Provincial Parks Act, which has been used to create numerous parks in the northern NCRB and which sets restrictions on development and extraction activities in the park areas (Government of Manitoba, 2016h)
- The Water Protection Act

Many other Manitoba Sustainable Development acts are relevant in the northern NCRB, as are acts from other provincial departments. While the Department of Indigenous and Municipal Relations does not have direct power or responsibility over natural resources or water, it is highly engaged with service delivery and activities in the north through the Northern Affairs Act and portions of the Planning Act. Relevant responsibilities included in the Northern Affairs Act, some of which are shared with other departments, include drains and drainage (relevant to water flows), economic development (relevant to how land is used), strategic planning and some aspects of roads and transportation (Government of Manitoba, 2016g).

Other departments with relevant legislative abilities include the municipal functions of the Department of Indigenous and Municipal Relations (e.g., the Planning Act, the Manitoba Water Services Board Act), Growth, Enterprise and Trade (e.g., the Mines and Minerals Act, the Surface Rights Act), Manitoba Infrastructure (e.g., some aspects of the Water Power Act, the Highways and the Transportation Act (including winter roads) and some elements of The Water Rights Act.

5.6.3 Discussion

The above section suggests that there is existing legislation that could be used in the northern NCRB to manage resources, guide development towards sustainability and protect the environment. However, as some of the sources used in the literature review noted, environmental protection legislation does little if it is not enforced. As legislation is focused more on watershed goals, enforcement will need to be considered in the achievement of watershed objectives. In addition, the literature review indicated that incentive-based approaches are viewed by some as potentially more effective than regulations in watershed management and protection; this paper as a whole explores both options as valid.



Proponents for the use of environmental legislation point to the fact that it can provide the means to address problems. For instance, as noted in Section 3.2.6, the Canada Water Act and CEPA 1999 give power and responsibility to the federal government to collect and communicate environmental monitoring data. Therefore, the federal government has a directive to conduct monitoring and the opportunity to correct gaps in Canada’s monitoring system; a large portion of the northern NCRB has insufficient water quality and quantity data available. Given that the federal government is also responsible for water on federal lands (e.g., Indigenous reserves) in the northern NCRB, it can use legislation to meet and even surpass legislated requirements for wastewater treatment, drinking water treatment, monitoring and overall water management.

Since the northern NCRB is interprovincial (and international in its entirety), legislation further indicates the federal government has a role to play. The Department of the Environment Act and Canada Water Act both provide space for the federal government to offer some leadership and encourage collaboration. Additionally, the Canadian Constitution can be applied in interprovincial matters in relation to the federal government’s role in Peace, Order and Good Governance. For instance, a 1975 Supreme Court of Canada case, *Interprovincial Co-Operatives v. Manitoba*, considered a situation in which chlor-alkali plants in Ontario and Saskatchewan released mercury into interprovincial waters that flowed into Manitoba. Three out of seven justices said that the issue fell under the Peace, Order and Good Governance provision of the Constitution due to its interprovincial nature (Bailey, 2008).

Provincially, the Water Protection Act is highly relevant, recognizing “the importance of comprehensive planning for watersheds, with respect to water, land and ecosystems, on a basis that acknowledges and considers their interdependence.” Among other things, this act allows for the creation of watershed management plan (and sets out its content); enables the creation of “water quality standards, objectives or guidelines”; enables the creation of “water quality management zones”; and bans the sale of products containing phosphorus (with some exemptions) (Government of Manitoba, 2015f).

Through its section on watershed management plans, the Water Protection Act provides one potential way to create watershed-level entities in the northern NCRB, a role for legislation that the literature review identified as valuable. Manitoba also has this ability through the Conservation Districts Act, which enables the province to create conservation districts. There are 18 conservation districts in the province, but most are in southern Manitoba; none exist in the northern NCRB, and the nearest is the Kelsey Conservation District near The Pas.

The literature also discussed larger basin organizations created by legislation. Examples include the Mackenzie Valley Land and Water Board, Columbia Basin Trust and Murray-Darling Basin Authority. In addition to formally creating a watershed organization, legislation can define its structure (e.g., composition of board) and mandate, and provide some level of protection for the organization.

The option of creating conservation districts, which generally exist at a smaller watershed level, and a larger basin-wide scale, warrant consideration; as discussed in Section 3.2.2, having planning at multiple scales is valuable. Legislation could provide useful means to formally link scales.

The province is also responsible for water use, diversion and impoundment through the Water Rights Act, legislation that is potentially powerful for watershed management. Of particular interest is that this act gives the government the power to consider the protection and maintenance of aquatic ecosystems when deciding on an application for water use. The act allows the minister to refuse a license if groundwater



levels or water body levels on instream flows would be altered so as to negatively affect the aquatic ecosystem. The consideration of aquatic life when considering license approval is positive, though how this is applied in practice should be considered; this review does not analyze how strictly the protection of aquatic ecosystems is considered. Other jurisdictions have gone further in protecting ecosystem water rights; for instance, the State of Oregon created an Instream Water Rights Act to increase protection of waterways and their ecosystems.

Finally, an alternative to legislation warrants mention, given evidence in the literature review that some parties prefer voluntary initiatives. Non-binding guidelines supporting a more voluntary approach also exist at the federal and provincial levels. There are also numerous guidelines and other policies that, while not binding, are highly relevant to watershed management. These include the Canadian Water Quality Guidelines; Federal Water Policy (1987); Guidelines for Canadian Drinking Water Quality; Guidelines for Canadian Recreational Water Quality; Water Quality Guidelines for the Protection of Aquatic Life; Canadian Sediment Quality Guidelines for the Protection of Aquatic Life; Manitoba’s Water Quality Standards, Objectives and Guidelines; Principles and Guidelines of Sustainable Development; and Forest Management Guidelines for Riparian Management Areas

5.6.4 Summary

In summary, legislation already has a significant role in the northern NCRB, with voluntary guidelines providing additional direction. This research has not assessed whether or not existing legislation is currently adequately applied in the watershed. However, this review did establish that substantial legislation already exists at both the federal and provincial levels. While there may be opportunities to create new regulations to enhance governments’ abilities to improve watershed management, and existing regulations may well benefit from modifications, a fairly strong legislative foundation already exists to protect and enhance the northern NCRB.

5.7 Consistent and Long-Term Funding Sources

Lack of dependable and sufficient financing is a critical hindrance to effective watershed management that is commonly identified in the literature. In order to address this widespread challenge, innovative approaches have been developed in recent years in watersheds around the world to support both planning and implementation. While some focus on traditional funding approaches, such as support from government, others introduce options such as market-based approaches, linking user fees to watershed funding and developing trusts from revenues obtained by development. Some of these approaches can be found in the northern NCRB, though they are not currently applied at a watershed scale. Other approaches also have potential, as will be discussed in the analysis section.

5.7.1 Government Funding

The federal and provincial governments still provide a significant amount of land and water management-related funding in the region. Examples of government funding include:

- Water and wastewater treatment and management on reserves, solid waste disposal, other services (Indigenous and Northern Affairs Canada, with some involvement from and Health Canada in relation to water) (Indigenous and Northern Affairs Canada, 2014)
- Water and wastewater treatment outside of reserves, solid waste disposal, other services (Indigenous and Municipal Relations; Manitoba Sustainable Development; Infrastructure Canada through cost sharing) (Indigenous and Municipal Relations, 2015; Government of Canada, 2015)



- Fire services and suppression (Indigenous and Northern Affairs Canada; Manitoba Infrastructure)
- Northern Fishermen’s Freight Assistance Programs (Manitoba Sustainable Development)
- Flood and other disaster response (Indigenous and Northern Affairs Canada; support from Manitoba Infrastructure; Emergency Measures Organization)
- Northern highways, winter roads, marine/ferry services, other infrastructure (Manitoba Infrastructure and Transportation)
- Water monitoring (Environment and Climate Change Canada; Manitoba Sustainable Development)
- Conservation programming—e.g., the Caribou Recovery Strategy, forest renewal (Manitoba Sustainable Development)
- Orphaned and abandoned mine rehabilitation (Manitoba Mineral Resources, part of the Department of Growth, Enterprise and Trade)
- Enforcement of environmental regulation (Manitoba Sustainable Development; Environment and Climate Change Canada)
- Tourism development funding (Growth, Enterprise and Trade)

Local governments also frequently fund programs related to land and water management. For instance, the Town of Gillam (2008) spent CAD 367,200 on water supply and sewage disposal in its most recently available annual report; it appears to have received a similar amount in utility revenues from residential and commercial consumers.

In addition to this standard utility fee approach, the literature review identified that governments may also create innovative funding mechanisms for water and land management, such as licensing fees, permitting fees, water and resource user fees, recreation fees, taxation, resource royalties and pollution permits. One example of this approach is from a Manitoba Sustainable Development fee created in 2014, charged to angling, hunting and trapping licenses to create a Fish and Wildlife Enhancement Fund. Ten dollars from every angling license and CAD 5 from every hunting and fishing license goes towards this fund and is used for habitat rehabilitation, enhancement, monitoring and research (Manitoba Sustainable Development, n.d.a). While other fees, taxes and licenses were apparent in the traditional sense (e.g., local taxes are collected; polar bear tour operators in Churchill hold permits, though their cost could not be determined; user fees are charged at provincial parks), there was little other evidence of these funds being used for watershed management, or of innovative design to encourage beneficial actions.

5.7.2 Other Funding

Water and land management activities are also enabled and funded by Manitoba Hydro. For instance, it manages the Coordinated Aquatic Monitoring Program with the Province of Manitoba to collect long-term data in hydro-affected areas (see Section 3.2.6). Mitigation measures for effects from hydro projects have also been financed, such as the construction of the Cross Lake Weir (see Section 2.6). While some of these earlier activities were focused on mitigation, more recent activities have increasingly focused on programming, planning and engagement with local people. For example, Manitoba Hydro partnerships with Indigenous communities on projects such as the Wuskwatim represent non-traditional financing, and are presented below.

Funding for some resource, land and water activities by Indigenous communities comes from Northern Flood Implementation Agreements negotiated between communities, the Government of Canada, the



Government of Manitoba and Manitoba Hydro, as compensation for adverse effects from hydroelectric developments. Many of these funds are held in trusts, a long-term funding approach identified in the literature review as beneficial. For instance, NCN created the Nisichawayasihk Trust in 1996 and has used funds for a range of land and water-related initiatives such as a resource and land-use planning program (CAD 10,985,610 since 1996), a water treatment plant (CAD 1.5 million) and ecotourism development (CAD 300,000) (Nisichawayasihk Trust Office, 2015).

More recently, NCN set up a new trust, the Taskinigahp Trust, with revenues from the Wuskwatim project. As described in Section 3.2.5, NCN entered an equity partnership with Manitoba Hydro in which it obtains various benefits, including profits, from the hydroelectric development. The Taskinigahp Trust operates in a similar way as the Nisichawayasihk Trust (Nisichawayasihk Cree Nation, n.d.a).

Section 3.2.5 also presents another innovative funding approach: the sharing of mining taxes with Indigenous communities. While there is no indication of where this funding might go—for instance, whether or not some might be used for water and land management—we present it as an example of the type of funding that could benefit aspects of watershed management.

An unusual water treatment funding approach exists in the City of Thompson where, in 1956, the mining company Vale (then INCO) was required to construct the Thompson Water Treatment Plant and has since provided residents with potable water free of charge (Government of Manitoba, 2012). Vale uses roughly one third of the water treated, while Thompson uses two thirds (Barker, 2014; City of Thompson, n.d.). This arrangement will soon end, however; Vale is closing its smelting and refining operations in 2018 and, as such, is transferring ownership to the city (Barker, 2014).

5.7.3 Discussion

While there is no watershed-specific funding in the northern NCRB, the above review illustrates that there is a patchwork of financing that contributes to water and land management. Many funds support the best-known water and wastewater management activities and come from different levels of government. However, some examples represent more innovative thinking.

One critical aspect of funding in support of watershed management is secure, long-term funding commitments. Trusts created by Indigenous communities are one example of how funding can be translated into long-term, consistent funding. NCN uses profits from Nisichawayasihk and Taskinigahp Trust investments to fund a range of programming, including several initiatives that benefit waterways and resource management. The literature review presented the examples of the Columbia Basin Trust, Northern Development Initiative Trust and Norway's GPF to illustrate how resource revenues can be used for long-term benefits. Similarly, equity partnerships with Manitoba Hydro, in which revenues are shared with Indigenous communities (and sometimes placed in trusts), can be considered innovative approaches with potential for water and land benefits.

The financing by Vale (formerly INCO) of water treatment in Thompson also offered an example of a private-public partnership to meet multiple needs. While funding by industry of such services was not identified in the literature review, it is an unusual example of industry investing in local water provision while also providing water for its own operations.

Several innovative funding options identified in the literature review are not yet apparent in the northern NCRB. The literature review identified payments for ecosystem services as one progressive approach to watershed management. For instance, one revenue source could be carbon storage in the region (e.g.,



in boreal forest, wetlands, permafrost). Since these ecosystems are carbon sinks (i.e., they store carbon), carbon offset payments could be possible where emissions are reduced or avoided.

In addition, funding could be generated for watershed management through innovative use of licensing, fees and taxation. While it would not be desirable to create undue burden on citizens, companies or industry, local governments or potentially a future watershed organization could raise funds from such mechanisms. Precedents elsewhere include the Okanagan Basin Water Board raising significant funds through levies on regional districts, conservation authorities raising funds in Ontario through recreation user fees and France implementing a user-pay approach to water. Given that natural resources (e.g., minerals, forestry, wildlife for ecotourism) are drivers of development in the northern NCRB, new options could be explored to create revenues for water programming. For instance, modest user fees could be created for wildlife tourism, with those funds directed to conservation.

One existing approach for conservation funding is already available through the non-profit Wildlife Habitat Canada, one of the key objectives of which is to “provide a funding mechanism for wildlife habitat conservation programs in Canada” (Wildlife Habitat Canada, n.d.b). The organization holds an annual art competition for the design of a Canadian Wildlife Habitat Conservation stamp, which is used to validate Migratory Game Bird Hunting Permits from Environment and Climate Change Canada. Revenues from the stamp, as well as associated products (e.g., art prints), fund habitat conservation projects across Canada, with CAD 50 million having been distributed since 1985. None of the conservation projects listed in available records (2009–2015) occurred in the northern NCRB (Wildlife Habitat Canada, n.d.a), but there would be potential for the program to fund projects in northern Manitoba in the future.

In southern Manitoba, funding for watershed planning and implementation by conservation districts is provided primarily by the provincial government (CAD 5,162,400 in 2013/14), municipalities (CAD 1,720,800, collected through tax levies) and other sources (e.g., NGOs, industry, other government programs; CAD 2,977,000) (Government of Manitoba, 2014). In accordance with the Conservation Districts Act, participating municipalities provide CAD 1 for every CAD 3 of provincial grant funding (Government of Manitoba, 2016f). As noted elsewhere in this paper, the conservation district approach could be useful in the northern NCRB. However, one limitation might be that the act specifies that, in order for a district to be created, municipalities apply in writing to the minister for its establishment (Government of Manitoba, 2016f). Given that there are far fewer municipalities in the northern region than in southern Manitoba, and large tracts of the watershed and its sub-watersheds are not part of any municipality (see Figure 26), this approach may not apply in all areas.

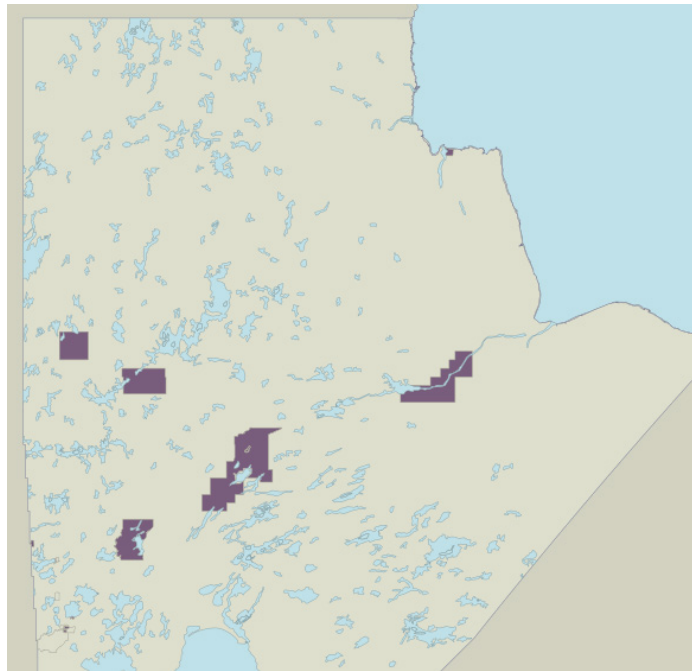


Figure 25. Municipalities in northern Manitoba Source: Association of Manitoba Municipalities

Source: Association of Manitoba Municipalities (2014)

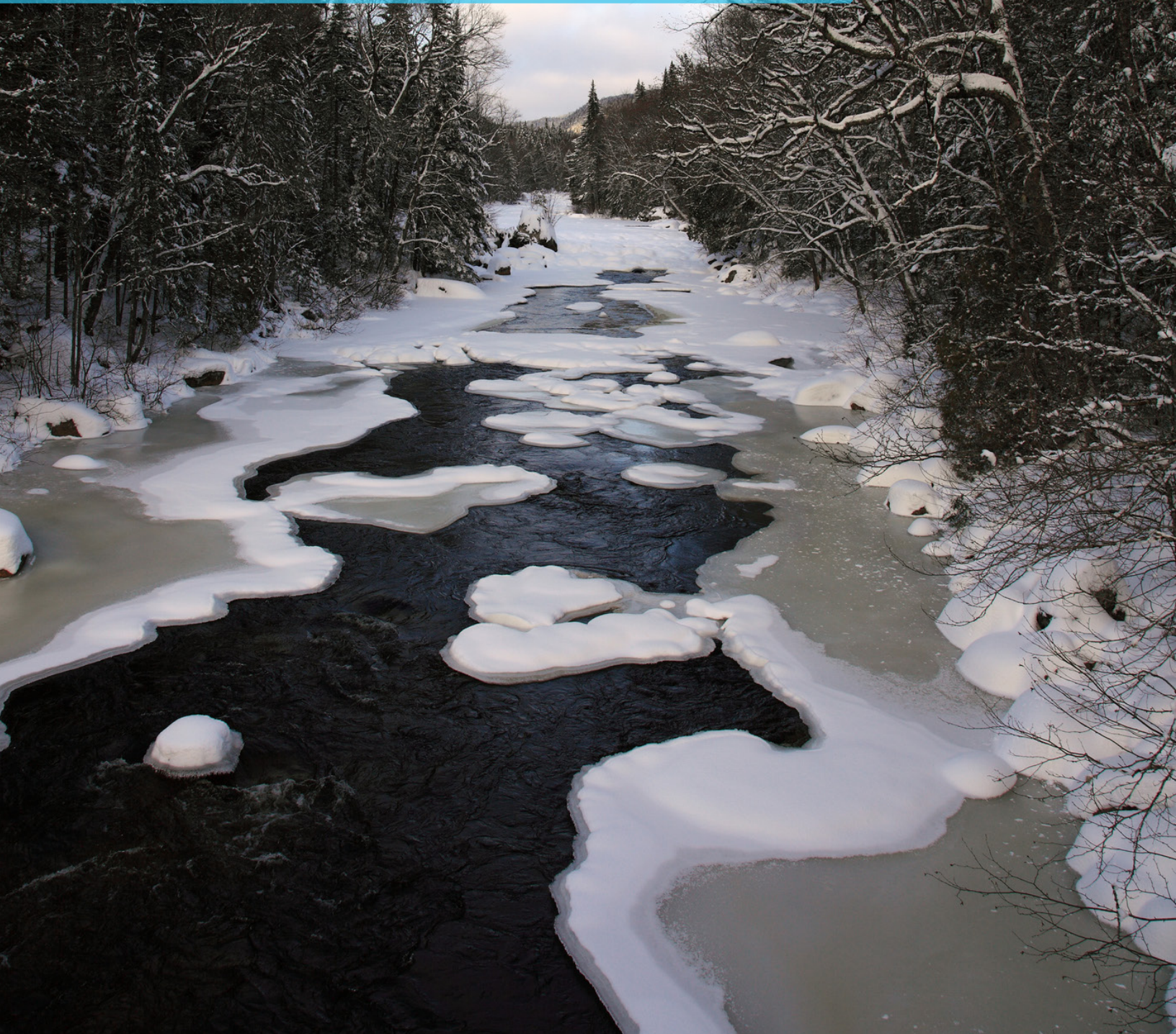


5.7.4 Summary

It was apparent in the literature review that few watersheds have consistent, long-term funding sources, and that many also struggle to have sufficient funding to carry out implementation of their management plans. While there is no funding currently dedicated to whole-watershed planning and management in the northern NCRB, existing water and land management-related funding may still provide a foundation for scaled-up activities. Based on our review of other watersheds, we would recommend, where practicable, gaining increased understanding of existing funding in the watershed and integrating it into a framework to better understand where existing funding exists and if optimization could occur. In addition, new funding should be sought to initiate watershed planning, followed by implementation. Given that both the provincial and federal governments have significant legislated obligations in northern Manitoba, some responsibility for funding may fall to them, but there is also potential for more innovative funding mechanisms. The already existing use of trusts could be expanded to further fund watershed and conservation work. Given the high amount of natural resource development and use in the region (e.g., forestry, mining, hydro, ecotourism etc.), new approaches could be found to fund ecosystem management that would help maintain resource development through fees on users (e.g., hydroelectricity consumers, tourists) and/or other forms of payments for ecosystem services. Doing so in a strategic manner could help keep the watershed healthy and support continued availability of these natural resources for future generations.



6.0 Conclusions and Recommendations





6.0 Conclusions and Recommendations

The MA (2005) highlighted the value of benefits that we receive from ecosystems (ecosystem services). It also noted that provision of adequate supplies of fresh water is one of the key services that ecosystems provide to humanity. While the availability of water for human uses depends in part on the proper functioning of ecosystems, water is also essential for the proper functioning of ecosystems in the first place. In fact, the MA reported that 15 of 24 identified services provided by ecosystems to humanity, particularly those related to fresh water, are in global decline (Perry et al., 2012).

Whether reflected in markets, as commodities, or understood as being valued culturally, these benefits highlight why natural systems such as watershed ecosystems need active management and what we stand to lose if we do not consider these services in relation to each other. Watershed ecosystems commonly provide us with provisioning services such as fresh water, food, fuel, building materials and biochemicals; regulating services such as climate regulation, hydrologic flow regulation, erosion control and pollination; cultural services such as recreational, spiritual and educational opportunities; and supporting services such as soil formation and nutrient cycling (MA, 2005). These in turn are the basis for human well-being, including good health, livelihood opportunities and spiritual connections.

The NCRB in its entirety is the third largest basin in North America and drains more than 1.4 million km² of land. This transboundary basin supports millions of livelihoods and lives, is the source of food and drinking water for millions of people, and provides billions of dollars worth of economic development. It is also habitat to a rich biodiversity including fish, waterfowl and signature mammals such as caribou and polar bears.

This research provides information and makes a strong case for strategic management in the NCRB, with an initial examination of the portion in northern Manitoba (the “northern NCRB”). This is partly due to the complexity of policies and governance in this vast, transboundary system, and partly due to the fact that we hope to leverage some of the attention that the Lake Winnipeg basin has gotten in the past few decades as a watershed requiring management. This point is further supported by comments made by the Manitoba Clean Environment Commission (2015): “although there are many programs and bodies focusing on Lake Winnipeg, they pay little consideration of water issues further downstream along the Nelson River. The commission believes that the Manitoba government, in consultation and cooperation with jurisdictions within the Lake Winnipeg watershed, should set specific and practical goals for Lake Winnipeg and the Nelson River ... The federal government should take a greater role in cross-border coordination” (p. 19).

Finally, the vast array of ecosystem services in this northern region is significantly different from those in the southern parts of the basin, for example, involving more mining, hydroelectricity development, forestry, traditional uses and subsistence-based food. A first attempt at understanding and managing these ecosystem services can in turn be used to inform management efforts in the remainder of the basin, focusing then on a transboundary approach.

The Lake Friendly Accord and Stewards Alliance have been established in recent years for Lake Winnipeg management (Government of Manitoba, 2015c), encompassing almost 1 million km² of the NCRB’s 1.4 million km². These initiatives provide momentum and insight for strategic management in the NCRB. The accord provides a political mechanism to bring together parties from jurisdictions outside of Manitoba. In addition, the Stewards Alliance has created a *Priorities for Action* document (Lake



Friendly, 2015) that calls for a water-quality based goal of a 50 per cent reduction in phosphorus to Lake Winnipeg from different sources. The remainder of the document provides elements of an action plan, focusing on specific sectors and areas to achieve this goal and other necessary co-benefits. Finally, the multiple parties reflected in the Lake Friendly Stewards Alliance represent the collaborative, multi-party process that is critical for good watershed management.

Similar elements of ecosystem-based governance were identified in our research using a review of literature conducting, in many cases, meta-analyses across basins. These principles emphasize the need for strong leadership and capacity; a clear basin plan with specific goals; consistent and long-term resourcing; a role for legislation in establishing basin-wide planning and the use of regulatory instruments for appropriate goals; strong monitoring and reporting systems; multi-party approaches to ensure that different perspectives are included; and, specifically important in this region, a need for shared decision making with Indigenous communities. A study of these principles in the context of the northern NCRB leads us to make the following recommendations.

Another reason for embarking on northern NCRB management in the present time is the current political climate. The Government of Canada (2016) budget emphasizes Indigenous communities, including their water infrastructure. References to improving the socioeconomic conditions of Indigenous Peoples relate broadly to good ecosystem management and the provision of services including, but not limited to, drinking water, waste management, community infrastructure and economic development. We assert that sustainable development in northern communities is linked closely with ecosystem management to ensure that the foundational natural systems that provide many of the benefits that we need are maintained in the long term.

6.1 Recommendations

The need and logic for integrated management based on understanding of ecosystems has been clearly articulated for decades, but a key challenge identified is the weak institutional and financial capacity for its implementation. The MA (2005) highlighted ecosystem services as a way to understand and assign an economic value to the tangible benefits from ecosystems and promoted their valuation and the use of markets and other policy instruments as ways to finance their management. Based on this, we provide the following specific recommendations.

Recommendation #1: Prioritize a Northern NCRB Initiative

The first and somewhat obvious recommendation we make is that the northern NCRB needs our attention due to a variety of factors. In order to ensure that development in the northern portion of Manitoba is sustainable and that decision making is informed by integrated thinking and long-term objectives, a basin-planning effort will go a long way. Clearly this needs to be prioritized at political, policy and operational levels to ensure that social, environmental and economic objectives for the region are understood and managed. While in many cases such planning efforts are the result of a crisis (e.g., in Lake Winnipeg, the algal blooms are driving a basin initiative), we recommend that we avoid crises by acting now.

A starting point for northern NCRB planning could be the 1999 COSDI report, which embraced basin-level planning along with other principles identified in this report (multi-party initiatives, transparency and reporting, inclusion of Indigenous Peoples, adequate resourcing). While the document is 17 years



old, the value of large-area planning has not diminished. The current provincial government could work in partnership with other parties to help guide its implementation, particularly in northern Manitoba where large area planning is lacking.

Recommendation #2: Identify, Quantify and Prioritize Ecosystem Services in the Northern NCRB, Ideally through a Combination of Analytical and Multi-party Approaches

Basins around the world are increasingly being managed for specific ecosystem services, such as biodiversity, flood control, nutrient capture, carbon sequestration, agricultural sustainability, and cultural and spiritual values. Based on a previous review of global, transboundary basins (Roy et al., 2011), we recommend that ecosystem services help communicate and prioritize key aspects of watershed management. The northern NCRB possesses a richness of ecosystem services, some of which are already being managed to some degree (e.g., hydroelectricity; wildlife to support ecotourism; efforts to protect important cultural and spiritual sites). However, these ecosystem services have not been systematically identified, quantified and analyzed. Such an approach has proven useful in other geographies to enhance understanding of the full benefits of a watershed ecosystem, and also to consciously manage it to prioritize some, preserve others, and generally ensure appropriate balance and recognition of trade-offs.

Providing economic values to these watershed ecosystem services would also help in their communication and would add further appreciation. Some services in the basin already have an economic value attached to them (e.g., domestic and export value of minerals or forestry products, some recreational activities, hydroelectricity production). Others, such as biodiversity and climate regulation, are not currently represented in the economy, but nonetheless have value; without them, there would be economic consequences. Methods exist to calculate the monetary value of such services (e.g., Costanza et al., 1997; Voora & Venema, 2008).

In order to identify and appropriately understand the ecosystem services in the basin, we recommend that a multi-party process be used. The following recommendation is for the creation of a multi-party body to help guide basin management; it is quite possible this entity could participate in ecosystem service assessments.

Recommendation #3: Form a Multi-party, Basin-Level Organization to Consider Northern NCRB Management and Fund it and its Activities Adequately and Consistently. Include Shared Decision Making with Indigenous Peoples.

With parties and decision making in the basin fragmented by jurisdiction and geography, one essential step towards large-basin management would involve the creation of a multi-party body at the basin scale. Such an entity could take many forms, such as being non-governmental, spearheaded by one government or established as a multi-lateral organization. Any structure would have potential to function well provided it has or is provided with the mandate, resources and relationships to lead the initiative.

Initially, such an organization could be formed in Manitoba, but a mid-term goal should be to involve other interests in the NCRB, including those in the Saskatchewan and Alberta portions of the Churchill River basin, as well as those upstream of Jenpeg (i.e., the full Nelson River basin, as well as the connected Churchill River Basin).

An important feature of a basin organization would be significant inclusion of Indigenous Peoples, including a decision-making role in planning, co-management, benefit sharing and Indigenous ownership/operation of companies/infrastructure.



Recommendation #4: Access Traditional and Innovative Sources for Adequate Funding for a Northern NCRB Initiative

One of the biggest barriers to watershed management success identified in the extant literature is a lack of adequate and consistent funding. As such, one of our primary recommendations is that any initiative for large-basin planning in the northern NCRB needs to be adequately funded. We believe that using the ecosystem services framework allows us to access markets and non-traditional sources of funding for watershed management. This could include revenue-sharing agreements, carbon markets for preserving forest and wetland-based carbon sinks, and even create locally appropriate ecosystem services-based markets, such as for water quality. Such resourcing must finance not only the creation of a plan, but also its implementation, monitoring and revision of the plan for periodic updating and improvement.

We recommend that diverse funding sources be sought (see Section 5.7), but emphasize that several of the options this report identifies have strong potential to be stable, long-term sources; trusts, revenue sharing, funding protected by legislation and innovative use of local taxation/levies and user fees all have such potential.

Recommendation #5: Use Existing Entities and Processes to Build Basin-Level Thinking, Operating at Multiple Scales

In a northern NCRB initiative, we believe while to some degree government could take a leadership role, a viable alternative could also be leadership provided by a multi-party steering committee, building on current institutional roles and programming. Potential representatives on this steering group could include people from the RMBs in northern Manitoba, the former Thompson Economic Diversification Working Group (which took a broad regional approach) and various Manitoba Hydro activities, such as its recent regional cumulative effects assessment. In addition, processes such as a recently announced task force on Manitoba's Northern Economic Development Strategy the Government of Canada's support of new relationships with and improved socioeconomic conditions for the country's Indigenous people have potential to contribute to basin-level thinking.

In terms of existing processes, a variety of policies, legislation and programs exist at the federal, provincial, municipal levels (these are listed in Appendices 1 and 2). While many complement each other, in the context of basin planning, a closer look at the specific roles, redundancies and gaps in policy mechanisms will be a useful early step in the process. For instance, the role of regulations under the Canadian Environmental Assessment Act and the Manitoba Environment Act show how these complement each other in the context of basin planning. It is also important to understand the role of water power licensing under the Manitoba Water Power Act to ensure that licensing or relicensing of new and existing hydroelectric power stations and facilities are conducted systematically and against some broadly agreed-upon regional goals and priorities.

Recommendation #6: Enhance Monitoring, Data Sharing and Reporting

For a northern NCRB planning and management initiative to be effective, environmental and socioeconomic knowledge of the basin are necessary. Without sufficient data on environmental, social and economic considerations—including of baseline conditions—management targets and goals (important parts of basin plans) cannot be created. Fortunately, a significant amount of monitoring and data collection is already carried out in the basin by various entities. In order to support northern NCRB management, additional steps could include:



- Connecting monitoring and data collection to clear, basin-level questions and objectives.
- Sharing and centralizing existing environmental data (centralization likely to be carried out by basin-level organization identified in recommendation #3).
- Ensuring consistency in data collected.
- Identifying data gaps, and setting up mechanisms to begin collecting data on topics and in geographies that are missing.
- Incorporating traditional knowledge.
- Sharing and centralizing socioeconomic data, and identifying data gaps etc. (as described above for environmental data).
- Identifying and publicly sharing baseline conditions for the basin and watersheds within it.
- Eventually producing state-of-the-basin reports, as well as other communication products.
- Looking at citizen science/community-based monitoring, including a role for Indigenous communities in monitoring.

6.2 Next Steps

In order to implement many of the recommendations we have made, clarifying objectives, building broad-based support and establishing leadership are critical. IISD’s research on the northern NCRB will continue to clarify and reinforce the urgency and need for these and provide analysis on specific components of our vision for a northern NCRB initiative. Having articulated a strong case for ecosystem management in the region, some potential next steps for our research will include:

- Analyses of specific ecosystem goods and services in northern Manitoba based on land use and land cover, and with inputs from relevant interests.
- Initial discussions with key government and non-governmental entities to make the case for basin management and build towards a multi-party process.
- Development of key indicators of well-being for the northern Manitoba part of the basin as a way to articulate some regional priorities.
- Detailed policy analyses to clarify what mechanisms exist and how these could play a role in ecosystem management.



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Appendix 1. Communities and Relevant Interests in the Northern NCRB

Northern Affairs Communities
Nelson House; Nelson House First Nation; Pikwitonei; Wabowden; Ilford; Thicket Portage; Herb Lake Landing; Norway House; Cross Lake (Incorporated Community)
Indigenous Communities and Corresponding Reserves in the Basin
Nisichawayasihk Cree Nation
Reserves: Kapawasihk; Mile 20 Second Revision Indian Reserve; Monahawuhkan; Nelson House 170; Nelson House 170a; Nelson House 170b; Nelson House 170c; Numaykoos Sakaheykun; Odei River Indian Reserve; Opekanowi Sakaheykun; Opekunosakakanihk; Suwannee Lake Indian Reserve; Suwannee Lake Indian Reserve 09924; Wapasihk; Wapikunoo Bay Indian Reserve; Wapisu Lake Indian Reserve; Wuskwi Sakaheykun; Wuskwi Sipi
Tataskweyak Cree Nation (TCN): Split Lake 171; Split Lake 171a; Split Lake 171b
York Factory First Nation: York Landing
Fox Lake Cree Nation: A Kwis Ki Mahka Indian Reserve; Fox Lake East 2; Fox Lake West 3
War Lake: Mooseocoot; Mooseocoot No. 2; Mooseocoot No. 3
Norway House Cree Nation: Norway House 17; Norway House 17A; Norway House 17B; Norway House 17D-2; Norway House 17D-3; Norway House 17D-6; Norway House 17D-7; Norway House 17D-8; Norway House 17 Ponask Lake; Anderson; Winnipegosis Indian Reserve
O-Pipon-Na-Piwin Cree Nation: O-Pipon-Na-Piwin Cree Nation 1
Marcel Colomb First Nation: Black Sturgeon
Barren Lands: Brochet Indian Reserve No. 197
Mathias Colomb Reserves: Highrock 199; Kamihkowapihskak Pawistik Indian Reserve; Kimosominahk Indian Reserve; Mistiategameek Sipi Indian Reserve; Moosowhapihsk Sakahegan Indian Reserve; Napahkapihskow Sakhahigan Indian Reserve; Nihkik Ohnikapihs Indian Reserve; Ohpahahpiskow Sakahegan Indian Reserve; Pachapesihk Wasahow Indian Reserve; Pukatawagan 198; Sisipuk Sakahegan (A) Indian Reserve; Sisipuk Sakahegan (B) Indian Reserve; Sisipuk Sakahegan (C) Indian Reserve; Wepuskow Ohnikahp Indian Reserve
Northlands Reserves: Lac Brochet 197a; Sheth Chok Indian Reserve; Thuycholeeni Az ᑭᑦ Indian Reserve; Thuycholeeni Indian Reserve; Tthekeal ᑭᑦ Nu Indian Reserve
Cross Lake Reserves: Cross Lake 19; Cross Lake 19A; Cross Lake 19B; Cross Lake 19C; Cross Lake 19D; Cross Lake 19E; Cross Lake 19X05; Cross Lake 19X06; Cross Lake 19A; Cross Lake 19A; Whiskeyjack
Pimicikamak
Municipalities
Churchill; Mystery Lake, LGD; Thompson; Flin Flon; Leaf Rapids; Snow Lake; Gillam; Lynn Lake; The Pas
Tribal Councils
Keewatin Tribal Council; Swampy Cree Tribal Council
Indigenous Organizations and Responsibilities
Nisichawayasihk Trust and The Taskinighap Trust: <ul style="list-style-type: none"> • Resource Management Program • Commercial Fisherman Program / Nelson House Fisherman's Association • Nelson House Trappers Association • Country Foods Program • Claims Program (NFA-related)
Nelson House Fisherman's Association (NHFA): <ul style="list-style-type: none"> • Start-up program • Canadian Economic Development Fund (CEDF)



Nelson House Trappers Association – (within Nisichawayasihk Trust):
<ul style="list-style-type: none"> • Fur subsidy • Snowmobile Program • Start-up program • Trap line Trail Cutting Program
The Ketetowenow Trust
Northern Association of Community Councils
South Indian Lake Fisherman’s Association
Manitoba Keewatinowi Okimakanak (MKO)
Treaty Relations Commission of Manitoba
National Aboriginal Lands Managers Association (NALMA)
Manitoba Uske (Lands): Includes members from Norway House, NCN, Cross Lake, O–Pipon–Na–Piwin Cree Nation.
Other organizations include: Assembly of Manitoba Chiefs; Assembly of First Nations; First Peoples Development; Manitoba Metis Federation Inc.
Resource Management Boards
Nine total: Split Lake (Tataskweyak Cree Nation); Nelson House (Nisichawayasihk Cree Nation); York Factory (York Factory First Nation); Norway House (Norway House Cree Nation); Cormorant Community; Cedar Lake (Chemawawin First Nation and Easterville Community); Fox Lake (Fox Lake Cree Nation); Moose Lake (Mosakahiken Cree Nation and Moose Lake Community); and Cross Lake Community.
Industry, Businesses, Partnerships, etc.
Vale
Hudbay
Manitoba Hydro
Tolko
Freshwater Fish Marketing Corporation
Wuskwatim Power Limited Partnership
Taskinigahp Power Corporation
Hudson Bay Port Company;
Omnitrax Canada
Keewatin Railway Company
Other (Civil Society Organizations, Universities etc.)
University College of the North
Manitoba Wildlands
Centre for Indigenous Environmental Resources (CIER)
Northern Manitoba Sector Council
Churchill Gateway Development Corporation (Arctic Bridge) – replaced by Churchill Arctic Port Canada
Association of Manitoba Municipalities
Indigenous Government
Pimicikamak Government; Métis Nation; Governments of First Nations and Cree Nations listed above (Nisichawayasihk Cree Nation, Tataskweyak Cree Nation etc.)
Federal Government Entities
Indigenous and Northern Affairs; Environment and Climate Change; Fisheries and Oceans Canada; Natural Resources Canada; Health Canada; Agriculture and Agri-Food; Transport Canada; Canadian Council of Ministers for the Environment; Council of Energy Ministers; Public Health Agency of Canada etc.
Provincial Government Entities
Indigenous and Northern Affairs; Environment and Climate Change; Fisheries and Oceans Canada; Natural Resources Canada; Health Canada; Agriculture and Agri-Food; Transport Canada; Canadian Council of Ministers for the Environment; Council of Energy Ministers; Public Health Agency of Canada etc.

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