Bathurst Caribou Range Plan:

Interim Range Assessment and Technical Methods Report

March, 2017

Acknowledgements

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Disclaimer

This is a technical background report to the Bathurst Caribou Range Plan: Interim Discussion Document (December 2016). It describes the technical information considered or created while crafting the Interim Discussion Document. The audience for this report is intended to be technical specialists—a plain language summary has not been produced as key information is included in the Interim Discussion Document.

This report does not represent the results of community engagement nor Government policy direction.

Traditional knowledge has been integrated from publicly available reports or other sources provided exclusively for use in the BCRP process. Knowledge of indigenous peoples is intellectual property and is protected by international intellectual property rights on indigenous peoples. As such, Aboriginal peoples reserve the right to use and make public parts of their traditional knowledge as they deem appropriate from time to time. Use of this traditional knowledge by any other party does not infer comprehensive understanding of the knowledge, nor does it infer implicit support for activities or projects in which this knowledge is used in print, visual, electronic, or other media.

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1 Introduction

1.1 Purpose

This interim report is a technical support document for the Bathurst Caribou Range Plan (BCRP) *Interim Discussion Document* (Bathurst Caribou Range Plan 2016). It describes the methods and information used to support the development of the *Interim Discussion Document*. Topics addressed include the caribou herd and its habitat, people living within the range and engaging with the Bathurst herd, important land use and economic activities occurring within the range, and how different natural and human factors may affect caribou. Key findings and management concerns are summarized.

1.2 Background

The Bathurst herd is a population of migratory barren-ground caribou that traditionally calves near Bathurst Inlet in the Kitikmeot Region (i.e., central arctic) of Nunavut. Its annual range extends across a large part of the tundra and taiga biomes of Nunavut and the eastern Northwest Territories. At approximately 390,000 km^2, the Bathurst range planning area (**Figure 1**)[1] is almost the size of Newfoundland and Labrador. In previous years its calving distribution extended to the east of Bathurst Inlet and its winter range reached to the boreal forests of northern Saskatchewan.

The Bathurst herd is an important component of the sub-arctic ecosystem from ecological, socio-economic and socio-cultural perspectives, and is a shared resource between many different aboriginal groups, including the Tłı̨chǫ, Łutsel K'e Dene First Nation, Yellowknives Dene First Nation, Métis, Athabasca Denesuline and Inuit.

Within the last 30 years, community members and biologists have observed a decline in the numbers of Bathurst caribou. Community members report less caribou, fewer than seen in living memory. Results of photographic calving ground surveys show that the Bathurst herd declined from an historic peak of over 450,000 in 1986 to an estimated ~35,000 caribou in 2009 (Nishi et al. 2014). Following management intervention (see WRRB 2012 and 2016a), primarily in the form of harvest restrictions, the trend appeared to stabilize between 2009 and 2012. However, the population further declined approximately 40% from 2012 to 2015 and is now estimated at approximately 20,000 caribou (Boulanger et al. 2016). Overall the herd has decreased 96% since the peak population in 1986.

[1] The BCRP range planning area is based on caribou radio-collar locations collected between 1996 and 2014. The boundary has been modified from Nagy (2011).

FIGURE 1. THE BATHURST CARIBOU RANGE PLANNING AREA AS DEFINED BY RADIO-COLLAR LOCATIONS COLLECTED BETWEEN 1996 AND 2014. THE BATHURST HERD HISTORICAL RANGE AS IDENTIFIED BY TRADITIONAL KNOWLEDGE IS ALSO SHOWN.

During this period of population decline, there was an unprecedented increase in mineral exploration activity on the annual range of the Bathurst herd, followed by the approval and development of four new diamond mines in Northwest Territories (Diavik, Ekati, Snap Lake and Gahcho Kué). Improved road and trail access into the herd's winter range also facilitated high levels of harvesting. The combined effects of increasing development and human access and harvesting lead to recommendations to

establish and implement cumulative effects monitoring and management frameworks that would minimize negative impacts, to the extent possible (MVEIRB 2013). Recently, in response to the dramatic population declines experienced by the Bathurst and other northern Canadian barren-ground caribou herds, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recently designated barren-ground caribou (*Rangifer tarandus groenlandicus*) as a threatened species[2].

In an attempt to address the cumulative impact concerns identified by community members as well as MVEIRB (2013) and other groups (see WRRB 2016b), the Government of Northwest Territories, Department of Environment and Natural Resources initiated a range planning process for the Bathurst herd, with a focus on managing levels of cumulative direct and indirect disturbance to Bathurst caribou. This range assessment and technical report contains the information and methods used to support the Bathurst Caribou Range Plan (BCRP) planning process.

1.3 Report Organization

This report is organized into five major parts:

- **Section 1:** Context, organization and general approach;
- **Section 2**: Caribou people – people and their expertise, knowledge, relationship, and values related to barren-ground caribou;
- **Section 3**: Land use and economic assessment – the current situation, potential future development scenarios, levels of human disturbance, and economic considerations;
- **Section 4**: Caribou assessment – natural and human factors affecting Bathurst caribou, and important habitats; and
- **Section 5**: Summary of key findings and management issues.

The main report is supported by seven appendices (each appendix is provided as a separate document):

- **Appendix A:** Traditional Knowledge References and Information Sources Reviewed in Support of Bathurst Caribou Range Plan
- **Appendix B:** Traditional Knowledge Workshop Report (March 30-31, 2016)
- **Appendix C:** Human Feature (Development Footprint) Mapping
- **Appendix D:** Human Zones of Influence Assumptions and References
- **Appendix E:** Land Use Economic Evaluation Methods
- **Appendix F:** Methods and Summary of Key Results for Bathurst Caribou Range Plan using the CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Integrated Caribou Model
- **Appendix G:** Water Crossings and Land Bridges Identified by Traditional Knowledge in the Bathurst Range Planning Area.

[2] COSEWIC definition of threatened: A species likely to become endangered if limiting factors are not reversed.

1.4 General Approach

The Range Plan is being developed by a Working Group with Government, Aboriginal, and non-government industry and conservation representatives from Northwest Territories, Nunavut and northern Saskatchewan. A Project Team and Task Groups with expertise in meeting facilitation, caribou, traditional knowledge, land use and cumulative effects supports the Working Group. Please see the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016) for a full description of the planning process and project participants.

Key desired outcomes of the BCRP are to recommend ways to manage human-caused disturbance to caribou and caribou habitat, and to do so in a manner that integrates and draws upon both traditional knowledge and science perspectives to support decision-making. The general approach used to create the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016) was based on these two important considerations.

1.4.1 Planning Steps

The following general steps were used to develop the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016):

1. Understand the range (people, land use and caribou):

- Information was gathered on people, land use and Bathurst caribou and caribou habitat through literature reviews, input of Working Group members and other experts, traditional knowledge submissions from Aboriginal Governments and organizations, and through a traditional knowledge workshop.
- The amount of current and potential future human-caused disturbance was estimated by creating a range-wide human development map and future development scenarios.
- Range assessment areas were created to better understand the different parts of the range, and to create a potential disturbance management framework (range assessment areas are discussed in Section 1.4.2, below).

2. Understand the major factors affecting caribou:

- Traditional and scientific perspectives on factors affecting caribou were documented.
- A caribou computer model was used to explore how different natural and human factors may affect caribou populations.

3. Identify key issues or management concerns:

- Based on above, key issues or management concerns were identified that should be addressed within the scope of the range plan.

4. Explore management options to address those concerns:

- The BCRP Working Group is generally using a structured decision-making approach to explore and evaluate management options, that considers the sometimes competing objectives related to caribou, cultural and economic values.

The *Interim Discussion Document* (Bathurst Caribou Range Plan 2016) summarizes the different management strategies being considered, and is seeking input on those strategies. This supporting document describes the technical information required or considered when developing the management strategies.

1.4.2 Range Assessment Areas

At approximately 390,000 km^2 the Bathurst range planning area is large and diverse. The range spans from the taiga forests in northern Saskatchewan to the Arctic Coast tundra in Nunavut. Different types and intensities of land use occur in different parts of the range, some areas have been affected to a greater extent by wildfire, and the amount of human access varies greatly. To better understand the potential land use and management issues affecting caribou in the different parts of the range, the BCRP Working Group developed the concept of range assessment areas (RAAs)[3]. Five RAAs were created by considering human land use patterns, administrative boundaries, and Bathurst caribou range use and habitat conditions (**Figure 2**). **Figure 3** identifies land management considerations in the BCRP planning area, in relation to the RAAs. Each RAA is summarized in **Table 1**. Many results displayed in this report are reported or described within the context of the five RAAs.

[3] The RAAs and the overall BCRP planning area are not legal boundaries and have no relationship to traditional territories, interim land withdrawals, or land claim negotiations; they were created for use only in the Bathurst range plan.

FIGURE 2: RANGE ASSESSMENT AREAS IN THE BATHURST CARIBOU RANGE PLANNING AREA.

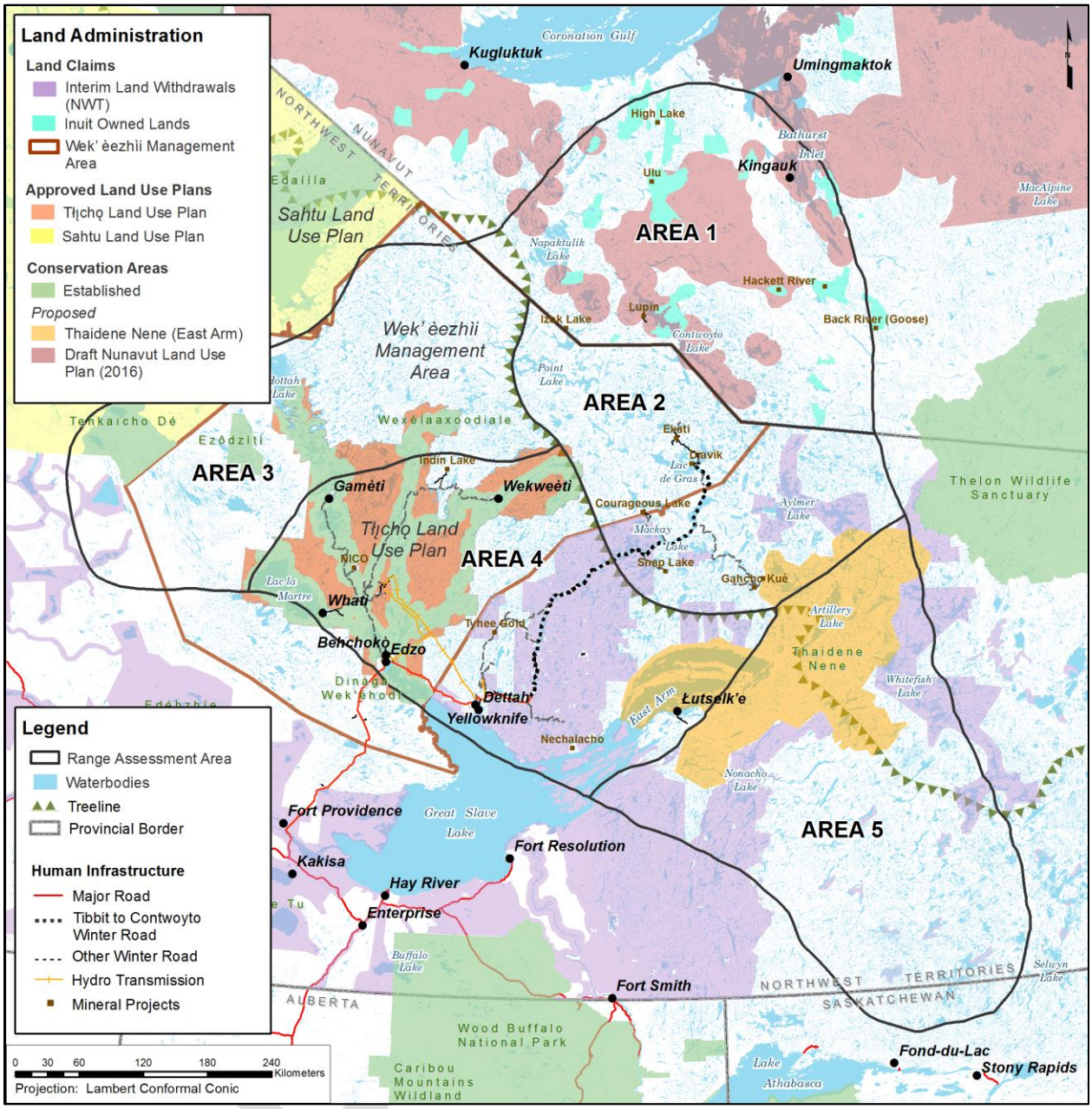

FIGURE 3. RANGE ASSESSMENT AREAS AND LAND MANAGEMENT CONSIDERATIONS IN THE BATHURST RANGE PLANNING AREA.

TABLE 1: SUMMARY OF BCRP RANGE ASSESSMENT AREAS.

Range Assessment Area	Area (km^2 and %)	Rationale for Creating RAA	Caribou Habitat and Range Use	Land Use	Land Management
AREA 1: Nunavut	75,902 km^2 (20%)	Nunavut is a separate jurisdiction with different land administration, environmental assessment and land ownership than NWT. Most of the Bathurst calving and post-calving area is within Nunavut.	• RAA1 is in the tundra biome; it contains the majority of the Bathurst calving grounds as well as important post-calving and summer habitat. • RAA1 may also be used in winter by other caribou herds – Dolphin and Union, and Beverly-Ahiak. • Wildfire is not a major source of natural disturbance on the tundra.	• A number of active mineral claims and leases, and advanced mineral exploration projects are within the area. • While the current level of land use is relatively low, RAA 1 has the potential to experience the largest amount of near-term future increase in human land use, including new producing mines, surface transportation and marine ports.	• A large part of RAA1 is Inuit Owned Land. • The Draft Nunavut Land Use Plan (2016) is being considered and proposes new protected areas for the core calving and post-calving area, as well as identified freshwater crossings.
AREA 2: NWT Central Tundra	56,134 km^2 (14%)	The central NWT tundra contains the four diamond mines developed since the late-1990s, and is currently the area of highest mineral interest and activity in NWT.	• RAA2 is central to the Bathurst herd annual range, with summer, fall and spring migration all occurring in this area. • Wildfire is not a major source of natural disturbance on the tundra.	• RAA2 is the 'diamond fields' of the North Slave Geological Province, with three currently active diamond mines. • The majority of active mineral claims and leases in the NWT portion of the Bathurst Range are in RAA2. • The diamond mines are important economic drivers for NWT.	• Land use plans are not currently in place or in development. • The western part of RAA2 is in the Wekeèzhii Management Area. • A small part of this area is under interim land withdrawal for land claim negotiations (Akaitcho Dene).
AREA 3: NWT Winter Range - Northwest	77,001 km^2 (20%)	This part of the NWT winter range has low human land use and has experienced a lower amount of wildfire	• RAA3 has been used as winter habitat by Bathurst caribou with increasing frequency over the past decade.	• RAA3 is remote and currently receives low levels of industrial land use.	• Most of RAA3 is in the Wekeèzhii Management Area.

Range Assessment Area	Area (km^2 and %)	Rationale for Creating RAA	Caribou Habitat and Range Use	Land Use	Land Management
		disturbance than other parts of the winter range.	• Wildfire has been less active in this part of the winter range. • The Bathurst and Bluenose East herds overlap in this wintering area.	• There are currently very few mineral interests or active mineral claims. • RAA3 represents an important winter caribou hunting area with access centered on trails extending north to Hottah Lake; there is considerable inter-annual overlap in winter distribution between the Bathurst and Bluenose East herds.	• Part of RAA3 is covered by the Tłı̨chǫ Settlement Area, and the approved Tłı̨chǫ Land Use Plan.
AREA 4: NWT Winter Range - Central	84,858 km^2 (22%)	This part of the winter range has the highest level of human land use in the Bathurst annual range. Most of NWTs human population lives in RAA4 – it contains all of the permanent settlements and infrastructure, including the City of Yellowknife, the Snare and Bluefish electrical facilities, and all-season highways.	• RAA4 has the highest level of combined human and wildfire disturbance in the range. • This part of the winter range has received consistent winter use by Bathurst caribou. • A large part (18%) of the area was burned by wildfire in 2014, with approximately 36% of the area being affected by wildfire since the 1960s.	• All permanent settlements and road infrastructure within the Bathurst range are in RAA4. • All-season and winter roads provide a high level of access into this part of the winter range. • The southern part of the Tibbit-Contwoyto Lake winter road begins in RAA4. • There are existing mineral interests and several past mines. • RAA4 represents an important area for winter caribou hunting. Prior to harvest restrictions	• Part of RAA4 is covered by the Tłı̨chǫ Settlement Area, and the approved Tłı̨chǫ Land Use Plan. • Large interim land withdrawals for land claim negotiations (Akaitcho Dene) are in place. • The western part of RAA4 is in the Wekeèzhii Management Area.

Range Assessment Area	Area (km^2 and %)	Rationale for Creating RAA	Caribou Habitat and Range Use	Land Use	Land Management
				established in 2009 on the Bathurst herd, this area received the most use by all NWT hunters due to the high level of road and trail access.	
AREA 5: NWT Winter Range - Southeast	95,127 km^2 (24 %)	This part of the winter range is remote and currently has low land use pressures, but has experienced a large amount of wildfire disturbance.	• This part of the winter range has received lower use by caribou in recent years • RAA5 experienced many large wildfires over the past decades, and most (60-70%) of the forested area south of treeline has experienced a burn since the 1960s. • RAA5 is considered to be part of the winter range of the Bathurst and Beverly-Ahiak herd. Occasional and variable overlap with Bathurst and Qamanirjuaq caribou has also occurred.	• RAA5 is remote and currently receives low levels of industrial land use. • There are few mineral interests or active mineral claims. • RAA5 has been an important winter caribou hunting area for communities in NWT and northern SK, with primary winter range use by Beverly-Ahiak caribou, and variable use by the Bathurst and Qamanirjuaq herds.	• RAA5 includes the proposed Thaidene Nene (East Arm) National Park (or Territorial Park). • In addition to Thaidene Nene, other large interim land withdrawals are in place for land claim negotiations (Akaitcho Dene, Athabasca Denesuline and Northwest Territories Métis Nation).
Total	389,022 km^2				

1.5 References

Bathurst Caribou Range Plan. Interim Discussion Document. December, 2016.

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Mackenzie Valley Environmental Impact Review Board (MVEIRB). 2013. Report of environmental impact review and reasons for decision. EIR 0607-001. Gahcho Kué Diamond Mine Project, DeBeers Canada Inc. July 19, 2013. Yellowknife, NT. 207pp.

Nishi, J. S., B. Croft, J. Boulanger, J. Z. Adamczewski, and A. Kelly. 2014. An estimate of breeding females in the Bathurst herd of barren-ground caribou, June 2009. File Report No. 144, Government of the Northwest Territories, Yellowknife, NT. 101 pp.

Wekèezhii Renewable Resource Board (WRRB). 2010. Report on a Public Hearing held by the Wekeezhii Renewable Resources Board, 22-26 March 2010, 5-6 August 2010, Behchoko, NT. and Reasons for decisions related to a joint proposal for the management of the Bathurst caribou herd. Wek'eezhii Renewable Resources Board, Yellowknife, NT. 20 pp.

Wekèezhii Renewable Resource Board (WRRB). 2016a. Report on a Public Hearing Held by the Wek'èezhìı Renewable Resources Board, 23-24 February 2016, Yellowknife, NT., & Reasons for Decisions Related to a Joint Proposal for the Management of the Bathurst ek (Barren-ground caribou) Herd - PART A. Wek'èezhìı Renewable Resources Board, Yellowknife, NT. 41 pp + Appendices

Wekèezhii Renewable Resource Board (WRRB). 2016b. Reasons for Decisions Related to a Joint Proposal for the Management of the Bathurst ek (Barren-ground caribou) Herd - PART B. Wek'èezhìı Renewable Resources Board, Yellowknife, NT. 41 pp + Appendices

2 Caribou People

2.1 Introduction

The Bathurst caribou range is a socio-cultural and physical landscape that caribou share with Dene, Inuit, and Métis, who are all "Caribou People," as well as non-Aboriginal Northerners. Aboriginal groups have existed with and relied upon caribou for their survival for thousands of years.

> *We are Caribou People you know. That is what they call us. (Herman Catholique, pers. comm. 2017).*

Communities within the range planning area in the Northwest Territories include Yellowknife, the Tłı̨chǫ communities of Behchokǫ̀, Edzo, Whatì, Gamètì and Wekweètì, the Yellowknives Dene communities of N'Dilǫ and Dettah and the Denesuline community of Łutsel K'e. Surrounding participating communities include Kugluktuk and Cambridge Bay in Nunavut, the Athabasca Denesuline villages of Fond-du-Lac, Stoney Rapids and Black Lake in Saskatchewan, as well as the South Slave communities of Fort Smith and Fort Resolution in southern Northwest Territories.

This chapter describes the traditional knowledge of the caribou-human relationship and values related to caribou, as well as the methods used to document and incorporate these understandings as shared by the Caribou People from throughout the Bathurst range planning area, into the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016).

2.2 Traditional Knowledge of the Caribou People

Caribou are the most significant cultural keystone species (Garibaldi 2009) for the Aboriginal cultures that live within the Bathurst range.

> *Throughout the world, people strongly identify with plants and animal species on which they depend for cultural and economic reasons. These species, CKS [cultural keystone species], comprise more than food or sources of raw materials. They permeate a culture's stories, spiritual practices, and language and daily practice. ... Just as ecologists have long recognized that some species, by virtue of the key roles they play in the overall structure and functioning of an ecosystem are essential to its integrity, certain plants and animals feature prominently in language, ceremonies, and narratives of Indigenous peoples. (Garibaldi 2009: 4).*

The Dene, Inuit, and Métis cultures have developed around the unique relationships forged between humans and caribou. Caribou People have based their cultural identities around these relationships, and they have depended on caribou for subsistence since the time caribou and people could speak to one another and people could become caribou. Respect is at the core of the relationship between people and caribou because thoughtful and deliberate treatment of caribou by humans ensures that caribou continue to offer themselves to people. In the past, people lived along the caribou migration routes, and in the years when caribou came close they were assured health and wealth in terms of food, clothing, tools and more.

> *In fall time we go live with caribou. The good hunters, there are a lot of people like that. They go anywhere and they meet caribou right away because the animal knows that this person, the way it will be treated and taking care of it, is why the animals gives itself to him. This is how the elders were taught. This is the way my culture works in the past. (7A, BCRP TK Workshop, March 2016)*

The caribou's migration route is effectively a social network: Caribou People across the Northwest Territories and Nunavut have established their camps and communities along well known migration routes, water crossings and other areas frequented by caribou since time immemorial. Still today, tent rings and caribou bones mark traditional migration routes.

> *Where the people have been, how they have used their lands, and what changes the people have observed are remembered by the people: that is the essence of the traditional knowledge of peoples (born) to their lands. This knowledge is passed from an experienced generation to the next, so that the peoples learn accumulated patterns of change. They use this knowledge to plan the paths they need to take to ensure their survival. (YKDFN 1997a: 14).*

Respect is at the core of the relationship between people and caribou where thoughtful and deliberate ways of treating caribou ensure that caribou continue to offer themselves to people.

Knowing caribou means understanding their movements, migrations, body condition, and lifecycle: understanding how caribou think; respecting that caribou can transition from caribou to people and vice versa; and treating caribou with great reverence and gratitude. *Knowing caribou* could make the difference between survival and death and so this expertise was carefully developed and passed from one generation to the next. *Knowing caribou* and the responsibility for caribou guardianship that flows from this knowledge have combined to help shape recommendations and options within the BCRP.

> *Hunting as an economy and culture, is based on a balanced relationship between the ndè and the people. The land and all beings within it are part of a social landscape. In Tłı̨chǫ culture, inanimate beings, such as the wind or lakes, are sentient beings with the ability to act and choose based on personal agency. Similarly, all animate beings, such as caribou, birds and fish, are also intelligent individuals with the ability to make conscious choices based on personal agency. The land is a social network with whom one can communicate and develop long-lasting social relationships. Animals are beings with personality and knowledge; they are not solely biological objects acting on instinct. This understanding makes the land more inclusive because all beings act socially towards each other, and to humans, in similar ways as humans relate to other humans. The concept of nature, then becomes a socio-natural landscape. (Dedats'eetsa: Tłı̨chǫ Research and Training Institute. May 4 2016: 61)*

Caribou People have always shared caribou expertise through oral tradition from one generation to the next. In the last few decades they have also carefully documented traditional knowledge of caribou wellbeing, health, behaviour, movements, migrations, spiritual elements and other aspects through

audio, video, mapping, and interviewing initiatives. Through these various processes, insights into traditional use and values have been identified, articulated, and integrated into wildlife management initiatives, educational programs, and other processes relevant to northerners.

2.2.1 The Caribou-Human Relationship Today

Before modern settlements and established grocery stores, caribou were so important to physical survival that the years when caribou migrations diverted or populations declined were times of great hardship. Today Aboriginal peoples report that their connection with caribou is still central to what defines them, suggesting that caribou are still as important to their cultural survival. Although many foods are available to people today, caribou remain vital to the health of Caribou People because the herd represents much more than just calories.

> *When you skin out the head of the caribou you will find writing on its forehead. No one can actually read this writing. However, in the past some elderly women would say it meant 'wherever the people are, that is where the caribou will go.' The caribou would always eventually migrate towards the people. That is what they said was written there. (ML, 2000 in Kendrick et al. 2005:181 in Lutsel K'e Dene First Nation. April 2016: 9)*

Elders have been known to slip into depression and lose their health without caribou, not only because they lack caribou meat in their diet, but because they "miss being with them" spiritually (Thorpe and Barnaby 2016). The experience of hunting, sharing meat with community members, and passing on knowledge of how to prepare hides from one generation to the next is critical to cultural integrity and this is lost when there are no caribou (Condon et al. 1995).

The health of caribou habitat is not only critical to the health of the caribou herd, but also to the health of the Caribou People who depend upon both. When caribou habitat is lost or degraded, so is the land available to carry out cultural practices such as hunting, trapping and otherwise spending time on the land. The same circumstances that cause caribou populations to decline, also cause the loss in opportunities for Caribou People to practice their cultures and affirm their identities. As a result, the BCRP represents an effort to preserve the cultures of the Caribou People as well as the herd and its habitat.

2.3 Methods

From the outset it was well understood that the traditional knowledge of the Caribou People would be vital to achieving the BCRP's central goal of preserving a healthy range in a resilient landscape condition. Traditional knowledge derived from a literature review, workshop, and community-based map data – as well as from BCRP Working Group members – formed the basis for developing key principles and processes that guide the BCRP. That participating Caribou People generously shared what was in many cases highly sensitive or confidential traditional knowledge, speaks to the dedication of Caribou People to helping the Bathurst caribou.

The arguably controversial act of translating TK from its oral tradition into the written word and from there trying to summarize key themes was formidable and necessarily both imperfect and incomprehensive; likewise, the complex understandings within TK cannot be easily represented by the points and lines of a map. Indeed, some people question the appropriateness of removing TK from the oral tradition, let alone "extracting TK tidbits" or what Nadasdy called "TK nuggets" (1999) for the purposes of mapping and analysis. While documented TK can provide important caribou understandings, it is important to recognize that it is necessarily taken out of a more complete context, and that many of its rich understandings can be lost in the process. These challenges associated with recording traditional knowledge – much of which remains undocumented – mean that the TK integrated into the BCRP can never truly be considered complete or comprehensive. Much on the specifics and challenges of interpreting TK "data" and oral history has been published in the academic literature including comment on the ethics, protocols and methodologies of TK research (Cruikshank 1994; Legat et al. 1995; Abele 1997; Duerden 1998; Nuttall 1998; Burgess 1999; Nadasdy 1999; Wenzel 1999; Faye 2001, Aurora Research Institute 2003; Nadasdy 2003; Folliott 2004; Huntington et al 2004; Berkes 2008; Hulan and Eigenbrod 2008). Caveats associated with this practice specific to the BCRP are listed in **Section 2.3.2**, below.

2.3.1 Information Gathering

The BCRP Working Group used four approaches for gathering the traditional knowledge of the Caribou People. First, Aboriginal members of the Working Group provided critical and ongoing input, advice, suggestions, understandings and direction on how, where and what Aboriginal understandings about caribou should be considered. Second, a review of public and available documented traditional knowledge references, including spatial (mapping) information, was carried out. Third, new and existing information was synthesized by some Aboriginal governments and organizations for use in the BCRP. And fourth, a two-day workshop dedicated to sharing traditional knowledge of Bathurst caribou was held with Elders and other knowledge holders in Yellowknife on March 30-31, 2016.

2.3.1.1 BCRP Working Group

The Bathurst Caribou Working Group has a total membership of 21 groups, including 11 Aboriginal organizations and seven Indigenous groups. Each group selected their representative based on his/her caribou expertise. These individuals sit on the Working Group Committee and have participated in nine working group meetings between 2015 and 2017. During these meetings, members provided key guidance when reviewing the appropriateness, accuracy and comprehensiveness in considering traditional knowledge in the BCRP. Rich discussions provided vital insights into areas of convergence and divergence in traditional knowledge and conventional scientific understandings of caribou. A review of minutes from the Working Group meetings shows that these discussions themselves represented – even embodied – the integration of both ways of knowing in the BCRP.

2.3.1.2 Literature Review

As part of the BCRP planning process, key sources considered included:

- Summary reports commissioned by the BCRP from participating groups detailing available TK relevant to the Bathurst Caribou (AD 2016; LKDFN 2016; NWTMN 2016; NSMA 2016; Dedats'eetsa 2016a; YKDFN 2016)
- Report from the TK Workshop convened by the GWNT ENR for the purposes of the BCRP (Thorpe and Barnaby 2016)
- Key community collaborations and reports (Zoe et al. 1995; Dogrib Treaty 11 Council 2001; Parlee and LKDFN 2000, 2001; Legat et al. 2001, 2002; Thorpe et al. 2001; Ellis et al. 2002; Parlee et al. 2005; Legat et al. 2008; Dedats'eetsa 2013, 2014, 2015; 2016b)
- Literature reviews of TK related to the caribou (Parlee et al. 2013; Trailmark 2015) and state of knowledge in the West Kitikmeot Slave Study area (SENES 2008)
- Published literature (e.g. Kendrick 2005; Legat 2008)
- Academic theses (e.g. Thorpe 2000; Wray 2010; Bechtel 2011; Dokis-Jansen 2015)

Note that much emphasis was given to the literature reviews (e.g. Parlee et al. 2015) as well as the summary reports (AD 2016; Dedats'eetsa 2016a; LKDFN 2016; NWTMN 2016; YKDFN 2016). Additional references broadly informed the BCRP process according to the following broad themes but were not the focus of the literature review:

- Caribou habitat and TK (Dogrib Treaty 11 Council 1998; Dogrib Treaty 11 Council 2001, 2002; Legat et al. 2001; 2002; Thorpe et al. 2001)
- Community-based monitoring and TK (LKDFN 2001; Lyver 2002; Kofinas et al. 2003; Lyver et al. 2005; Legat et al. 2008; Padilla and Furgal 2010; EMAB 2012; Dokis-Jansen 2015)
- Cumulative effects and TK (e.g LKDFN 2001; Dedats'eetsa 2016a; 2016b)
- Environmental change and TK (Thorpe 2000; Lyver 2002; Wesche and Armitage 2010)
- Bridging TK and Science (Gunn et al. 1998; Lyver 2000; Andrews 2002; Bateyko 2003; Nadasdy 2003; Anderson and Nuttall 2004; Berman and Kofinas 2004; Hawley et al. 2004; Moller et al. 2004; Armitage 2005, Berkes 2005, Berkes et al 2005, Ellis 2005, Huntington et al. 2002, 2004; Lyver and Gunn 2004; Sloan 2004; Scott 2004; Stevenson 2006; Berkes 2008; Golder et al. 2010; Bechtel 2011; Bayha 2012)
- Co-management, resource management and wildlife (Thorpe et al. 2001; Thorpe 2002; Kendrick 2003; Wenzel 2004; Gilchrist et al. 2005; Kendrick et al. 2005; Manseau et al. 2005; Nuttal et al. 2005; Parlee et al. 2006; Padilla 2012; Parlee 2012; Sangris 2012)

Finally, some reports carried out as part of environmental assessment processes for proposed developments or reports from operating mines were reviewed (Terra Firma 2004; BHP Billiton 2007; EMAB 2008, 2012; Thorpe Consulting Services 2014a, 2014b).

The availability of published and non-confidential traditional knowledge of caribou references varies between communities across the range of the Bathurst herd. Some groups have had access to greater

funding in order to better develop their internal traditional knowledge databases or to carry out traditional knowledge projects. For example, resource development within territories of some groups is more intensive than in others, and so the number of traditional knowledge reports carried out as part of environmental assessment processes (and the associated funding) has similarly varied.

In response to some of these challenges, the BCRP offered funding to each Aboriginal organization in both 2014/2015 and again in 2015/2016 to synthesize their own traditional knowledge of caribou references and sources that could be used in the BCRP. Many groups generously shared what was previously confidential -- this gesture itself testified to their engagement and concern about Bathurst caribou. The fact that this sensitive information and knowledge was shared underscores the level of caring expressed by Caribou People: the trade-off between holding traditional knowledge close to advance individual Nation interests was weighed with sharing this traditional knowledge with the BCRP in part to help caribou. Understandings shared in these reports significantly improved the quality and scope of the BCRP in ways that would not have otherwise been possible. A complete list of traditional knowledge and information sources reviewed is listed in **Appendix A**.

2.3.1.3 Traditional Knowledge Workshop

To build upon the literature review and to address caribou issues specific to the BCRP process, a TK workshop was convened in Yellowknife March 30-31, 2016 with participation from Aboriginal partners. A total of 14 delegates participated, while an additional 10 individuals were observers who occasionally participated. Of the delegates, only two were women. This two-day workshop focused on the following questions:

- How can the relationship between people and caribou be healed? Who needs to be involved? When? Where?
- What do the youth need to understand to continue a healthy relationship with Caribou?
- How do you know that you are being listened to?

Participants reviewed and signed a consent form to have their insights documented in the report and filled out evaluation forms to provide additional feedback on the TK Workshop, BCRP or to contribute insights that they weren't otherwise able to share in the workshop setting.

A modified semi-directed interview process was adapted by facilitators Joanne Barnaby and Natasha Thorpe, in accordance with a draft agenda presented to the workshop participants as a guide for discussion.

The following description of a similar traditional knowledge gathering exercise involving the Mi'kmaq Grand Council neatly describes the organic process by which the knowledge held within the group was recalled and shared during the workshop.

> *The Elders would serve as mnemonic pegs to each other. They will be speaking individually uninterrupted in a circle one after another. When each Elder spoke they were conscious that other Elders would serve as 'peer reviewer' [and so] they did not delve into subject matter that would be*

questionable. They did joke with each other and they told stories, some true and some a bit exaggerated but in the end the result was a collective memory. This is the part which is exciting because when each Elder arrived they brought with them a piece of the knowledge puzzle. They had to reach back to the teachings of their parents, grandparents and even great-grandparents. These teachings were shared in the circle and these constituted a reconnaissance of collective memory and knowledge. In the end the Elders left with a knowledge that was built by the collectivity. (Stephen J. Augustine, Hereditary Chief and Keptin of the Mi'kmaq Grand Council in Augustine 2008:2)

A transcriber made detailed notes each day of the workshop so that clarification or edits could be made as quickly as possible. Based on these transcripts, a stand-alone report documenting activities and insights shared during this workshop was prepared and reviewed by participants. A draft version of the TK Workshop Report was circulated to participants and feedback subsequently incorporated. The draft workshop report is included as **Appendix B.**

2.3.1.4 Traditional Land Use Mapping

At the request of the BCRP Project Team, communities generously agreed to share critical insights into caribou from their respective community traditional knowledge databases. Key themes such as caribou harvesting trails, migration routes, calving grounds, habitat, and crossings were shared and used in the BCRP *Interim Discussion Document* to inform the goals, objectives and proposed management approaches. These spatial files, overlapping in many areas, were then mapped together across the range and results combined with other information and integrated into the BCRP *Interim Discussion Document*. Understandably, not all groups were comfortable sharing spatial information due to uncertainty in land claim negotiations and other land-based processes.

2.3.2 Traditional Knowledge Methodology Caveats

This report was prepared within a maelstrom of conditions: consider the challenges of recording what is otherwise an oral tradition; the complexities inherent in "being in relationship" with caribou; variations and differences in caribou behaviour, habitat, migrations, movements etc. across a vast area that spans traditional territories and political divides, and the realities of trying to speak with confidence about observations made within a time of rapid environmental change and the associated realities of living within profound uncertainties and extremes (Krupnik and Jolly 2002; BQCMB 2011; Legat 2012; Parlee and Furgal 2012; Jacobsen 2013). This is the underlying context upon which the BCRP process has been carried out.

As with all TK review, documentation and integration efforts, there are numerous limitations and caveats that must be considered. This report presents results from a necessarily incomprehensive limited literature review, one workshop, and simply cannot do justice to the rich history of previous works, both documented and undocumented. The following specific limitations of TK data in addition to some caveats associated with the TK elements of this process must be considered:

- The controversial act of taking TK from the oral tradition into the written word and from there trying to summarize key themes was formidable and necessarily both imperfect and incomprehensive. The context in which TK is conveyed is primarily oral, from person to person. Shifting from an oral to written form presents unique challenges as the meaning of some of the issues and concepts raised by contributors may be compromised. For example, intonation, expression, tone, and meaning can be altered when representing TK on paper.

- When reviewing the TK maps, one must consider that each group is at a different stage of mapping their spatial TK and developing their internal databases. Thus, some areas within the range of the Bathurst herd may show more TK data than others; more "data points" in a certain part of the range may simply mean groups that have traditionally used that area have mapped more of their TK, not that unmarked areas are less important for traditional use. Also, any TK map can only represent the specific TK held by the particular Elders and land users who participated in the TK mapping exercise.

- It was not possible to review hundreds of pages of consultant reports prepared for environmental impact assessments of proposed mining or oil and gas developments; although it is recognized that there may be some additional information contained in these industry reports that may be relevant. However, a selection of reports that were readily available is included in the present review. (e.g. BHP Billiton 2007; KIA 2014; TCS 2014a, 2014b).

- Out of respect for the nature and quality of traditional knowledge, rather than simply review the literature, much of the original 'voice' of these primary sources was preserved through inclusion of direct quotes. However, documenting TK in written form presents the wisdom, experience, and knowledge as static and neglects the fact that TK is dynamic and evolving, continuously enhanced, and updated through ongoing observations.

- Observations communicated in Aboriginal languages were translated into English, thereby creating some potential for misinterpretation or loss of some information. Also, some interpreters provided near verbatim translations while others summarized key themes and topics in English. The general challenges of translation and interpretation are well documented.

- Working Group members and the TK Workshop participants may have been influenced by the nature, extent, and content of the discussions and the composition of the audience. For instance, it is possible that elders may have provided more detailed information when youth were present and been more tentative to discuss sensitive issues when certain parties (e.g. government) was present. During Working Group meetings, wildlife information provided by attending scientists may have also influenced the direction and content of the discussions among workshop participants.

- More men than women participated in the BCRP process and so there are elements of the female perspective that are missing.

2.4 Results

2.4.1 Overview

Review of the literature, TK workshop minutes, and traditional land use data reveals a number of overarching themes consistent across cultures throughout the range, and appear to underlie the Caribou Peoples' relationship with caribou:

- Caribou represent the future, and so people must safeguard caribou for future generations;
- People understand caribou and are their guardians: caribou are people and people are caribou, such that taking care of caribou is the same as taking care of oneself;
- The relationship between people and caribou is suffering and needs to be renewed and healed;
- People's identity is bound to caribou through the way of life provided by caribou in terms of subsistence and sustenance;
- More than just life-giving, caribou are wealth: financial, material, nutritional, spiritual.

Several additional common themes were identified from the literature reviewed, from the last few decades in particular, which included the following salient observations:

- Caribou People from both NU and NWT say many of the same things about caribou and these observations have been similar through time (e.g. caribou are sensitive animals; caribou populations cycle; caribou depend on healthy habitat);
- The Bathurst caribou herd is declining (e.g. populations are declining, caribou are increasingly unhealthy);
- Caribou People forecasted recent changes in caribou and feel partially responsible for these changes;
- Caribou People feel as though their relationship with caribou has changed and needs to be repaired;
- People depend on caribou for their way of life; caribou are a cultural keystone species;
- Caribou People have always known the places important to caribou (e.g.. water crossings, calving grounds, and land bridges) as evidenced by the overlap between traditional camps and caribou migration routes;
- Respect is at the core of the relationship between people and caribou: lack of respect is why caribou are in decline and the caribou-people relationship is changed;
- Many threats (roads, development, predators, forest fires/current burn policy, climate change, wasteful harvesting, cumulative effects, etc.) have changed the relationship between people and caribou and caribou well-being;
- Caribou are smart and can adapt: they learn to avoid areas of disturbance, people and predators, they know where to go for good food, etc.;
- Youth must be taught how to respect caribou and given opportunities on-the-land to learn the caribou way of life;

- Everybody must work together: all people of NU and NWT as well as community members, biologists and other resource people.

In addition to these themes and observations, Caribou People throughout the range also report that they have long known the following:

- People and animals could speak the same language;
- Caribou are a sacred animal that everybody depends upon;
- Every human has a bit of caribou heart;
- All caribou have one mind;
- People are not the boss of caribou.

With all of the above providing a basis for Caribou Peoples' observations of changes to the Bathurst caribou herd and its range, knowledge holders report the following recent trends:

- The Bathurst herd is declining profoundly; although a minority of individuals suggest that the herd has shifted or disappeared until conditions are safe.
- Natural and human disturbances, including the cumulative impacts of mineral exploration, development and environmental change, threaten both caribou and their habitat – with environmental change being the most significant contributor to changes in caribou and their habitat.
- Migration routes are largely determined by habitat; threats to habitat quality and integrity through increased forest fires and human disturbance have affected the Bathurst herd.

2.4.2 General Understanding of Caribou

Since time immemorial, Caribou People have carefully studied caribou, amassing a deep and intricate understanding of the animal's health, behavior, habitat and patterns. Like Aboriginal people across the Bathurst range, Gwich'in knowledge holders, for example, are able to distinguish sex, age and other caribou characteristics as follows:

- Bulls and cows have light hair around their tail and belly;
- Cows are lighter in colour than bulls;
- Caribou look healthiest in fall when they are growing their winter coat;
- Older bulls have white throats which turn grey in spring;
- Cow caribou have smaller bodies, shorter necks and smaller antlers;
- Young caribou are darker and scruffier (because they are always playing);
- Bulls drop their antlers in December while cows retain them till March;
- All caribou talk to each other (like all animals); young caribou are noisier than other caribou;
- Vadzaih's feet make a unique clicking sound, so a large herd makes a lot of noise when running. (Parlee et al. 2013: 4)

Knowledge holders from across the Bathurst caribou range report familiarity with all manner of caribou behavior, including bulls fighting to mate with cows and experienced cows leading their entire herd north to the calving grounds; individual caribou prancing proudly or running in circles to the point of exhaustion to avoid insects; whole herds intermixing and migration routes shifting; and the overall population falling as human disturbances threaten caribou and their habitat, and then rebounding when conditions are favourable (Dogrib Treaty 11 Council 2001; Thorpe *et al.* 2001; ACFN 2003; Kendrick *et al.* 2005; Łutsel K'e Dene First Nation 2005; Legat *et al.* 2008; Croft and Rabesca 2009; ; WRRB 2013; NSMA 2012; Beaulieu 2012; Judas 2012; Barnaby and Simmons 2013; ACCWM 2014; KIA 2014; LKDFN 2016; NSMA 2016; NWTMN 2016; YKDFN 2016).

Traditional knowledge asserts that caribou are smart, have sharp senses, good memories, spook easily, and are very curious. Owing to their acute senses, caribou have always been known by Aboriginal people to be sensitive to noise, dust, light, pollution and contaminants (Legat et al. 1998; NWTMN 2016). Caribou are always learning and can recall migration routes and habitats so that they know where to travel and where to calve. Given that caribou are people and people are caribou, it is understood that caribou are attracted to people and will offer themselves to people, but only when they are respected and treated properly.

When caribou are healthy and relaxed, they are known to tilt their snouts in the air: "healthy animals walk with their heads up," (John Jerome in GSCI 2015: 57; EMAB 2012). They are also known to be playful, jumping in the air to display their good condition.

> *You could tell looking at a caribou right away if it's a poor one or a fat one… And usually [caribou] try to show off and jump up in the air, let the predators know they were ready for a rumble or something. That must be part of their survival thing. Even the little ones do that. (James Firth in GSCI 2015: 29)*

When caribou are undisturbed they are curious and playful.

> *They do play lots you know... play with one another. That is why lot of time you can fool a caribou by rubbing two sticks together, that is because when you rub stick you know they think it's caribou playing over there. Well, they have to go over there and see what it is. They don't walk over there, they just full blast over there. . .That is why if your caribou run away from you, you hide and rub that stick together, it will come back to you . . . always come back to you (Gabe Andre in GSCI 2015:30).*

> *In the olden days, when [people would] come on the lake and they'd see caribou on the other side of the lake, they'd sit down and make tea. And the caribou would get curious, and they'd come over to check what's going on. Even if they smell the smoke, they know it's not a forest fire because it's just a little smoke. (GSCI 2015: 25)*

At the same time, knowledge holders also report that when caribou are stressed they raise their noses into the air, lifting them higher the more alarmed they become.

> *The caribou are running in front of the helicopter. When a caribou gets scared or surprised or threatened, that's what they do. They put their nose up and sometimes they jump and then they go on a really fast gallop because they don't know what's going on and they're threatened. (Fred Sangris in EMAB 2012: 20)*

Depending on the scale considered, Aboriginal peoples explain that caribou are known to return to the same calving grounds using the same migration routes year after year (Thorpe et al 2001; Dogrib Treaty 11 Council 2001; Kendrick 2003; Padilla and Kofinas 2010; EMAB 2012; KIA 2014).

> *Young caribou know where to migrate and use their memories as well as what they have learned from the cows. They follow the leaders and using their sense of smell to guide them to quality forage (Thorpe et al. 2001; Dogrib Treaty 11 Council 2001).*

The caribou, or more particularly the leaders, also know where they are supposed to go: "they been going there ever since the world started. Thousands of years," (Joan Nazon *in* GSCI 2015: 35).

> *They're going to go where there's the best feed, or where the leaders go. I don't know why the leaders know, but where the leaders go, they go. That's part of their DNA . . . part of their survival (Tom Wright in GSCI 2015: 35).*

Cows share their knowledge; they teach their young how and where to migrate:

> *Bluenose caribou calves learn how to make a living in the world from their mothers. Calves just go only where it go, and follow his mother, that way they know what to do. Calves make a particular sound to call to their mothers, and the mother knows right away, look for young one. That is if the young calf don't know where the mother went...make loud sound, and hear them right away (Gabe Andre in GSCI 2015: 37).*

> *Don't matter if there is 1000 caribou, still calves still know which one is their mother. I see that, if cow is going to cross a lake, or cross a river, the calf can get on the back...sit on their back. They wouldn't swim by themselves...they swim but they wouldn't stay in the water that long, they just jump on top their mother (Gabe Andre in GSCI 2015: 37).*

TK suggests that some caribou can adapt to changes in the environment by migrating along different paths or greater distances (Dogrib Treaty 11 Council 2001; Katz 2010; EMAB 2012; Sangris 2012; Tłı̨chǫ Government 2013; Jacobsen 2013; GSCI 2015). Many community members have suggested that shifts in migrations further north occur as caribou are trying to adapt to changes along their range, in their habitat, population, and body condition.

> *Caribou has its own way to survive, they are like human beings. How will they survive? They will probably change what they eat (Dora Nitsiza in Dedats'eetsa 2013).*

2.4.3 Knowledge of the Range and Important Places

The process of mapping traditional land use and values reveals insights into the Caribou Peoples' relationship with caribou and their traditional territories, and provides an invaluable visual tool to guide the BCRP. TK mapping shared by community members shaped the goals, objectives and proposed management approaches developed for the BCRP *Interim Discussion Document*.

People have long understood the significance of certain areas and geographic features for caribou, and have selected their harvesting and camping sites accordingly (Dogrib Treaty 11 Council 2002; Stewart et al. 2004; Dedats'eetsa 2016b). Many placenames are biogeographical indicators that can be traced back to caribou (Stewart et al. 2004). However, sometimes the association is not obvious:

> *An interesting finding is that only two placenames have emerged to date that include terms for 'caribou' . . . Caribou is the most important animal to the Dogrib people and most families have a full-time hunter, therefore one might assume that if placenames are indicators of bio-geographical knowledge then placenames with caribou should be numerous. . . .A number of placenames refer to caribou without mentioning them, for example by mentioning a favourite caribou food (Daàghôôtì '[Type of Lichen] Lake) or a caribou crossing (Kwik'ìiædaà 'Gun Crossing'). These kinds of names are potentially more informative than names just including the word 'caribou' because they indicate descriptions of the bio-geographical surroundings that are useful for other purposes. (Dogrib Treaty 11 Council 2002: 58)*

With respect to important places, analysis of the documented traditional knowledge indicates two primary types within the Bathurst range:

- Areas determined by permanent features such as water crossings and land bridges, and
- Areas determined by caribou behavior such as calving grounds or wintering areas.

Permanent features are fixed locations that cannot be moved – if they are damaged, destroyed or blocked by human land use features, they will no longer be available for caribou to use. Areas determined by caribou behavior are more flexible in regards to location, and may shift over time due to changes in environmental conditions or natural disturbance (e.g., wildfire). Traditional knowledge on water crossings, land bridges and other important parts of the Bathurst range are included in their respective topics under **Section 4**, Caribou Assessment.

2.4.4 Knowledge of Impacts to Caribou

Leaders, elders, hunters, and other community members as well as wildlife biologists explain that barren-ground caribou habitat quality and amount is declining across northern Canada due to climate change, wildfire, and human development and land use, and most caribou populations are in decline. The cumulative impact of these factors and activities on caribou habitat has not gone unnoticed by people who share their lands, waters, and world with barren-ground caribou (Dogrib Treaty 11 Council 2001, 2002; Thorpe *et al.* 2001; ACFN 2003; Kendrick *et al.* 2005; Łutsel K'e Dene First Nation 2005; Parlee and Manseau 2005; Dumond 2007; Legat *et al.* 2008; Croft and Rabesca 2009; Sahtú Land Use

Planning Board 2013; WRRB 2013; North Slave Métis Alliance 2012; Beaulieu 2012; Judas 2012; Barnaby and Simmons 2013; ACCWM 2014; GSCI 2015; Trailmark 2015; AD 2016; Dedats'eetsa 2016b LKDFN; 2016; NSMA 2016; NWTMN 2016; YKDFN 2016).

Traditional knowledge of impacts to caribou resulting from natural and human factors is discussed under **Section 0**.

2.5 Summary

Caribou People from across the range of the Bathurst herd have provided key insight into caribou behavior, movements and migrations and tendencies as well as a stronger understanding of the spiritual elements surrounding caribou and the rules that people must follow as caribou guardians. Respect is at the key of these understandings. Building on these insights, TK is at the foundation of understanding ways to heal the relationship between caribou and people and to map out ways in which the range can be "managed" to support overall caribou wellbeing.

As this Section has illustrated, caribou insights documented in the TK literature, shared at the March 2016 TK workshop, contributed through TK reports assembled for the *BCRP Interim Discussion Document*, and recorded in the spatial databases, show remarkable repetition, consistency and congruity across Aboriginal groups and traditional territories. Very similar stories repeat, grounded in knowledge of caribou held, shared and realized since time immemorial: Aboriginal peoples across the Bathurst range are making the same observations and are guided by similar traditional knowledge. In the western scientific view, this "repeatability" speaks to the level of confidence that can be entrusted in traditional knowledge as "these are things that are really happening," (Aqigaq 2001 in Fox 2002: 30).

Although the challenge of reducing TK to a few key themes is itself problematic, the BCRP *Interim Discussion Document* was grounded in the following:

1. The relationship between people and caribou is suffering and needs to be renewed and healed;
2. Respect is at the core of the relationship between people and caribou: lack of respect is why caribou are in decline and the caribou-people relationship is changed;
3. People understand caribou and are their guardians;
4. People depend on caribou for their way of life: people are caribou and caribou are people;
5. Many threats (roads, development, predators, forest fires/current burn policy, climate change, wasteful harvesting, cumulative effects, etc.) have changed the relationship between people and caribou and caribou well-being;
6. Caribou are smart and can adapt: they learn to avoid people and predators; they know where to go for good food, etc.;
7. Caribou People have always known the places important to caribou (crossings, calving grounds, land bridges, calving grounds) as evidenced by the overlap between traditional camps and caribou migration routes;
8. Youth must be taught how to respect caribou and given opportunities on-the-land to learn the caribou way of life;

9. People predicted caribou populations would decline;
10. People feel strongly that TK should have been accepted as fact earlier; and
11. Everybody must all work together: all people of NU and NWT as well as community members, biologists and other resource people.

Finally, the BCRP Working Group has focused on integrating traditional knowledge and science—two ways of knowing—without crediting the knowledge collected to one system or the other because, for the most part, findings from traditional knowledge and scientific research affirmed and confirmed each other (e.g. caribou populations are declining; caribou health is compromised; forest fires are burning caribou habitat) even when the process or rationale for recording observations differed (e.g. caribou populations are declining due to disrespect and fractured relationships with people, versus cumulative impacts or climate change).

2.6 References

A complete list of references and information sources reviewed or cited is included as **Appendix A**.

3 Land Use and Economic Assessment

3.1 Introduction

This section describes the major land uses (mineral exploration and development, transportation and hydroelectric generation and transmission) in the Bathurst range and their economic considerations. Both the current and potential future situations are examined. While it is recognized that other important land uses, such as tourism and recreation, also occur in the Bathurst range, these three land uses account for the majority of human-caused habitat disturbance outside of communities. Human settlements and traditional economy and values are discussed in Section 3, above.

Current mineral exploration and development activities, and transportation and hydroelectric generation and transmission infrastructure, were summarized from available literature and mapping. With the assistance of a Mineral Task Group, the BCRP Working Group defined three future development scenarios to explore plausible patterns and amounts of development footprint within the Bathurst range. The purpose of the scenarios was not to attempt to predict the future but to examine potential levels of range disturbance resulting from different levels of land use activity that could then be examined as part of the structured decision-making evaluation framework.

An important goal of the BCRP is to recommend measures to reduce caribou habitat disturbance. Understanding the amount and location of disturbance is therefore important. To provide a baseline estimate of current human development footprint in the Bathurst range, a human development map was created from a variety of information sources, including the GNWT Cumulative Impact Monitoring Program (CIMP) human disturbance database, the National Road Network, and mineral industry-provided information used to support project assessment and permitting activities. Please see **Appendix C** for a detailed description of human development footprint mapping methods. The land use and footprint mapping information was also used as the basis for creating the future development scenarios.

3.2 Land Use and Disturbance Concepts

Human land use can result in disturbance[4] to caribou. Human disturbance effects can be considered as either **direct** or **indirect**. Some land use features, such as roads, settlements or mine sites, have a direct physical footprint that results in habitat loss or alteration. An area of indirect disturbance may exist around these physical footprints, where noise, dust, smells or other factors influence caribou's use of habitat. This area is known as the zone of influence (ZOI). Within the ZOI, caribou may avoid these areas, use them less frequently, exhibit altered behavior, or have a higher mortality risk from harvest or predation. The ZOI concept can also be understood through the following community perspective:

[4] Disturbance is a temporary or permanent change in environmental conditions that might influence wildlife abundance and distribution. It is comprised of two aspects: direct disturbance is physical change (e.g. trees cut down or burned) whereas indirect disturbance is a change to non-physical aspects of the environment (e.g. noise, smell, light, etc.)

> *The concepts inǫ dè ɔǫ̀goèhshì (the caribou have thrown that land away) is translatable to the zone of influence. The forage conditions surrounding the mines are of poor quality and caribou chose to avoid the area and instead walk in a different direction, towards areas with no noise and better feeding grounds. The TK study for the Diavik Lichen and Soil Sampling Program (TRTI 2013) concluded that the lichen and vegetation, thus forage areas, were of poor quality for a radius of up to 15 kilometres around the mine site of Diavik. Extending from 15 to 30 kilometres, the quality of forage improved, but some locations were still impacted by mining activities. The amount of caribou activity, such as walking and feeding, increased with further distance away from the mine site. The increase in caribou activity correlates with improved caribou forage further away from the mine.* -- Dedats'eetsa: Tłı̨chǫ Research and Training Institute. May 4 2016: 63

In GIS mapping, ZOI is estimated as a buffer of a defined distance around the development features (**Figure 4**). The ZOI extent around different human development features was estimated based on literature reviews and values used in recent environmental assessments. ZOI extents assigned to each human feature type and supporting literature sources are provided in **Appendix D**.

Figure 4 illustrates concepts for the direct footprint of physical features and its associated ZOI. In this example the Snap Lake diamond mine is shown; the property is currently under care and maintenance, and is considered to have a 5 km ZOI surrounding the mine site. Its associated winter road is assigned a 1 km ZOI on either side of the road (2 km total width), which would only be active during the January-April haul period when the road is in use.

Based on the human development mapping and its associated ZOI extents, the amount of direct and indirect disturbance within the Bathurst range can be calculated using GIS. How human disturbance may affect caribou, and the potential effects of different levels of human disturbance on caribou populations, is explored in **Section 4.3.4** and **Appendix F**.

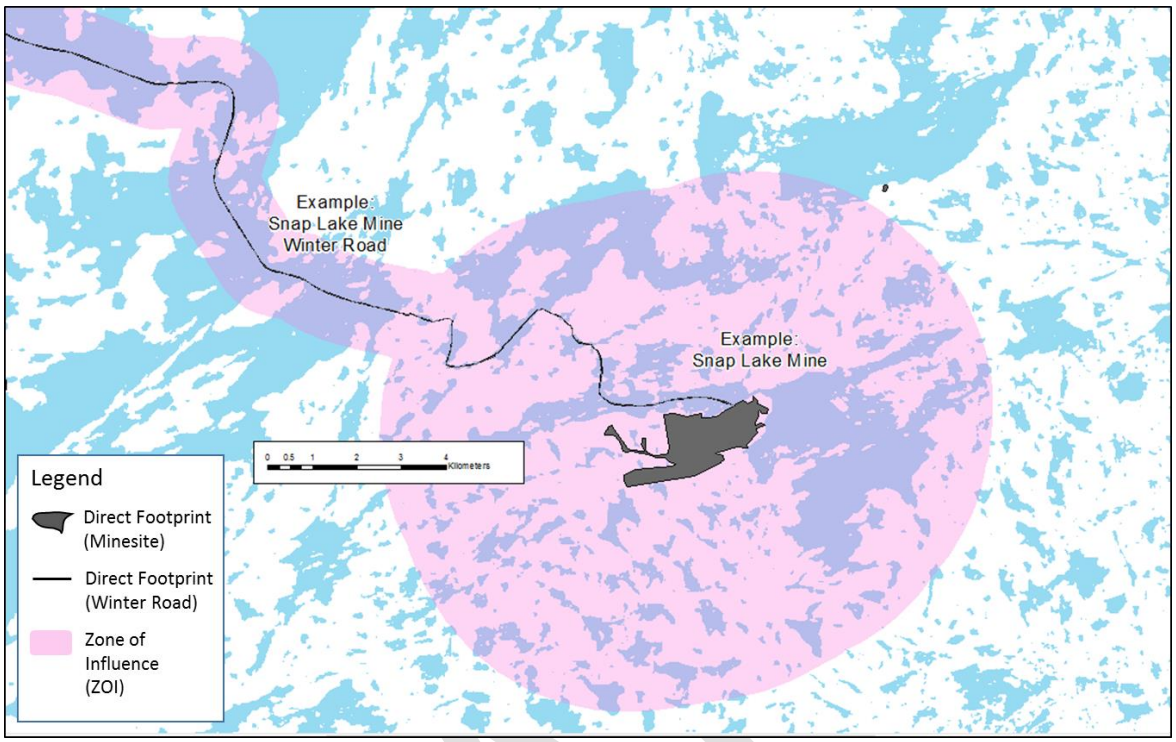


FIGURE 4: HUMAN DISTURBANCE CONCEPTS—DIRECT FOOTPRINT AND ITS SURROUNDING ZONE OF INFLUENCE (ZOI).

3.3 Current Situation

3.3.1 Major Land Uses in the Bathurst Range

3.3.1.1 Mineral Exploration and Development

Over the past century, the Bathurst range has experienced a high level of mineral exploration activity and multiple producing mines. During much of this period, exploration efforts were largely focused on gold, resulting in the construction of several producing gold mines. These included the Giant and Con mines near Yellowknife, the Tundra and Colomac mines in other parts of the Bathurst range in Northwest Territories, and the Lupin mine in Nunavut, near Contwoyto Lake (**Figure 5**). Silke (2009) provides a detailed operational history of mines in the Northwest Territories.

However, in 1993, diamonds were discovered in the Lac des Gras region of the Slave Geological Province in the central Bathurst range, leading to a dramatic increase in the level of mineral exploration in the central NWT and the Kitikmeot region of Nunavut. A prolonged mineral commodity cycle in the 2000s also led to increased interest in gold and base metal exploration. During this period from the mid-1990s to late-2000s, active mineral claims covered most of the central and northern portion of the Bathurst herd range (**Figure 6**). This large increase in exploration activity was the original source of the

cumulative effects concerns for Bathurst caribou as voiced by community members, regulators and scientists.

The diamond discoveries resulted in construction of four new diamond mines: Ekati, Diavik and Snap Lake (all in Northwest Territories), and the Jericho mine in Nunavut (**Figure 5**). A fifth diamond mine, Gahcho Kué, also in Northwest Territories, opened in fall 2016. All of these new mines are located within either the summer or calving and post-calving range of the Bathurst herd. The Jericho diamond mine in Nunavut operated briefly and is currently abandoned, while the Snap Lake mine was put under care and maintenance in late-2015. Several advanced exploration properties resulted from this period including Back River, Hackett River, High Lake and Izok Lake in Nunavut, and Courageous Lake, Indin Lake and Kennady Lake in Northwest Territories[5] (**Figure 5**).

In recent years, the level of mineral exploration has declined dramatically and active mineral claims and leases now occupy only approximately 5% of the Bathurst range planning area, with most occurring in the central Northwest Territories around the three producing diamond mines near Lac de Gras (**Figure 6**), and specific geological tracts in Nunavut. Given this low level of exploration, and the length of time needed to bring a mineral property into production, the potential to replace the existing producing diamond mines with new mines in the near future is uncertain.

[5] Some of these mineral deposits were known for decades but received renewed interest during the extended 2000s commodity mineral cycle.

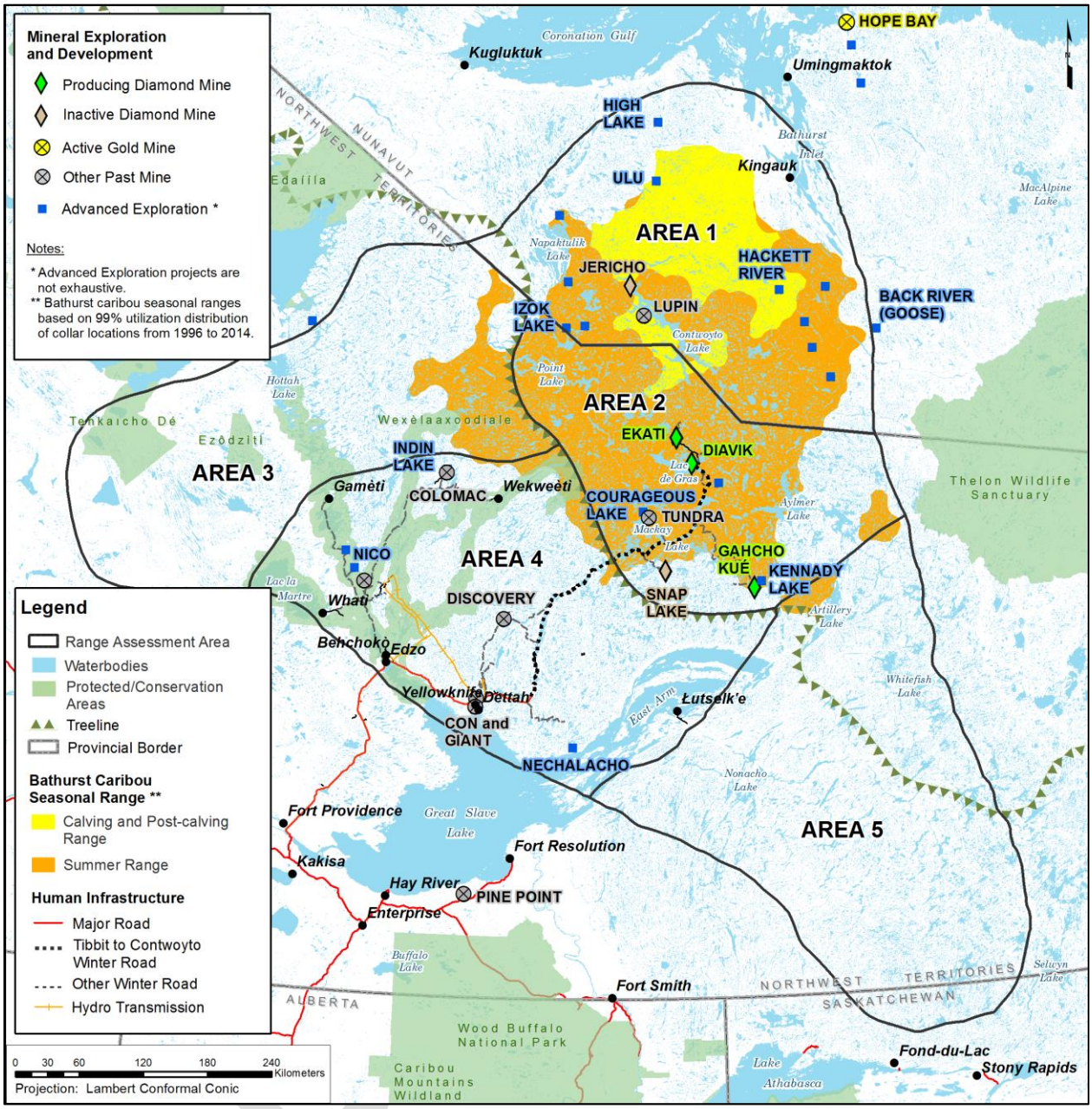


FIGURE 5: PAST MINES, NEW MINES CURRENTLY OPERATING OR UNDER CARE AND MAINTENANCE, AND OTHER ADVANCED EXPLORATION PROJECTS IN THE BATHURST RANGE.

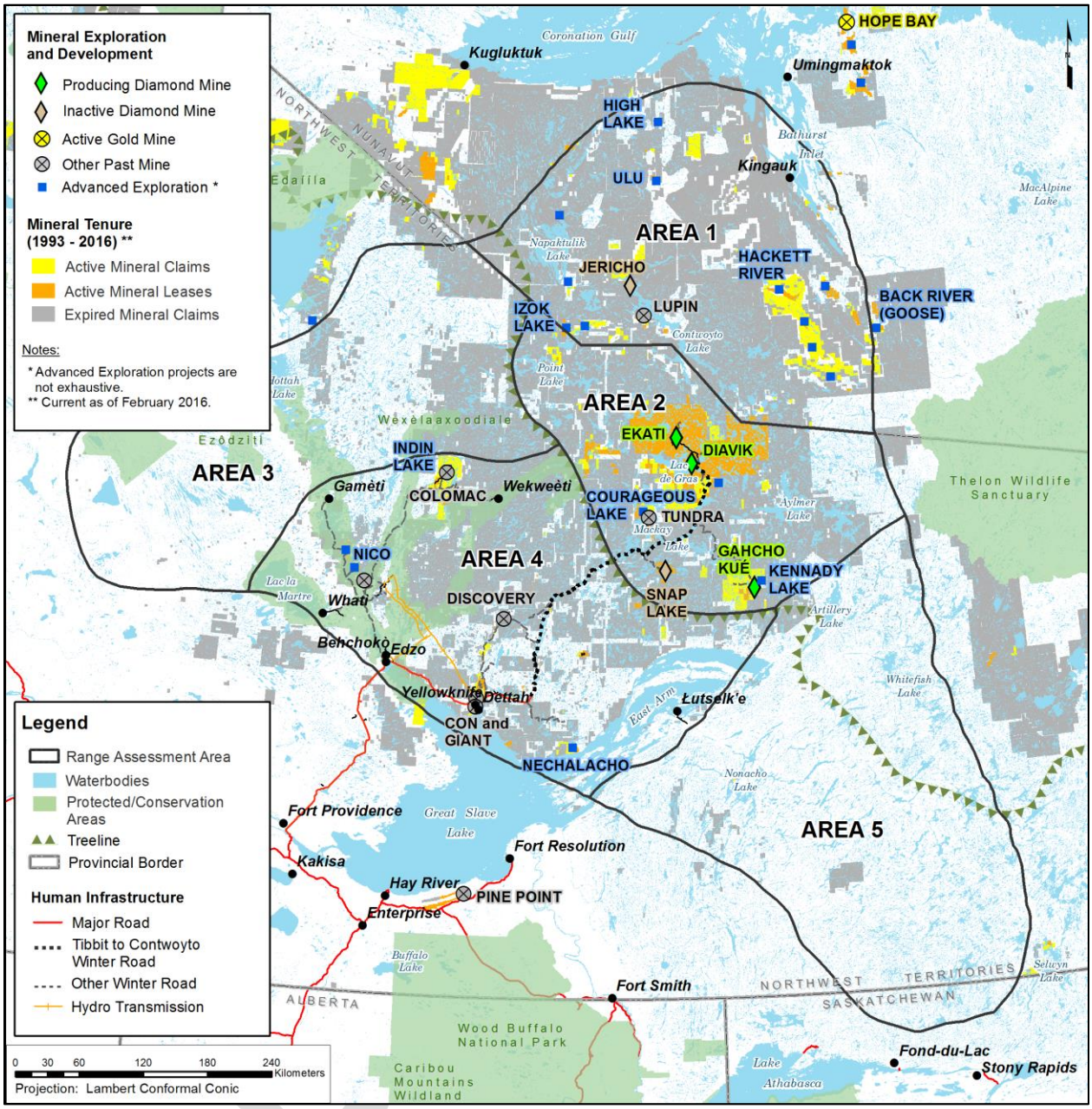


FIGURE 6: HISTORICAL AND CURRENT MINERAL TENURE ON THE BATHURST RANGE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF INVESTMENT, TRADE AND TOURISM, AND NATURAL RESOURES CANADA).

The Mineral Exploration and Development Cycle

Mineral exploration and development can be considered a long-term cycle spanning roughly 25-55 years comprised of five different phases: 1) early exploration, 2) discovery, 3) development/construction, 4) production, and 5) reclamation (**Figure 7**). A sustained level of mineral exploration is required to develop a mine, as fewer than 1 in 1,000 exploration projects generally result in a producing mine, and the average time to develop a mine is 10 to 15 years from discovery to production. Each stage of the mineral exploration and development cycle requires different types of jobs and has varying levels of economic contributions.

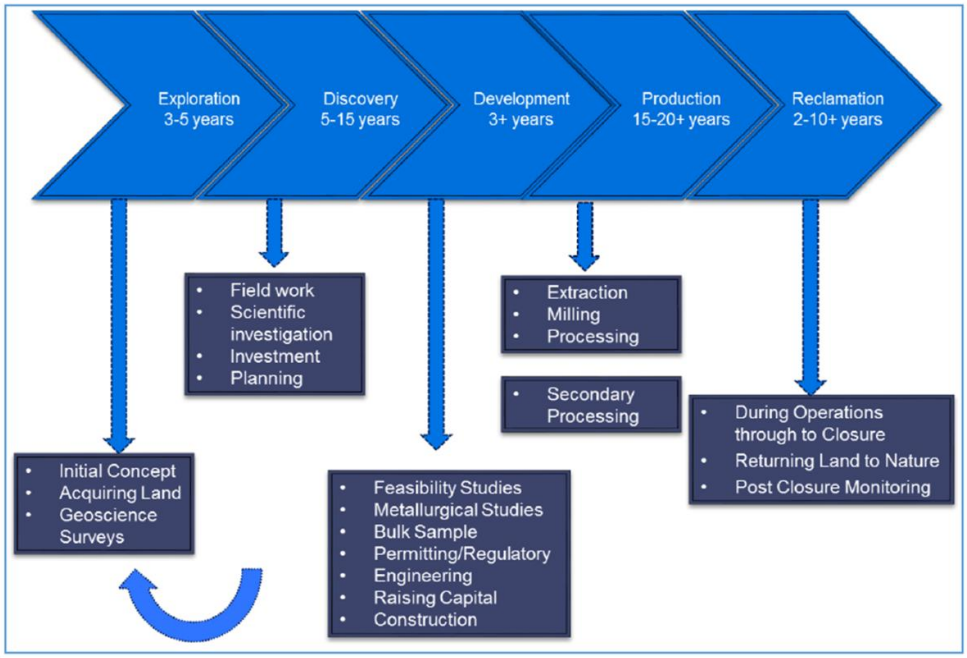


FIGURE 7: THE MINERAL EXPLORATION AND DEVELOPMENT LIFE-CYCLE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF INDUSTRY, TOURISM AND INVESTMENT).

Economic Contributions

Mineral exploration and development have been important components of the NWT economy and have contributed a major legacy of infrastructure, including highways, rail lines and hydroelectric facilities. With the addition of the new major diamond mines, the direct economic benefits of mining account for over one quarter of the NWT's Gross Domestic Product. Indirect benefits are also significant, through spending on transportation, construction, real estate and supporting activities such as monitoring, assessment and project planning. Mining is the largest private sector employer in the territory. Since 1998, the diamond mines alone have generated nearly $10 billion in NWT business contracts (over $4 billion of which were spent with Aboriginal-owned businesses) and have created over 20,000 total person years of employment (nearly half of which were Aboriginal employees) (NWT Industry, Tourism and Investment 2012).

3.3.1.2 Transportation

While there are few major roads in the Bathurst range, it is considered to be the most accessible barren-ground caribou range in Northwest Territories. Almost all roads and trails are located in the west central part of the winter range (RAA4), around the City of Yellowknife and the Tłı̨chǫ communities of Whatì, Wekweètì, Gamèti and Behchokǫ̀-Edzo, and the YKDFN community of Dettah (**Figure 8**).

The only major all-season road in the range, Highway 3, runs along the north shore of Great Slave Lake, connecting the City of Yellowknife and surrounding area to the highway system of southern Canada. Winter roads, operating seasonally between January and early April, are the most important transportation features. Winter roads connect the Tłı̨chǫ communities of Whatì, Gamèti and Wekweètì to Highway 3, and a number of other winter roads are used periodically to transport materials and fuel to mineral exploration sites. The most important winter road is the Tibbitt to Contwoyto Lake route which connects the three operating diamond mines near Lac de Gras to the public highway system (**Figure 8**). The Tibbit to Contwoyto winter road was originally constructed in 1982 to service the Lupin minesite near the Nunavut-NWT border. From its start at the end of Highway 4 (Ingraham Trail) to the Lupin mine, the Tibbit to Contwoyto Lake winter road spans approximately 600 km, although in recent years the road has only been constructed as far as the Ekati minesite (a distance of approximately 450 km). Approximately 87% of the road is routed over frozen lakes. In high traffic years, as many as 11,000 freight trucks travel the winter road at a rate of 12 to 15 trucks per hour, 24 hours per day. Three seasonal maintenance camps are located along the route.

The Tibbit to Contwoyto Lake winter road will likely continue to be constructed and used annually as long as the operating mines require resupply. GNWT is currently considering a 160 km all-season overland road (the Slave Geological Province all-season access road) to replace the southern section of the Tibbit to Contwoyto road, in order to extend the length of winter road operations. An all-season road from Highway 3, to the southwest of Behchokǫ̀, to Whatì is also being planned[6]. In Nunavut, an all-season road is being considered from Grays Bay to the central Kitikmeot region (the Grays Bay – Izok Lake corridor) and previously, an all-season road has been proposed between Bathurst Inlet and Contwoyto Lake (the BIPAR road corridor). Other project specific winter roads may also be built, as required.

3.3.1.3 Hydro Development and Transmission

Two major hydroelectric development and transmission systems are located along the western periphery of the Bathurst range (**Figure 8**). The Bluefish and Snare hydro systems supply power to the City of Yellowknife and other North Slave communities. Together they consist of five hydro generators and approximately 150 km of transmission lines. The Taltson hydroelectric facility, near Fort Smith, is not within the planning area but uses Nechalcho Lake, to the southeast of Lutsel'Ke, as a reservoir, resulting in fluctuating water levels.

[6] As of December 2016, the Behchokǫ̀ to Whatì all-season road was undergoing environmental assessment.

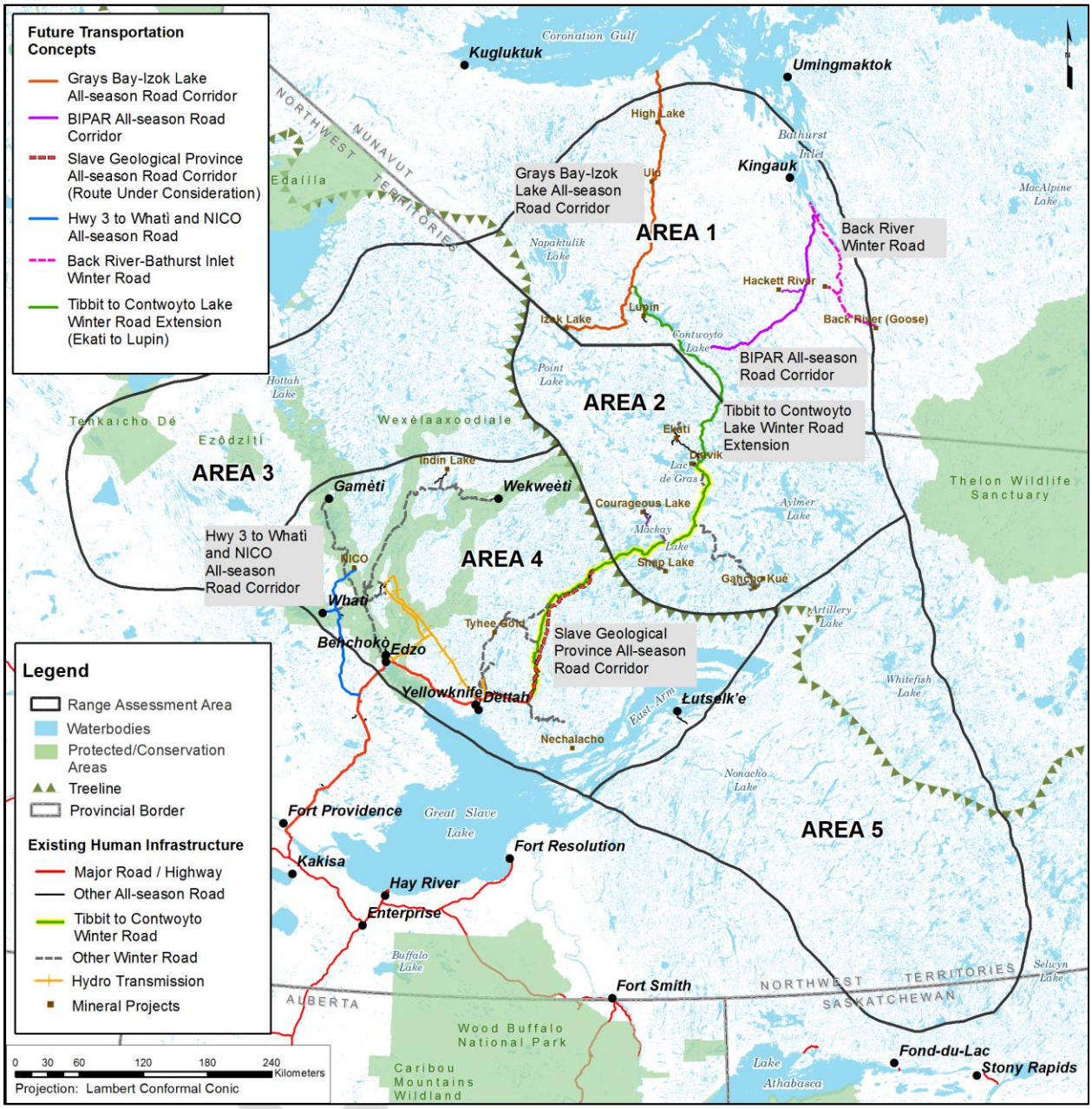


FIGURE 8: MAJOR TRANSPORTATION AND HYDRO FACLITIES AND TRANSMISSION LINES IN THE BATHURST RANGE.

3.3.2 Current Human Disturbance

Figure 9 shows the location of current direct human footprint and its associated ZOI resulting from land use. **Table 2** summarizes the amount of human disturbance within the Bathurst range, and by range assessment area. Using available mapping, the BCRP Working Group determined that less than 0.05% (179.5 km^2) of the Bathurst annual range is currently affected by direct development footprint. Some of the disturbance is seasonal. For example, the Tibbit to Contwoyto Lake winter road is only operational between January and early-April of each year, and crosses frozen waterbodies for much of its length. Settlements (e.g., City of Yellowknife) and active mine sites (e.g., Ekati, Diavik and Gacho Kué) are the largest sources of direct footprint, followed by linear features such as all-season and winter roads, trails and electrical transmission corridors.

While the direct footprint of human land use in the Bathurst herd range may be very small, in some areas the total human ZOI is substantial. Using the ZOI assumptions described in **Appendix D**, the BCRP Working Group estimated that approximately 5.6% (21,898 km^2) of the Bathurst range is currently affected by direct and indirect human disturbance (direct footprint with associated ZOI) (**Table 2**). The highest levels of human disturbance occur in the Northwest Territories, in RAA4 (central winter range), where all of the permanent settlements and all-season highways are located, and RAA2 (central tundra) where the current operating diamond mines are located (**Figure 9**). Although linear features have a relatively small direct footprint, they are a major contributor to total human ZOI on the Bathurst annual range, and facilitate access for humans into previously difficult to travel areas.

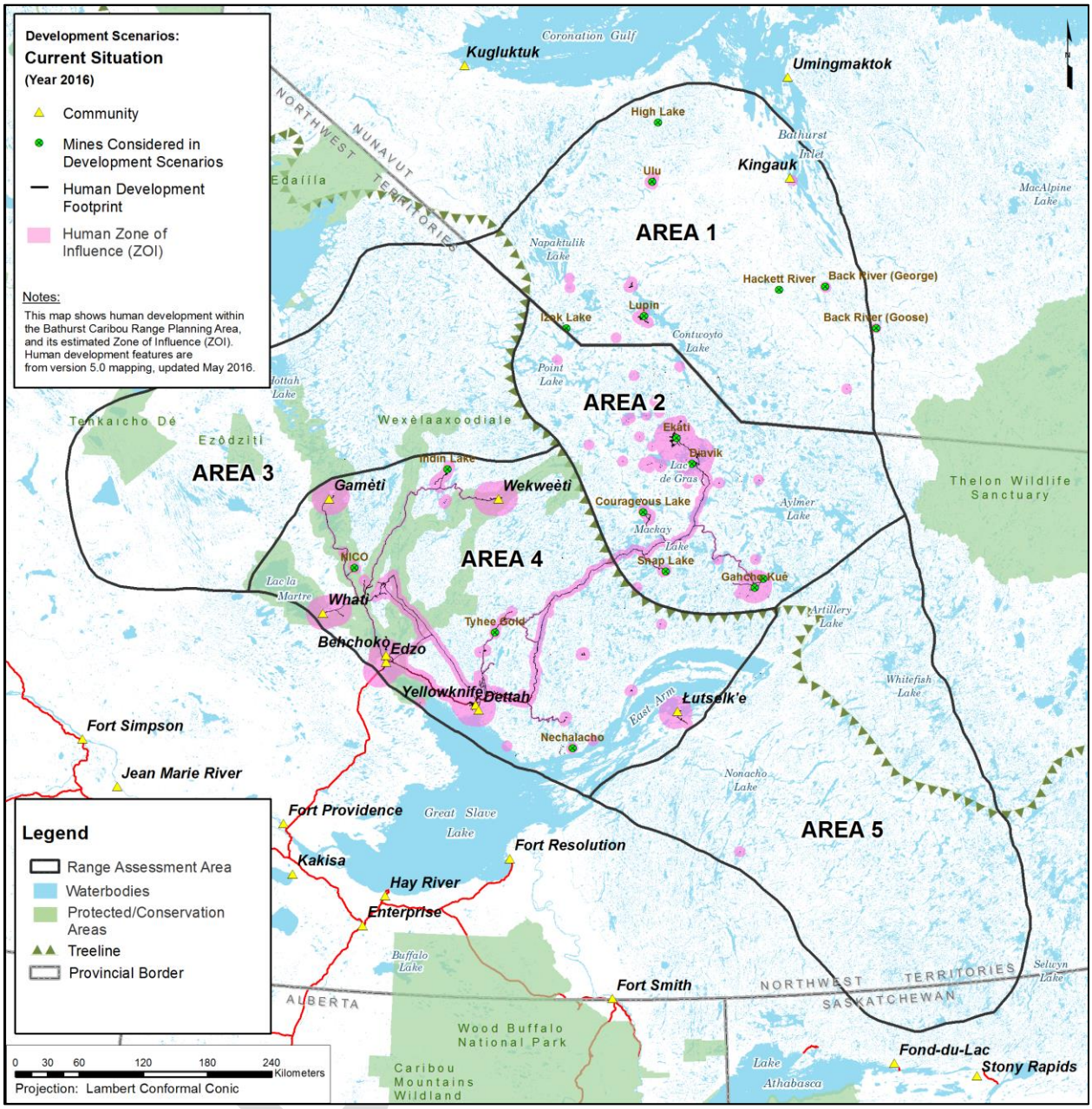


FIGURE 9: CURRENT DIRECT AND INDIRECT HUMAN DISTURBANCE IN THE BATHURST RANGE.

TABLE 2: CURRENT STATUS OF HUMAN DISTURBANCE BY RANGE ASSESSMENT AREA.

Range Assessment Area	Range Assessment Area Size	Direct Human Development Footprint		Total Human Disturbance (includes ZOI)	
	(km^2)	(km^2)	(% of RAA)	(km^2)	(% of RAA)
Area 1 : Nunavut	75,902 km^2	20 km^2	<1%	1,080 km^2	1.4%
Area 2: NWT Central Tundra	56,134 km^2	70 km^2	<1%	6,610 km^2	11.8%
Area 3: NWT Winter Range - Northwest	77,001 km^2	<1 km^2	<1%	<1 km^2	<1%
Area 4: NWT Winter Range – Central	84,858 km^2	90 km^2	<1%	14,120 km^2	16.6%
Area 5: NWT Winter Range – Southeast	95,127 km^2	<1 km^2	<1%	88 km^2	<1%
TOTALS	389,022 km^2	181 km^2	<1%	21,898 km^2	5.6%

3.4 Future Situation

3.4.1 Future Development Scenarios

Future development (land use) scenarios provide insight into the amount of human-caused change that may occur in different parts of the range in the future. The scenarios were created using information based on known or reasonably foreseeable future mineral development and transportation projects that may occur in the next 24 years (2016 to 2040)[7]. Early-stage mineral exploration (mineral staking and grass-roots exploration activities) was not addressed in the future development scenarios, but may be examined in the future. The BCRP considered three potential scenarios:

- CASE 1: Declining development;
- CASE 2: Continuing development; and
- CASE 3: Increasing development.

[7] The BCRP Working Group worked closely with the Mineral Task Group to develop assumptions and project parameters for the three development scenarios.

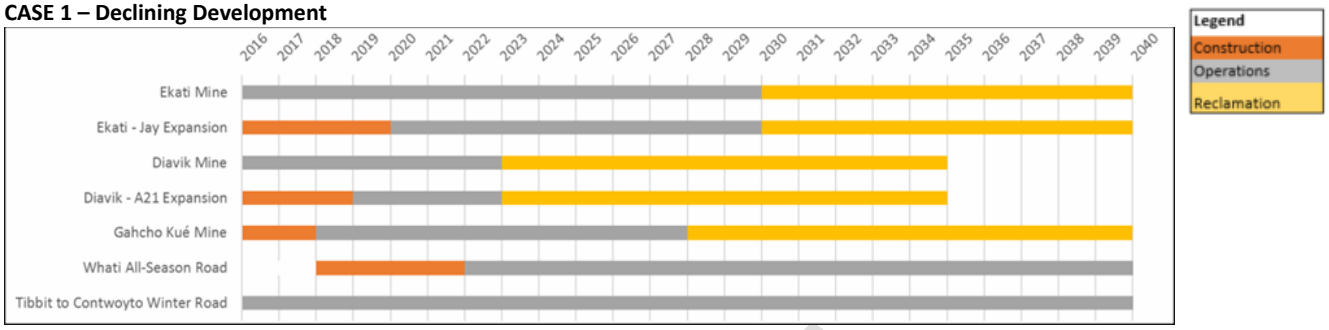
Table 3 summarizes the major assumptions for each scenario. For each case, a detailed timeline of construction, operations and reclamation was created for each project considered in the scenario (**Figure 10**). CASE 1 represents a situation of declining development, where the existing operating diamond mines and Tibbit to Contwoyto Lake winter road cease operations by 2040, and no new mines are brought to production. CASE 2 projects a similar level of development into the future as current, where the existing diamond mines are replaced by new mineral development projects in the coming decades, and the southern part of the Tibbit to Contwoyto Lake winter road is replaced by a new all-season road into the central Slave Geological Province. CASE 3 represents an increasing level of development with new all-season road infrastructure in Nunavut and several new mines being developed, both in Nunavut and Northwest Territories.

TABLE 3: OVERVIEW OF BATHURST RANGE PLAN FUTURE DEVELOPMENT SCENARIOS.

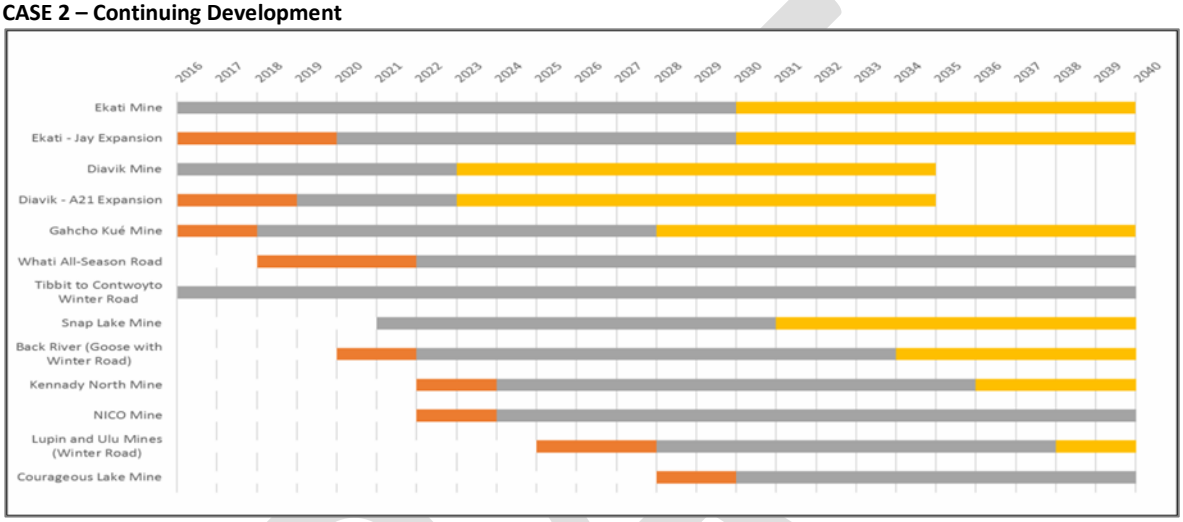
Scenario Assumptions	CASE 1: Declining Development	CASE 2: Continuing Development	CASE 3: Increasing Development
General Assumptions	CASE 1 assumes the existing producing mines are closed at the end of their projected life-span and no new mines are built, leading to the discontinuation of the Tibbit to Contwoyto Lake Winter Road. Mineral exploration declines or remains similar to current, with no other changes in transportation ore electrical utility infrastructure.	CASE 2 assumes that only a few of the existing advanced mineral exploration projects will become producing mines in the coming 24 years, mineral exploration will remain similar to current, and there will be limited change in current transportation and electrical utility infrastructure.	CASE 3 assumes that many of the existing advanced mineral exploration projects will become producing mines in the coming 24 years, the level of mineral exploration may increase, and the amount of transportation infrastructure will increase, but electrical generation will remain similar to current.
Advanced Mineral Exploration*	• Current mineral exploration projects.	• Current mineral exploration projects are maintained except those that advance to producing mines. • 3 new Advanced Exploration projects	• Current mineral exploration projects are maintained except those that advance to producing mines. • 7 new Advanced Exploration projects (CASE 2 plus 4 new)
Mineral Development	3 active mines: • 3 producing diamond mines (Ekati, Diavik and Gahcho Kué) • 1 diamond mine under care and maintenance (Snap Lake). The 3 producing diamond mines become past mines as they reach closure in 10-20 years future.	6 active mines: • Back River Project (Goose) • Snap Lake (re-opens) • Kennady North • Lupin-Ulu • NICO • Courageous Lake The 3 producing diamond mines become past mines as they reach closure in 10-20 years future.	12 active mines (CASE 2 plus the following 6): • Izok Lake • High Lake • Hackett River • Indin Lake • Nechalacho • Tyhee Gold
Transportation	Current all-season and winter road transportation network. After the Ekati, Diavik and Gacho Kué mine sites are closed, the Tibbit to Contwoyto Winter Road is no longer used.	Current road network maintained <u>except</u> construction of new all-season roads: • Hwy #3 to Whatì (replace existing winter road); • NICO to Whatì; • Tibbitt to Lockhart Lake (replaces approximately 150km southern section of existing winter road) Construction of Back River Project winter road to Bathurst Inlet and Marine Laydown facility proceeds.	Future low scenario <u>plus</u> new Nunavut minesite access roads: • IZOK road and port • BIPAR road and port (Phase I) • Back River utilizes BIPAR road and port
Electrical Generation and Transmission	Current facilities and transmission: • Snare; • Bluefish; and • Taltson	No change; current situation is maintained.	No change; current situation is maintained.
Settlements	Current situation	No change; current situation is maintained.	No change; current situation is maintained.

*Early-stage mineral exploration (staking and grass-roots exploration) is not currently addressed in the BCRP Development Scenarios.

CASE 1 – Declining Development



CASE 2 – Continuing Development



CASE 3 – Increasing Development

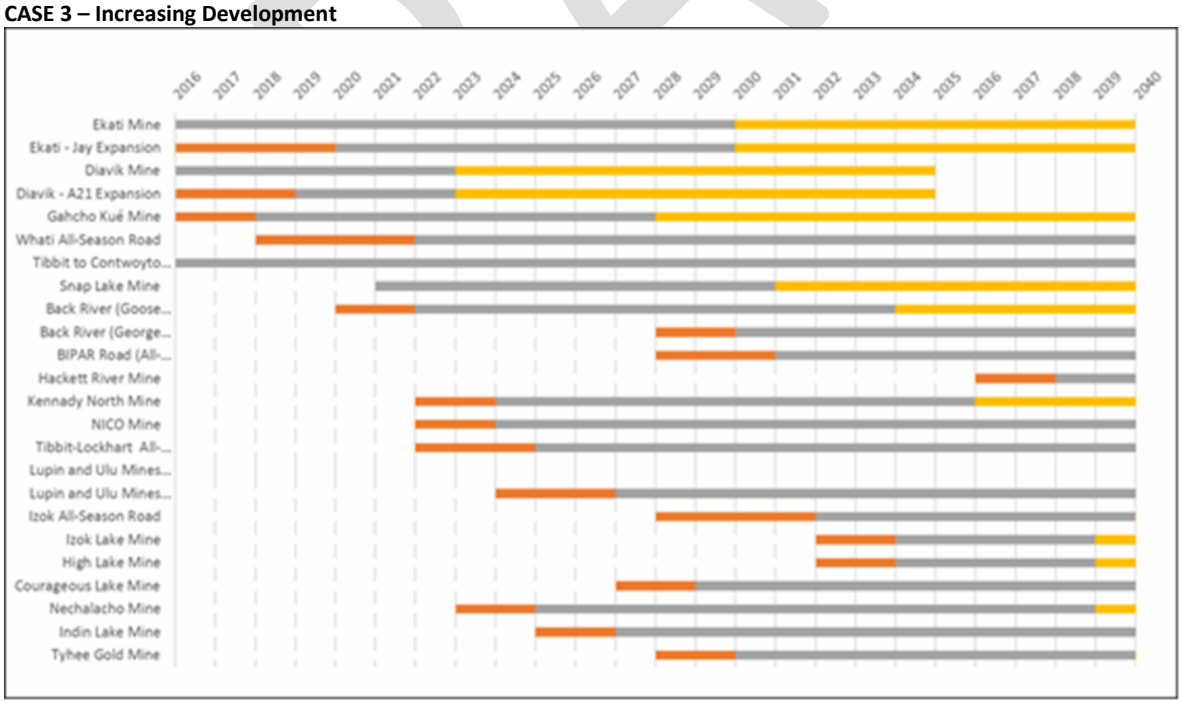


FIGURE 10: DETAILED TIMELINES FOR PROJECTS CONSIDERED IN BCRP FUTURE DEVELOPMENT SCENARIOS.

3.4.2 Disturbance Resulting from Future Development Scenarios

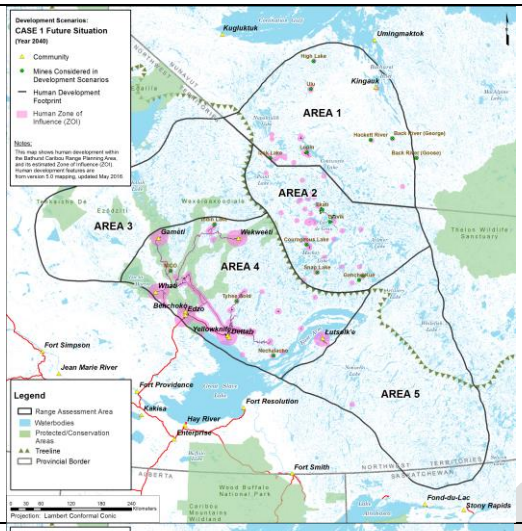
Figure 11 shows the mapped results of each scenario at year 2040. In all cases, there is very limited new land use activity projected for RAA3 (NWT Northwest Winter Range) and RAA5 (NWT Southeast Winter Range. Projected changes in total human disturbance resulting from the three development scenarios for RAA1 (Nunavut), RAA2 (NWT Central Tundra), and RAA4 (NWT Central Winter Range) are shown in **Figure 12**. Major results are as follows:

RAA1: Nunavut

- **Case 1**: There is no projected development, only minor increases in exploration activity. Total disturbance remains relatively constant below 1,700 km^2 into the future (this includes the Lupin and Ulu sites currently in maintenance mode).
- **Case 2**: The Back River (Goose) project begins in 2021 using winter road access only. The Lupin and Ulu projects begin in 2026 using an extension of the winter road from the south. Total disturbance reaches a high of over 4,600 km^2.
- **Case 3**: In addition to Case 2:
  - The Back River (George) project begins and the BIPAR all-season road is built in 2029. The Izok all-season road is built in 2029 along with an all-season connection to Lupin. Total disturbance rises to 7,600 km^2.
  - The Izok Lake and High Lake projects begin in 2033 using all-season road access. Total disturbance rises to over 9,400 km^2.
  - The Hackett River project begins in 2037 using all-season road access. Total disturbance rises to nearly 9,800 km^2.

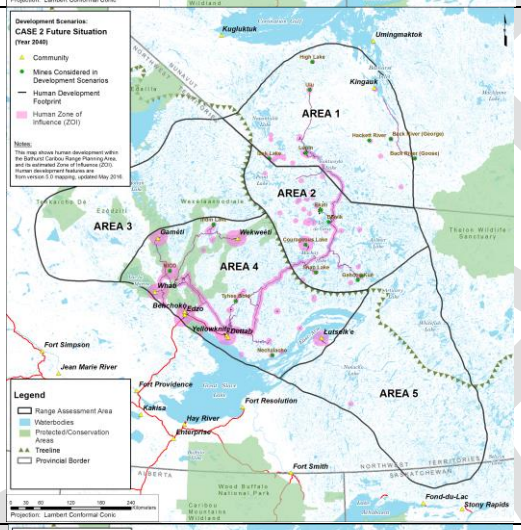
RAA2: NWT Central Tundra

- **Case 1**: There is no projected new mineral developments. Total disturbance begins at nearly 6,600 km^2, increases to over 6,900 km^2 when Gahcho Kue becomes fully operational, and then decreases significantly later when all mines enter the closure/reclamation phase and the winter road is no longer used.
- **Case 2** and **Case 3** are very similar, except for minor differences in exploration activity. In addition to Case 1, the Snap Lake mine resumes operations by 2023 along with the new Kennady North mine, and the Courageous Lake mine begins operations by 2030 and the winter road gets extended to support developments further north. Total disturbance rises to a high of over 8,400 km^2 by 2026, decreasing after 2030 when some mines enter the closure/ reclamation phase.



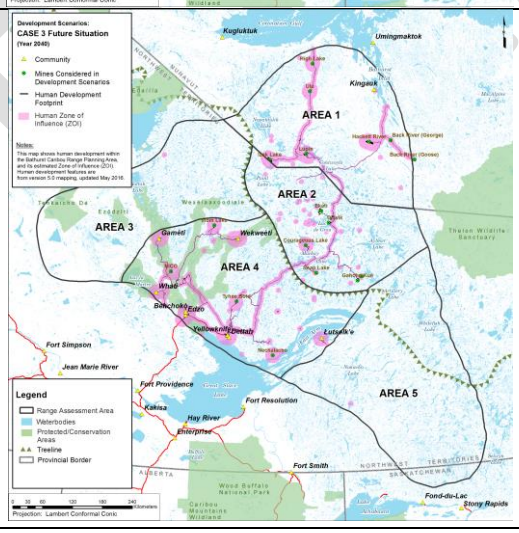
CASE 1:
Declining Development

Year 2040



CASE 2:
Continuing Development

Year 2040



CASE 3:
Increasing Development

Year 2040

FIGURE 11: POTENTIAL FUTURE HUMAN DISTURBANCE IN THE BATHURST RANGE: CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT). ALL MAPS SHOW RESULTS AT YEAR 2040.

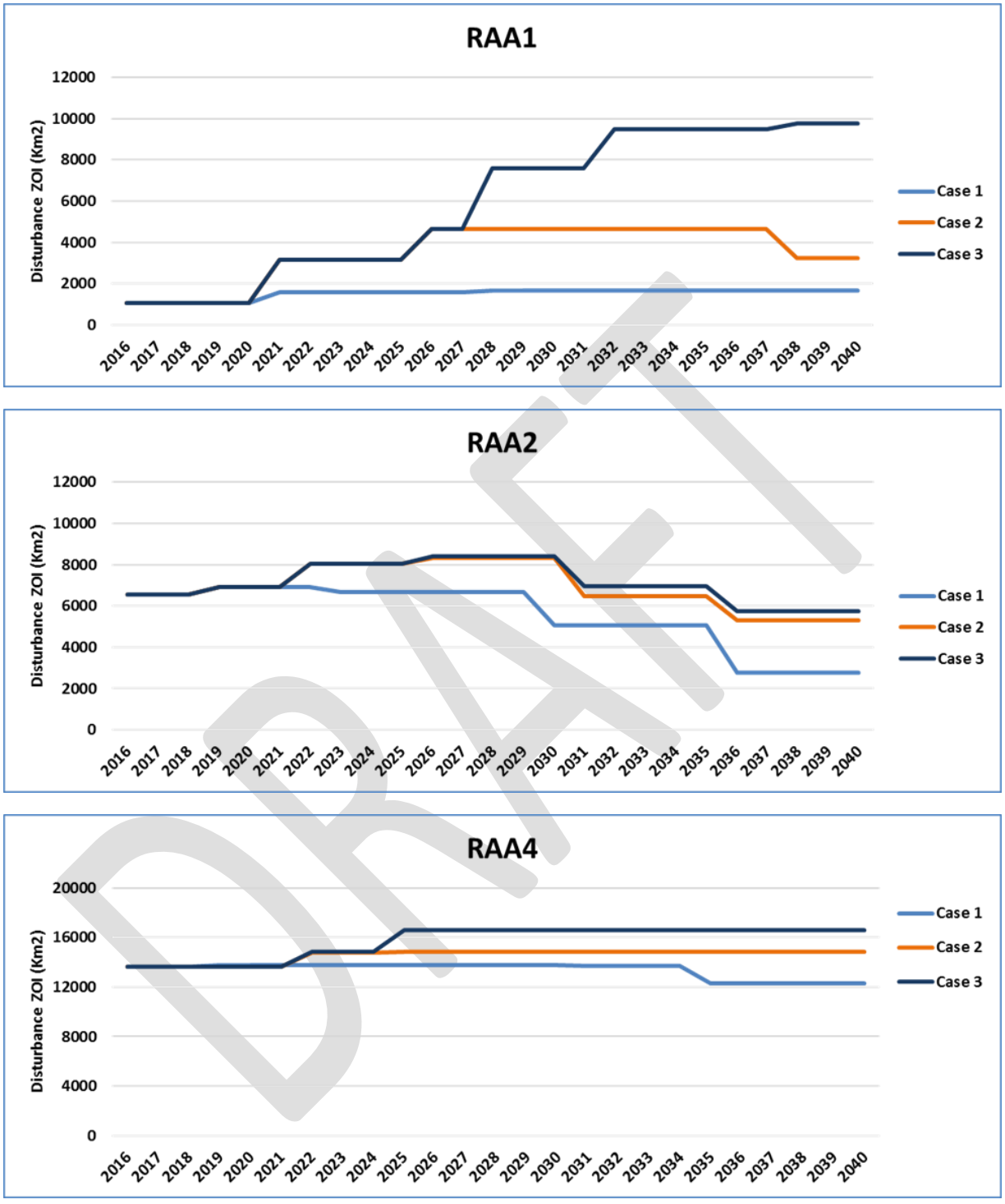


FIGURE 12: TOTAL HUMAN DISTURBANCE RESULTING FROM THREE FUTURE DEVELOPMENT SCENARIOS, CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT), IN RAA1, RAA2 AND RAA4.

RAA2: NWT Central Winter Range

- **Case 1:** There is no projected development other than the proposed Whati all-season road in 2019, which has a relatively small disturbance footprint (110 km^2). Total disturbance remains constant at 13,700 km^2 into the future, decreasing somewhat when the winter road is no longer required.
- **Case 2:** The NICO project begins in 2023 using an all-season road to Whati. Total disturbance then remains constant at 14,800 km^2 into the future.
- **Case 3:** In addition to Case 2:
  - The Nechlacho, Indin Lake and Tyhee projects all begin by 2029. The Tibbit to Lockhart all-season road is built in 2023, replacing that portion of the TCWR. Total disturbance then remains constant at 16,600 km^2 into the future.

3.4.3 Economic Assessment of Future Development Scenarios

An economic assessment of the three Future Development Scenarios was conducted to understand the relative economic outputs associated with each. This first-order assessment is based primarily on the use of published economic multipliers for Northwest Territories (NWT Bureau of Statistics 2012)[8]. Using input of the Mineral Task Group, three economic indicators were calculated for each scenario: Gross Domestic Product (GDP), Employment and Labour Income. The three indicators were each calculated for the general project phases of construction, operations and reclamation. Values were calculated in annual time steps based on the detailed project timelines shown in **Figure 10**.

The goal of economic evaluation within the BCRP range planning exercise is not to make precise predictions about future economic outputs resulting from potential mineral development and transportation projects. Instead, its purpose is to understand the relative changes that may occur as a means to explore the potential economic consequences of different caribou habitat management strategies that could alter, defer or limit future levels of future land use activity. Please see **Appendix E** for a detailed description of economic evaluation assumptions and methods.

The potential economic implications of the three development scenarios, reported by range assessment area, are as follows:

[8] Similar economic multipliers have not yet been gathered for Nunavut. The use of more sophisticated Input/Output economic models is currently under consideration.

RAA1 - Nunavut

Figure 13 and **Figure 14** show the projected change in GDP ($M/year) and employment (PY/year) resulting from development Case 1, 2 and 3 for RAA1:

- **Case 1**: There is no projected development, therefore no GDP or employment.
- **Case 2**: The Back River (Goose) project begins in 2021 causing a short term increase in construction related employment up to over 700 PY/Yr and increase in GDP to over 90 $M/Yr. The Lupin and Ulu projects begin in 2026 causing a decade-long rise in GDP to nearly 200 $M/Yr. Long-term employment opportunities increase up to nearly 700 PY/Yr for 3 years, then drop to around 300 PY/Yr by 2029 and again down to 150 PY/Yr by 2040.
- **Case 3**: In addition to Case 2:
  - The Back River (George) project begins in 2029 causing an increase in in construction related employment up to nearly 1,300 PY/Yr and increase in GDP to over 300 $M/Yr.
  - The Izok Lake and High Lake projects begin in 2033 causing a short term increase in construction related employment up to a peak of nearly 5,700 PY/Yr and increase in GDP to nearly 950 $M/Yr.
  - The Hackett River project begins in 2037 causing a second short term increase in construction related employment up to a peak of over 4,000 PY/Yr and increase in GDP to a peak of over 1,300 $M/Yr.
  - Izok and High Lake mines shift to reclamation phase in 2040 causing a drop in employment and GDP.
  - Long term non-construction employment hovers around 1,500 PY/Yr from 2033 onward.

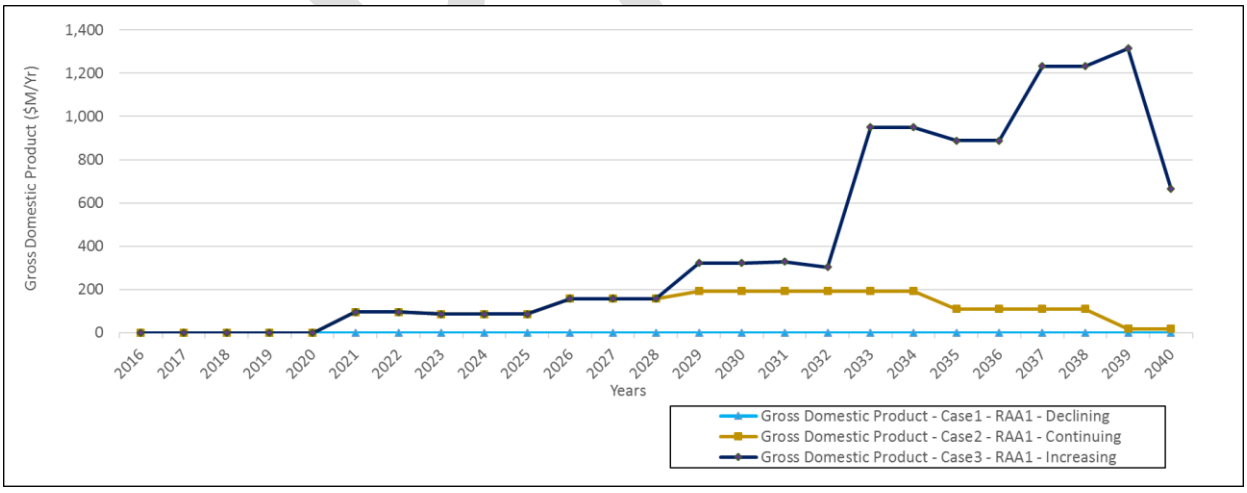


FIGURE 13: RAA1 (NUNAVUT) - PROJECTION OF POTENTIAL CHANGE IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

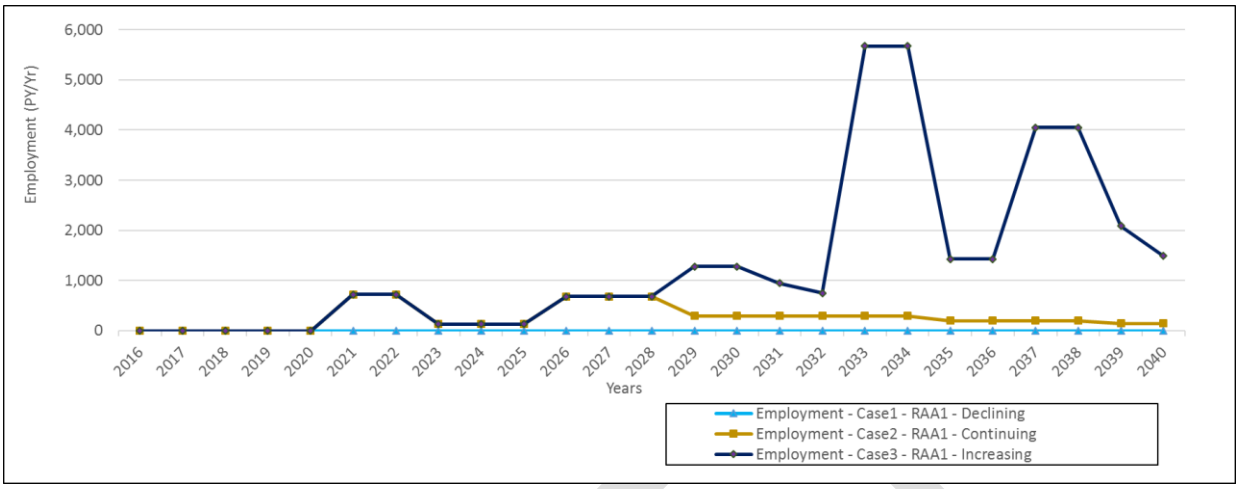


FIGURE 14: RAA1 (NUNAVUT) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

RAA2 – NWT Central Tundra

Figure 15 and **Figure 16** show the projected change in GDP ($M/year) and employment (PY/year) resulting from development Case 1, 2 and 3 for RAA2:

- **Case 1**: There is no projected new development. The current GDP of over 970 $M/Yr decreases over time to near zero as the current active mines reach reclamation and then closure. Similarly, the current active employment of 3000 PY/Yr decreases over time to very low levels.
- **Case 2** and **Case 3** are the same. In addition to Case 1:
  - The Snap Lake mine resumes operations by 2023 and along with the new Kennady North mine there is an increase in GDP to nearly 1,300 $M/Yr in 2023. GDP then drops with the closure of Diavik, before another increase to nearly 1,100 $M/Yr in 2030 with the construction of the Courageous Lake mine. Long-term GDP drops to 400 $M/Yr and then below 300 $M/Yr as the larger existing mines close.
  - The Snap Lake mine resumes operations by 2023 and along with the new Kennady North mine there is an increase in employment to over 3,500 PY/Yr in 2023. Employment then drops with the closure of Diavik, before another short-term increase to nearly 4,000 PY/Yr in 2030 with the construction of the Courageous Lake mine. Long-term employment drops to around 700 PY/Yr as the larger existing mines close.

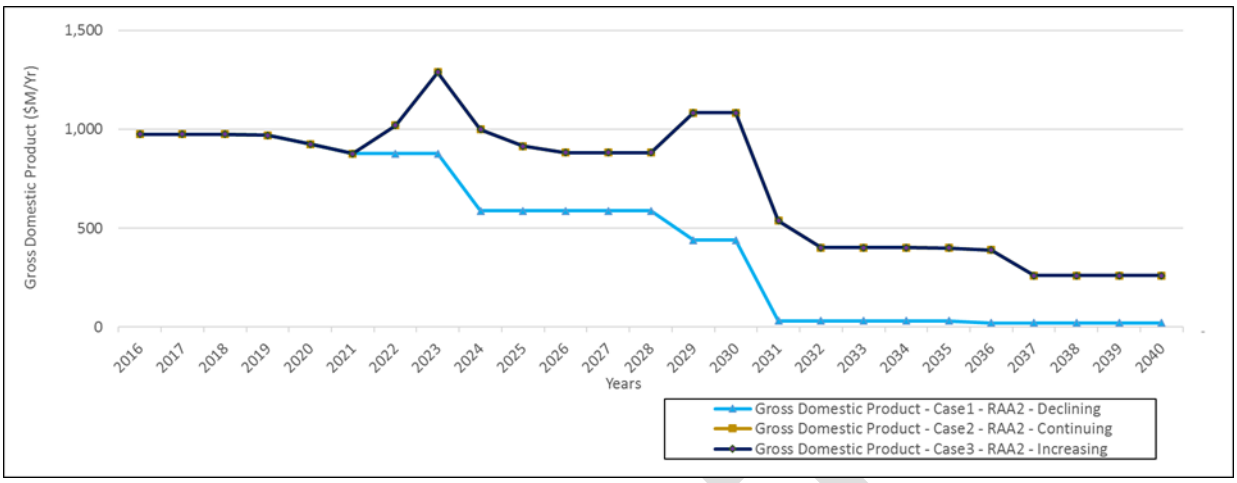


FIGURE 15: RAA2 (NWT CENTRAL TUNDRA) - PROJECTION OF POTENTIAL CHANGE IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

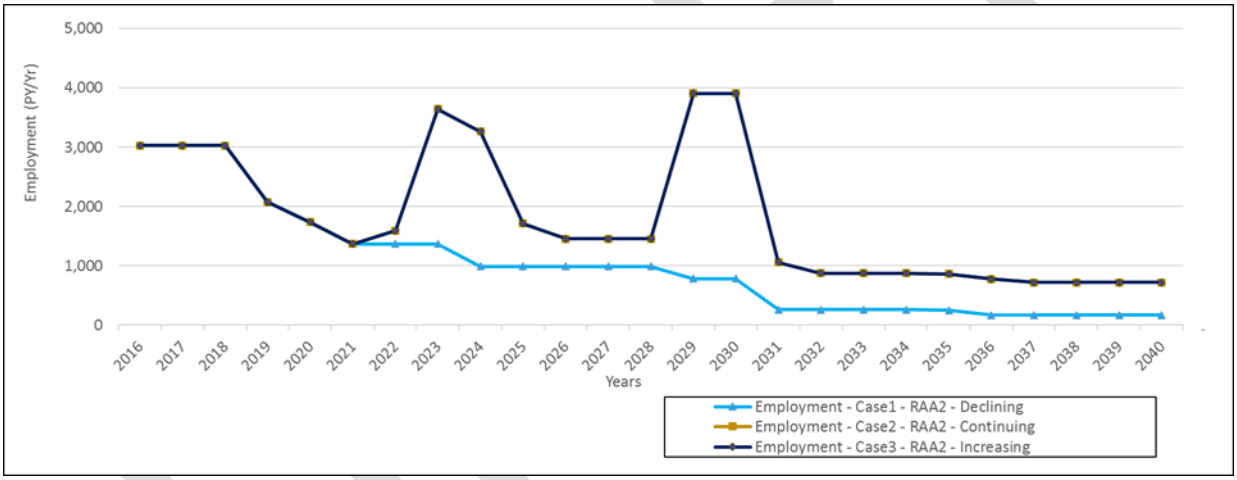


FIGURE 16: RAA2 (NWT CENTRAL TUNDRA) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

RAA4 – NWT Central Winter Range

Figure 17 and **Figure 18** show the projected change in GDP ($M/year) and employment (PY/year) resulting from development Case 1, 2 and 3 for RAA4:

- **Case 1**: There is an increase in GDP (up to over 20 $M/Yr) and employment (up to nearly 180 PY/Yr) during the three-year construction of the Whati road.
- **Case 2**: In addition to Case 1, the NICO project begins in 2023:
  - There is a two-year increase in construction related employment up to over 640 PY/Yr.

Long-term employment opportunities drop to around 80 PY/Yr.
    - There is a two-year increase in construction related GDP to over 80 $M/Yr. Long-term GDP drops to around 40 $M/Yr.

- **Case 3**: In addition to Case 2:
    - The Nechlacho, Indin Lake and Tyhee projects all begin by 2029.
    - There is an increase in construction related employment up to over 3,400 PY/Yr for two years. Long-term employment opportunities drop to around 740 PY/Yr.
    - There is an increase in long-term GDP to around 470 $M/Yr.

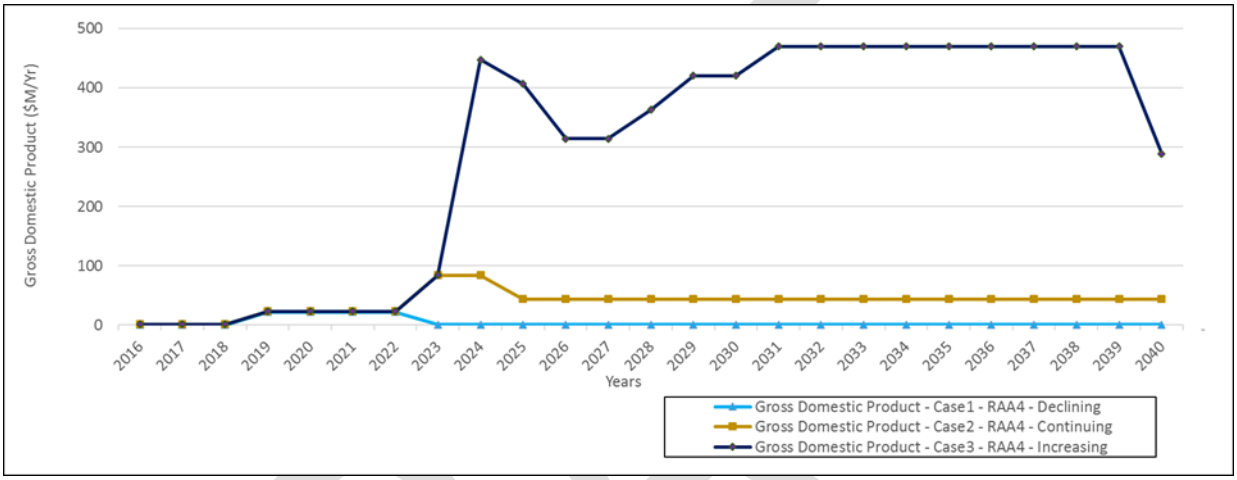


FIGURE 17: RAA4 (NWT CENTRAL WINTER RANGE) - PROJECTION OF POTENTIAL CHANGE IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

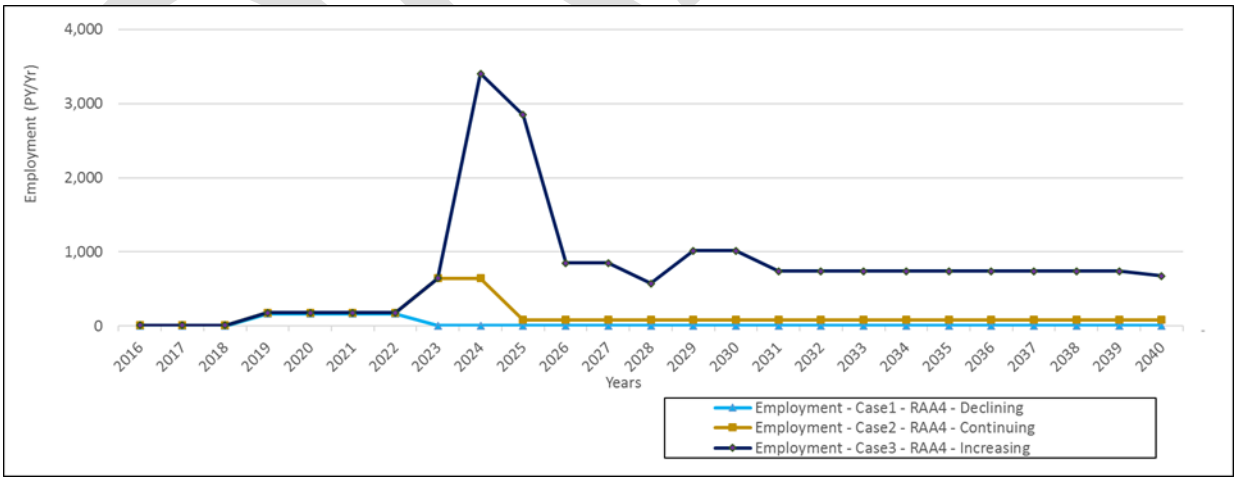


FIGURE 18: RAA4 (NWT CENTRAL WINTER RANGE) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

3.5 Summary

This section described the major industrial land uses (mineral exploration and development, transportation, and power generation and transmission), their economic considerations and levels of human-caused disturbance within the BCRP planning area. While other important land uses such as tourism and recreation also occur in the Bathurst range, these three land uses account for the majority of human-caused habitat disturbance outside of communities, a situation anticipated to continue into the future. Both the current and potential future situations were considered.

3.5.1 Current Situation

- Based on available human disturbance mapping and the ZOI assumptions described in **Appendix D**, approximately 5.6% (21,898 km^2) of the Bathurst range planning area is currently affected by direct and indirect human disturbance (direct footprint with associated ZOI).
- The highest level of disturbance is in RAA4 (NWT central winter range), where all of the permanent settlements and all-season highways are located.
- RAA2 (NWT central tundra), with the current operating diamond mines, contains the second highest level of disturbance.
- RAA4 has the highest level of road and trail access.

3.5.2 Future Situation

- With the assistance of the Mineral Task Group, three future development scenarios were created to explore potential levels of future human disturbance in the BCRP planning area.
- The future development scenarios ranged from declining development (CASE 1) to increasing development (CASE 3).
- In all scenarios, RAA3 and RAA5 were projected to have very low levels of industrial land use.
- RAA1 (Nunavut) has the potential to experience the largest increases in human development and associated disturbance.
- A coarse-level economic assessment of the three future scenarios indicated the potential magnitude of economic impacts generated by new mines and transportation infrastructure for the NWT and Nunavut economies.

The potential effects of the current and future disturbance outcomes on caribou are discussed in **Section 4**, below.

3.6 References

NWT Department of Industry, Tourism and Investment. 2012. Northwest Territories Mineral Development Strategy. Prepared by GNWT and NWT and Nunavut Chamber of Mines. Yellowknife.

NWT Bureau of Statistics. 2012. NWT Economic Multipliers—Overview and Results. Government of Northwest Territories. July 2012. Available online: http://www.statsnwt.ca/economy/multipliers/.

Silke, R. 2009. The operational history of mines in the Northwest Territories, Canada. A historical research project. Prepared for Northwest Territories Geoscience Office. Yellowknife, Northwest Territories. Available online: www.nwtgeoscience.ca.

4 Caribou Assessment

4.1 Introduction

This section describes the methods and information related to Bathurst caribou used to support development of the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016). Three major topics are addressed: Bathurst caribou population status and range use, factors affecting caribou, and sensitive or important areas of the Bathurst herd range.

4.2 About the Bathurst Caribou Herd

The Bathurst herd is a population of migratory barren-ground caribou (*Rangifer tarandus groenlandicus*) that traditionally calves near Bathurst Inlet in the Kitikmeot Region (i.e., central Arctic) of Nunavut. Its annual range extends across the tundra and taiga (boreal forest) biomes occurs within Nunavut and the eastern Northwest Territories. The Bathurst herd shares its annual range with at least three other migratory barren-ground caribou herds: the Bluenose East, Beverly-Ahiak and Dolphin Union[9] (**Figure 19**).

Barren-ground caribou are considered an ecological keystone species because of their simultaneous roles as large migratory grazers and primary prey for carnivores. They are also a cultural keystone species because they sustained and shaped the cultural identity of Inuit, Dene and Métis peoples throughout millennia. The Bathurst caribou herd is interwoven into Aboriginal languages, cultures and way of life, and people are still largely dependent upon barren-ground caribou for food and even clothing in the modern era (Tłįchǫ Government 2013).

[9] Community members worry less about whether caribou are from one herd or another given their subsistence relationship with caribou, but the identification of different populations (herds) allows biologists to collect and interpret data on status and trends. Identification of caribou populations also provides a basis for development and implementation of management actions. Although there is some limited interchange of individuals between populations and ranges of adjacent herds may overlap, for this range plan the focus is on the land important to the Bathurst caribou herd.

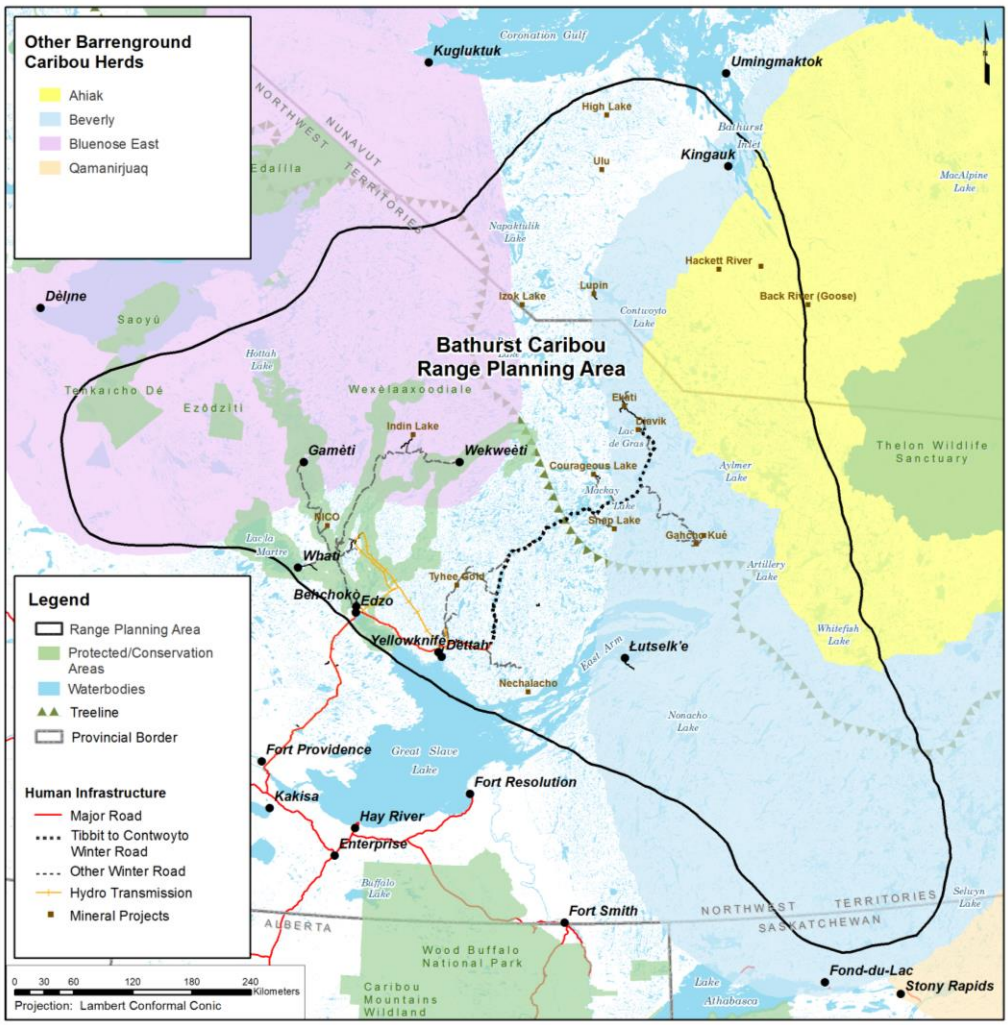


FIGURE 19. OTHER BARREN-GROUND CARIBOU HERDS OVERLAP WITH THE BATHURST HERD ANNUAL RANGE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES).

4.2.1 Population Status

For the Bathurst herd, the scientific understanding of recent patterns of abundance are based on multiple aerial surveys of the annual calving ground, which is a photographic survey methodology that was standardized in the mid-1980s to estimate abundance of breeding females (Heard 1985). **Figure 20** shows the gradual decline in population size of the Bathurst caribou herd from the 1980s to the early 2000s followed by a high rate of annual decline from the mid-2000s to present. The most recent June 2015 calving ground photographic survey resulted in an overall herd estimate of 19,769 ± 7,420 caribou in the Bathurst herd (Boulanger et al. 2016), which is a decrease of almost 96% over the time frame of the surveys.

Other demographic indicators for the Bathurst herd consistent with a declining trend between 2012 and 2015 (ENR 2014a) include:

- late-winter calf:cow ratios have averaged below 30 calves:100 cows (ratios of 30-40 calves: 100 cows or more are associated with stable herds);
- estimated cow survival has been well below the 80% needed for a stable herd; and
- there is evidence of low pregnancy rates in at least some years, including winter 2014- 2015.

Many traditional knowledge sources indicate that most populations of barren-ground caribou are presently in decline in the Arctic, and that the overall health of individual caribou has also declined (Dogrib Treaty 11 Council 2001, 2002; Thorpe *et al.* 2001; ACFN 2003; Kendrick *et al.* 2005; Łutsel K'e Dene First Nation 2005; Parlee and Manseau 2005; Dumond 2007; Legat *et al.* 2008; Croft and Rabesca 2009; Sahtú Land Use Planning Board 2013; WRRB 2013; North Slave Métis Alliance 2012; Beaulieu 2012; Judas 2012; Barnaby and Simmons 2013; ACCWM 2014; GSCI 2015; AD 2016; Dedats'eetsa 2016a, 2016b; LKDFN 2016; NSMA 2016; NWTMN 2016; YKDFN 2016).

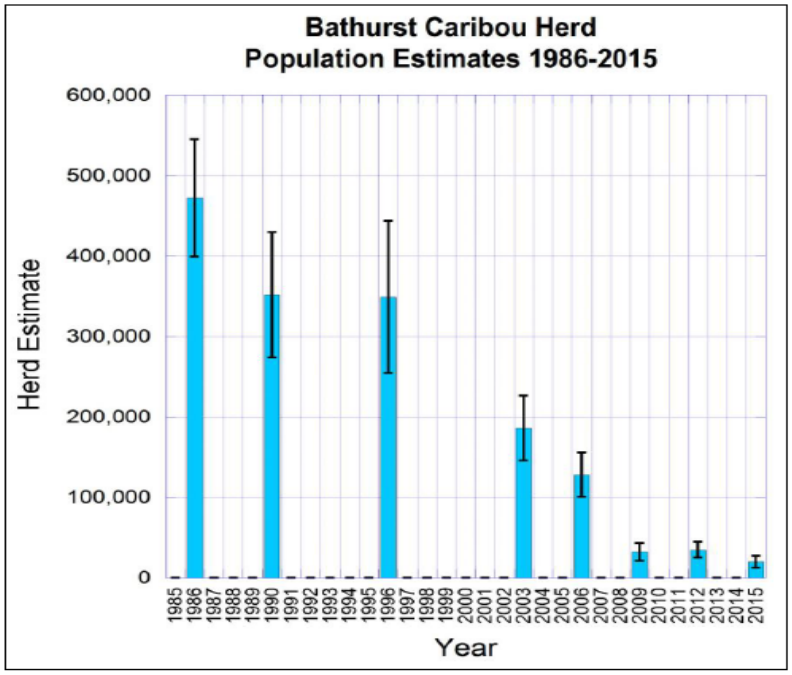


FIGURE 20: BATHURST CARIBOU HERD SIZE ESTIMATES FROM 1985 TO 2015 (SOURCE: BOULANGER ET AL. 2016).

Traditional knowledge and science tell us that barren-ground caribou go through periods of abundance and scarcity. Tłı̨chǫ elders have indicated that the 1940s and 1980s were periods of high caribou abundance. Community members across the north advise that numbers of caribou cycle from one year to the next or even from one decade to another, sometimes around a 30 year cycle.

Living memory tells us that there have been times in the past when numbers were low; however, community members are deeply concerned that such low numbers seen today are not like in the past. In the 1990s, people started warning that a decline like this might occur given too much disturbance to caribou (Legat et al. 2000).

> *I know however, that sometimes there would be no caribou in the area. Elders understood this to be a time when the caribou had to go elsewhere to find its food. This was natural earth balance and replenishment and it is all part of Mother Earths work. But lately the changes that [have] been happening has nothing to do the natural process. There are changes in behavior and movement of the caribou. Compared to the past the caribou has evidently changed.* – Unknown, Denesuline Né Né Land Corporation, 2016.

Many Elders predicted declines in caribou populations in the 1990s and are now especially frustrated that their fears were realized (Dokis-Jansen 2015; Thorpe and Barnaby 2016).

Although it appears that cyclical patterns of abundance and scarcity occurred with some regularity over a long period of time (i.e., multiple decades spanning a human lifetime), the previous patterns in abundance exhibited by Bathurst caribou in the past do not provide assurance that the herd will recover in the future.

4.2.2 Annual and Seasonal Ranges

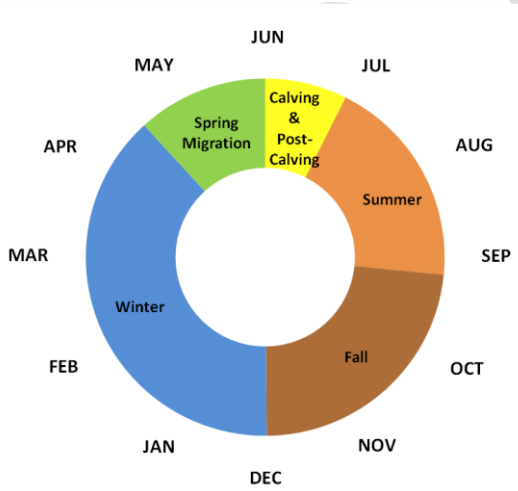
The annual range represents the total area used by the herd over the course of a year, whereas seasonal ranges describe the areas used by caribou at different times within a year. Range use as documented from a long-term caribou collar data set (1996 to 2014) and traditional knowledge has been used to understand the seasonal ranges and caribou movements within and between ranges. Seasonal range and range utilization analyses were completed by Caslys Consulting for the Government of Northwest Territories, Department of Environment and Natural Resources. A synthesis of available Traditional Knowledge, and new information gathered during the BCRP process, was used to represent community perspectives on recent and historical caribou range use.

Mobility is the ultimate adaptation of migratory barren-ground caribou that allows them to seek space to cope with an every-changing environment (Bergerud et al. 1984). Seasonal migration is the strategy that allows Bathurst caribou to avoid or minimize predation (Heard and Williams 1992), and to select resources within different parts of their range that have changing temporal and spatial patterns in forage productivity and nutritional value during the growing season (Griffith et al. 2001,), and high variability depending on snow conditions and forest age that influence forage availability during the non-growing season (Anderson and Johnson 2014, Barrier and Johnson 2012, Chen et al. 2012, Rickbeil

et al. 2016). The size of a herd's annual range reflects the caribou's need for space, which is expressed most strikingly by the extensive spring migration of breeding females from typical winter range areas in the boreal forest to the tundra calving grounds (Gunn et al. 2001, Gunn et al. 2013).

People have long understood that caribou numbers vary and where caribou go from one year to the next similarly changes. The herd-based concept and description of annual and seasonal ranges recognizes that the use and occurrence of caribou across the landscape is variable and dynamic over time. As caribou numbers increase, the herd requires more habitat and the area used by caribou becomes larger; when the herd declines in abundance the area occupied by caribou generally contracts as well.

In the BCRP, five seasonal ranges and periods are recognized: spring migration, calving and post-calving, summer, fall (including fall migration and breeding) and winter. **Figure 21** illustrates the timing of the five general seasons within the Bathurst herd annual life cycles, and their correspondence to caribou activity periods. Caribou calving typically occurs during a two-week period in early-June, followed by an early post-calving period for the remainder of that month. The summer season spans from late-June to early-September. Combined, the winter and fall seasons account for almost two thirds of the year.



	Caribou Activity Period	Date Ranges	Season	# Days	% of Year
1	Spring migration	20 Apr - 1 Jun	Spring migration	43	11.8%
2	Calving	2 - 16 Jun	Calving/Post-calving	27	7.4%
3	Post-calving	17 - 28 Jun			
4	Summer	29 Jun - 17 Aug	Summer	70	19.2%
5	Late Summer	18 Aug - 6 Sep			
6	Fall migration - pre-breeding	7 Sep - 16 Oct	Fall	85	23.3%
7	Rut/Breeding	17 - 31 Oct			
8	Fall migration - post-breeding	1 - 30 Nov			
9	Winter	1 Dec - 19 Apr	Winter	140	38.4%

FIGURE 21: THE FIVE GENERAL SEASONS OF THE BATHURST HERD ANNUAL LIFE CYCLE, WITH ASSOCIATED DATE RANGES (ADAPTED FROM NAGY 2011).

The annual and seasonal ranges of the Bathurst herd, and their intensity of use by caribou, based on the analysis of available satellite collar information between 1996 and 2014 (19 years of data), is shown in **Figure 22**. Similar range use and migration information recorded from traditional knowledge sources is shown in **Figure 23**. The historic range, as identified from traditional knowledge, is also displayed.

Barren-ground caribou use of space is variable over time, and the Bathurst annual and seasonal ranges represent a dynamic process that is also influenced by population size. As the Bathurst herd population has declined, patterns of range use by collared-caribou clearly show a smaller area of the annual and seasonal ranges being utilized. In recent years, only the central part of the Bathurst range has recorded use; Bathurst caribou have not been observed in northern Saskatchewan for many years. The extent of the range as identified by traditional knowledge corroborates the range retraction observed through radio collar information. Also, in the late-1990s, the Bathurst core calving area shifted from the east side of Bathurst Inlet to its current location (Gunn et al. 2008). Traditional knowledge holders also indicate the location of the calving grounds shifts over time according to the availability of food and other conditions.

> *Caribou tend to prefer these areas for calving grounds, because of this year's or last year's plants. It's not this years plants; it is from years before plants. That's why they go there. If they don't find plants they might move to a different area, to a different calving area, it might be past Bathurst. Sometimes they would be on the east side of Bathurst Inlet and sometimes on the west side, all along there, and anywhere, all the way down to James Bay area (KIA 2012: 41).*
>
> *From what I hear about calving grounds, they use that area for a few years and then there will be no food so they change until the food grows there again... they change until the place grows again. They don't just calve in one spot for life. They switch... to where there's food for them (C111 in KIA 2012: 42).*

This shift in calving area is illustrated by information displayed on **Figure 23**; the Traditional Knowledge information about calving areas was collected as part of the Tuktu and Nogak Project in 2001, and shows traditional caribou knowledge from the 1990s and earlier (Thorpe et al. 2001).

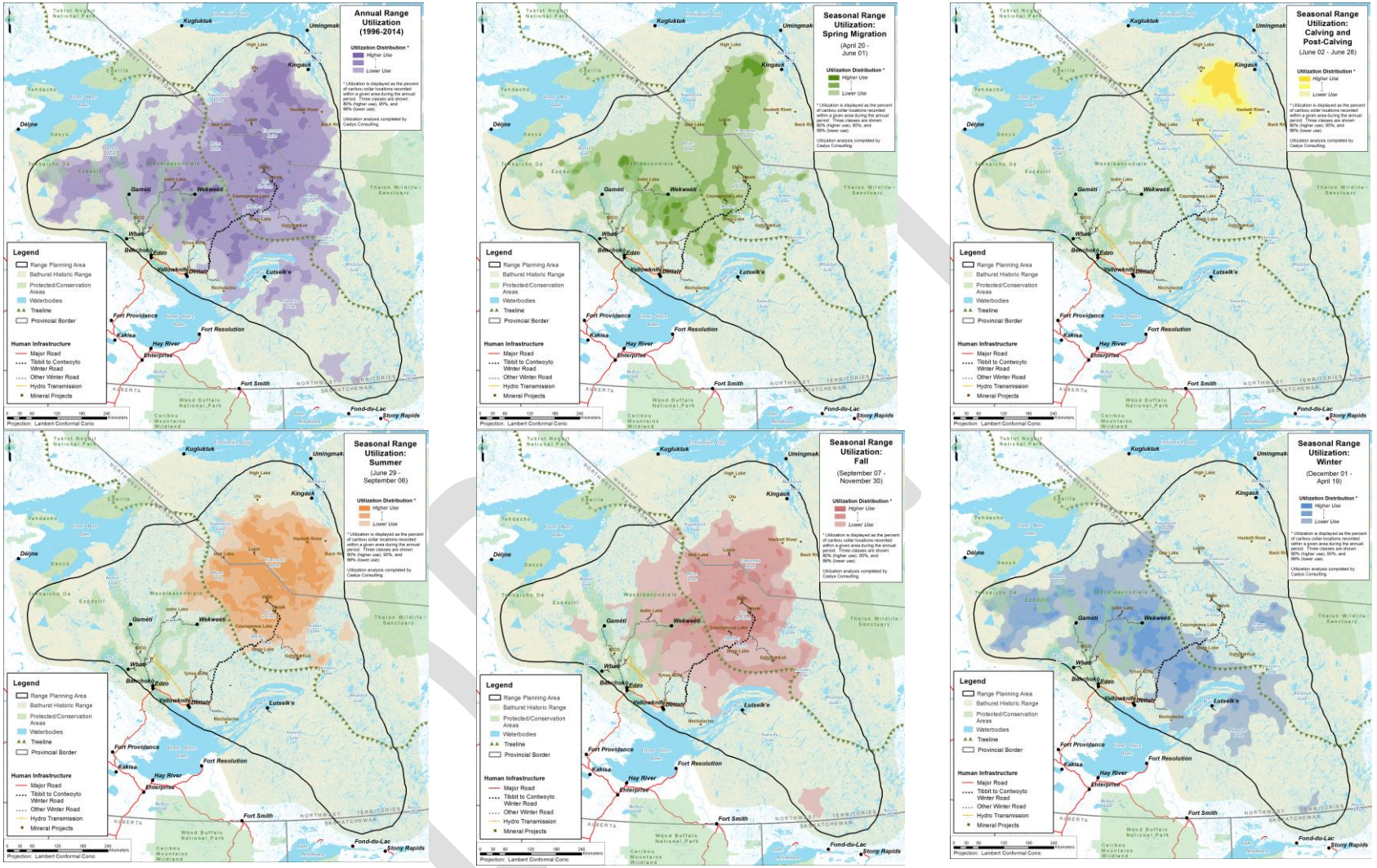


FIGURE 22: ANNUAL AND SEASONAL RANGES OF THE BATHURST CARIBOU HERD BASED ON SATELLITE TELEMETRY DATA FROM 1996 TO 2014. DARKER COLOURS INDICATE HIGHER USE BY CARIBOU.

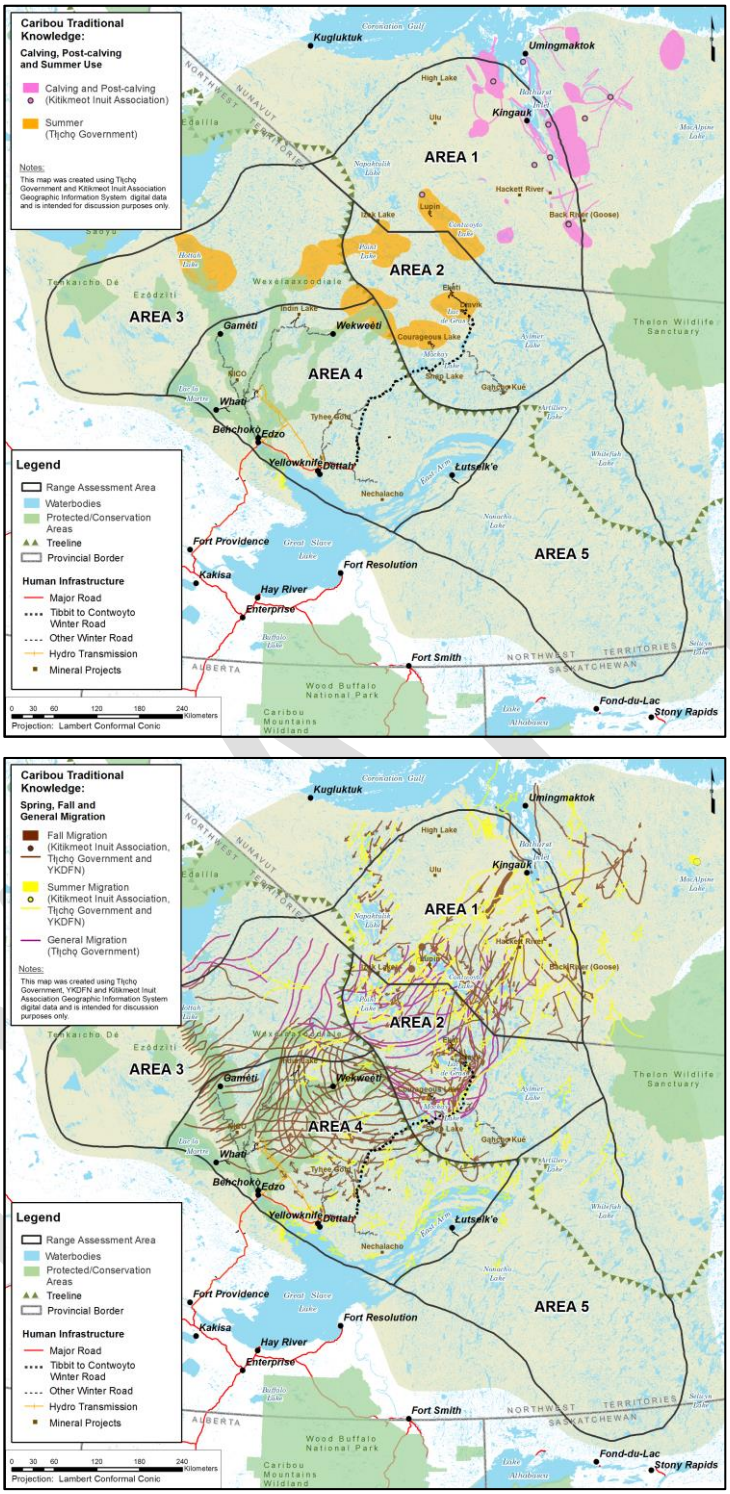


FIGURE 23: SEASONAL RANGES (CALVING AND POST-CALVING, AND SUMMER) AND SPRING, FALL AND GENERAL MIGRATION PATHS AS IDENTIFIED THROUGH TRADITIONAL KNOWLEDGE.

4.2.2.1 Seasonal Range Sensitivity

Barren-ground caribou are considered to be more or less sensitive to disturbance at different times of the year, an observation strongly supported by community members. It is therefore possible to rank the sensitivity of caribou and caribou habitat to disturbance during the different caribou periods and seasonal ranges. From a management perspective, ranking the sensitivity of caribou and caribou habitat can assist in developing recommendations for managing land use and disturbance accordingly.

Biologists have also recognized that sensitivity of caribou and caribou habitat may vary seasonally, with the best example of this being the general acknowledgement that caribou cows and newborn calves are highly sensitive to human disturbance during the calving and post-calving periods. The BCRP Working Group adapted previous work by the Porcupine Caribou Technical Committee (PCTC 1993) and the Beverly and Qamanirjuaq Caribou Management Board (BQCMB 1999) who rated relative sensitivity of a) caribou to disturbance during its annual life cycle and b) sensitivity of range used by caribou during those life cycle periods. The ratings were combined to produce a caribou-range sensitivity rating, which was provided as a general guide for assessing potential negative impacts of land use activities on caribou and caribou range at particular times of the year (**Table 4**).

TABLE 4: GENERALIZED RATING FOR SENSITIVITY OF MIGRATORY BARREN-GROUND CARIBOU AND CARIBOU RANGE TO LAND USE (SOURCE: BQCMB 1999).

CARIBOU LIFE CYCLE PERIOD	CARIBOU SENSITIVITY RATING[2]	RANGE SENSITIVITY RATING[3]	CARIBOU - RANGE SENSITIVITY RATING[4]
Spring migration	Moderate (3)	Moderate (3)	Moderate (6)
Calving	Very high (5)	Very high (5)	Very high (10)
Post-calving	High (4)	High (4)	High (8)
Late summer	Low (2)	Low (2)	Low (4)
Fall migration/rut	Low (2)	Low (2)	Low (4)
Early winter	Very low (1)	Low (2)	Low (3)
Late winter	Low (2)	Low (2)	Low (4)

[1] *Factors used to develop generalized ratings are provided in Appendix C.*
[2] *Ratings range from 1 (very low) to 5 (very high).*
[3] *Ratings range from 1 (very low) to 5 (very high).*
[4] *Caribou-range sensitivity rating = (caribou sensitivity rating) + (range sensitivity rating). Ratings range from 3 (low) to 10 (very high).*

The approach developed by the BQCMB (1999) (**Table 4**) was used to rank the sensitivity of caribou and caribou habitat during the different seasons of the year (**Figure 21**), and a numerical rank was applied to each of the seasonal ranges. **Table 5** displays the resulting seasonal range sensitivity ranks.

The calving and post-calving seasonal range is considered to be a time and place that is the most sensitive for caribou cows and newborn calves. During the calving period cow caribou are easily startled and become agitated, increasing the chances of still born calves or calf abandonment. The summer period is considered to be the second most sensitive part of the range, with the fall and winter periods considered the least sensitive periods.

The BQCMB range sensitivity ratings were adjusted for the summer period from low to moderate, to reflect recent studies that highlighted the sensitivity and importance of the summer period for barren-ground caribou (Russell et al. 1993) and the need for breeding females to maximize forage and nutrient intake so that they are in sufficient body condition for the fall breeding season (White et al. 2014) (**Table 5**). Since pregnancy rate of caribou cows is tied to their fall body size and condition, human-caused and/or natural disturbance of cows in summer has the potential to affect population growth. Disturbance of caribou in summer may therefore reduce the amount of time spent feeding and increase the amount of time spent in energetically costly activities (i.e., walking and running), which in turn can result in cows that have a reduced likelihood of conceiving during the rut due to lower than average body weights (White et al. 2014).

TABLE 5: GENERALIZED SENSITIVITY RATINGS FOR BATHURST CARIBOU AND THEIR SEASONAL RANGES TO LAND USE.

				Sensitivity to Disturbance			Sensitivity Scores to Disturbance		
Season	**Start - End Dates**	**Period**	**Range**	**Habitat**	**Caribou**	**Overall**	**Habitat**	**Caribou**	**Overall**
Spring Migration	20 Apr - 01 Jun	Spring	Migration	Moderate	Moderate	Moderate	3	3	**6**
Calving & Post-calving	02 Jun - 28 Jun	Spring	Calving & Post-calving	Very High	Very High	Very High	5	5	**10**
Summer	29 Jun - 06 Sep	Summer	Tundra	Moderate-High	High	High	3.6	3.9	**7.5**
Fall	07 Sep - 30 Nov	Fall	Tundra	Low	Low	Low	2	2	**4**
Winter	01 Dec - 19 Apr	Winter	Taiga	Low	Low	Low	1.5	2.0	**3.5**

Traditional knowledge literature also indicates that calving and post-calving grounds are uniquely important places within the range because caribou are particularly sensitive during and immediately following their calving period, and any stress can lead to great harm (Wray 2011; Beaulieu 2012; Sangris 2012; EMAB 2012; BQCMB 2011; GSCI 2015; Williams 2015). Caribou seek naturally protected areas for their calving grounds with environmental attributes that discourage hunting and other traditional forms of human disturbance. The following description of calving grounds in the summary of available TK carried out by Parlee et al (2013:28) is both succinct, and speaks to both the fragility and importance of these areas:

> *Calving grounds are critical areas of habitat, which are unique in terms of climate (good weather), and the availability of rich plant life necessary for the nutrition and development of young calves and nursing cows . Highly exposed areas where snowmelt and vegetation growth is early and well developed are important. Shady areas where cows and calves can escape from the sun are also important. Landscape features within the calving region also offer protection from predators including wolves, grizzly bears and wolverine.*

Knowledge holders report their Elders compelling them to minimize even the slightest potential disturbances within these areas.

> *My late uncle used to tell me that his dad used to tell him not to make tea around the flat lands as he did not want the ground to be full of soot from the firewood. These areas are the calving grounds for the caribou . . . The area is south of Bay Chimo. My late uncle's dad used to tell him not to make tea around that flat land area but to make tea further away from the area. That was the rule long ago (C13 in KIA 2014: 41)*

> *The Elders say you should never impact [calving grounds] in one form or another because they are really sacred. They care for these calving grounds, particular spots on the land where it's just like a large swamp, or swampy areas where the ground becomes yellow from the calves. After they calve. And they don't want to dirty that part of the land from all the ashes or any other thing. You can't camp there, or make fires (C51 in KIA 2014: 41)*

4.3 Factors Affecting Caribou

4.3.1 Traditional and Scientific Perspectives

Traditional knowledge and science tell us that many natural and human factors affect barren-ground caribou populations. Both perspectives recognize natural and human factors affect caribou, but traditional perspectives also consider the spiritual connection between people and caribou, and about ways of doing and behaving around caribou. A conceptual model for each perspective is introduced, and then each factor is discussed below.

4.3.1.1 Traditional Perspectives

Traditional perspectives on factors affecting caribou and the caribou-human relationship were documented based on available literature and during the BCRP Traditional Knowledge Workshop (March 2016). **Appendix A** describes the different traditional knowledge sources referenced. **Figure 24** illustrates a traditional perspective on how different natural and human factors combine to affect caribou and Caribou People.

4.3.1.2 Scientific Perspectives

Figure 25 provides a conceptual model of how different natural and human factors affect caribou habitat and populations. Natural and human factors are considered to influence caribou populations through either direct or indirect effects on habitat quality and availability, caribou productivity (births) and caribou mortality (deaths).

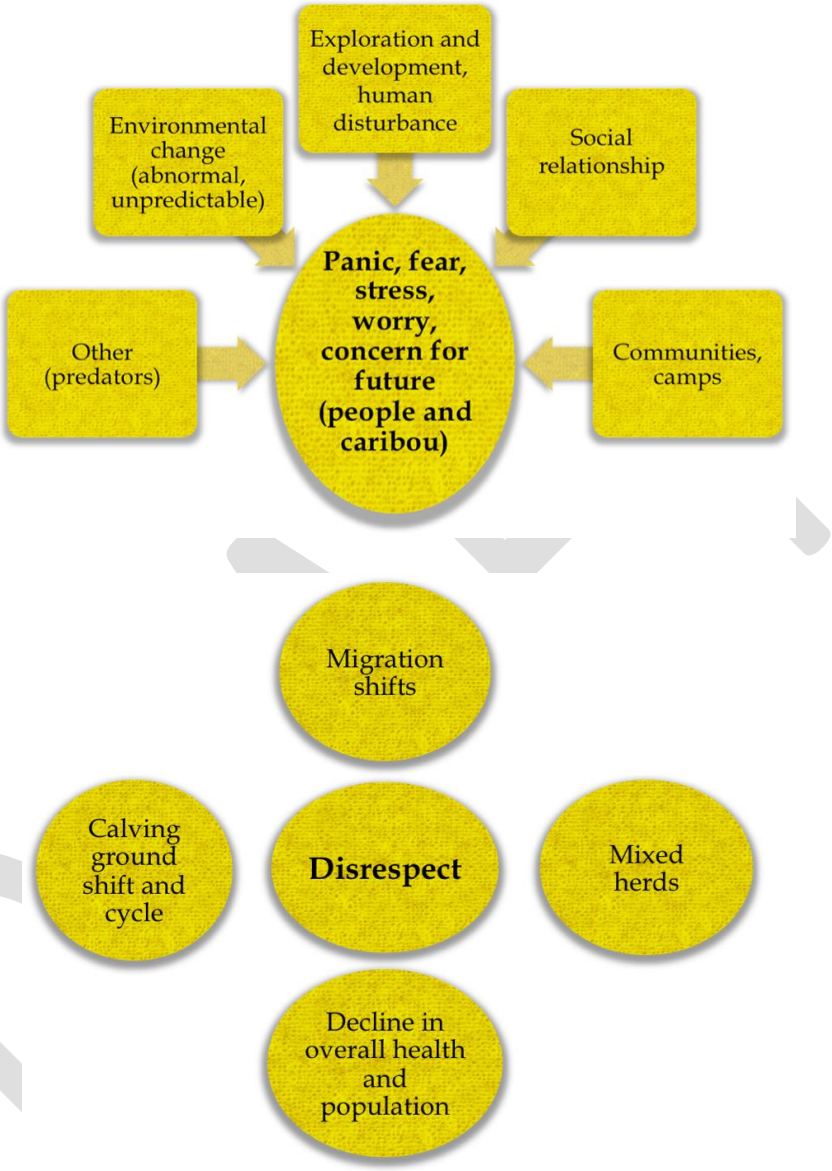


FIGURE 24: TRADITIONAL PERSPECTIVES ON FACTORS AFFECTING BARREN-GROUND CARIBOU AND CARIBOU HABITAT, AND THE HUMAN-CARIBOU RELATIONSHIP.

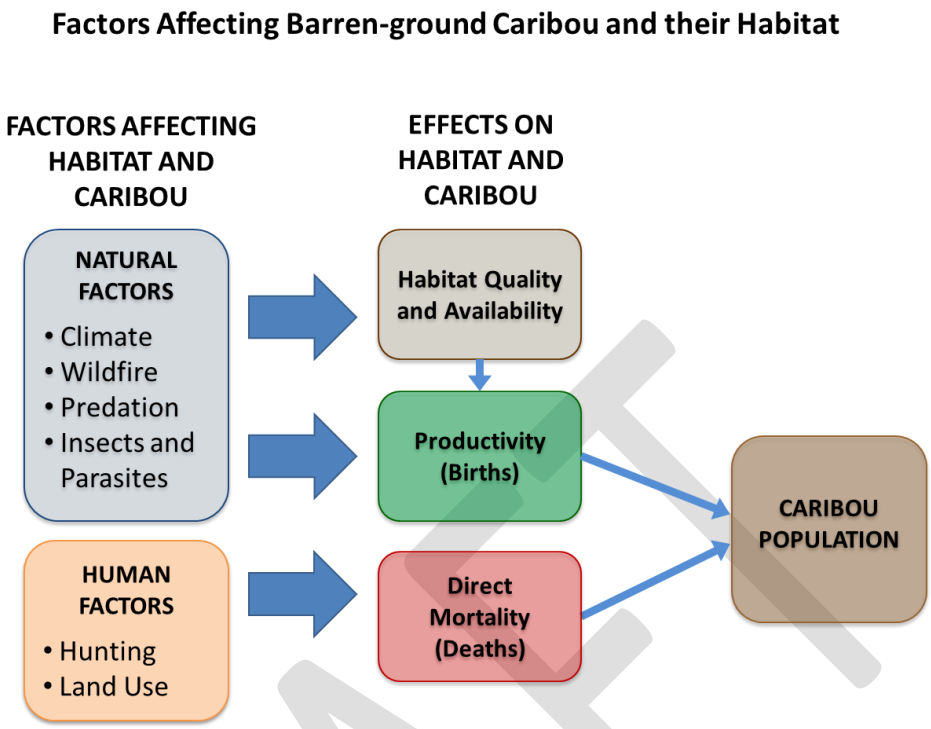


FIGURE 25: A CONCEPTUAL SCIENTIFIC MODEL OF FACTORS AFFECTING BARREN-GROUND CARIBOU AND THEIR HABITAT, AND EFFECTS ON POPULATION.

4.3.2 Natural Factors Affecting Caribou

4.3.2.1 Climate

Climate is the primary environmental factor affecting that affects temperature and precipitation conditions, and ultimately influences vegetation (habitat) type and productivity. Climate also directly affects barren-ground caribou through winter snow conditions (depth, icing events and timing), the timing of vegetation green green-up during the spring calving and post-calving period, and through summer temperature and precipitation. Activity of parasitic insects (see **Section 4.3.2.4**), parasites and diseases, important factors influencing individual caribou fitness, are also strongly linked to summer temperature and precipitation conditions. High insect harassment levels influence caribou behavioral patterns (decrease feeding time and increase activities such as walking and running) that may in turn reduce body condition of individual caribou. Summer temperature regimes and annual precipitation patterns also affects the amount and intensity of wildfire in the forested winter range.

Arctic ecosystems are especially vulnerable to global climate change as temperature and precipitation regimes are altered. Migratory caribou appear to prefer regions with higher snowfall and lichen availability in the fall and winter. In the summer, caribou prefer cooler and windier areas that have a lower abundance of insects. In winter, caribou avoid or use disturbed and recently burned areas less frequently. Direct and indirect consequences of climate change on migratory caribou possibly include

alteration in habitat use, migration patterns, foraging behaviour, and demography. In addition, changing climatic conditions may have very real implications on social and economic stress to Arctic and Subarctic Aboriginal human populations.

> *The herds that are left are getting decimated from the predators also more and more hoof rot. Everything is thawing out, the permafrost is thawing and everything is wetter and the hoofs can't dry out*. – 6B, BCRP TK Workshop, March 2016.

> *When we think about Bathurst herd you have to look at the whole ecosystem that is suffering. All the pressures that are part of the world like climate change, jet stream carrying dust from all over the world. It all drops down in Nunavut, NWT and all over Canada and the world. Think about the whole ecosystem not only the caribou we should be mindful of. The smallest microorganism to the biggest animal, we live off and depend on the other animals. The whole ecosystems are suffering. It tells me that animals and not only caribou are suffering*. – Bobby Algona, BCRP Workshop, April 2016.

Community members have noticed warming temperatures and the effects on caribou habitat and caribou. Traditional knowledge explains that food available for forage may be lessened by wildfire leading to skinnier caribou; ice at crossings may be too thin causing caribou to fall through and die; or overheating caribou may suddenly lie down and not get up again. Further, climate change is causing shifts in the ranges, habitats, and behaviours of other animals that can lead to competition with the Bathurst caribou for key habitat, particularly during times of intense fire activity. In addition, caribou are known to be scared away from other animals encroaching on their range.

> *There used to be lots of fat in the intestines, but not these days. The caribou are also not as fat and there are no soft fat in the stomach. There used to be thick fat in the large intestine but that too is not there.* -- Johnny Boline, May 6th, 2015 in Dedats'eetsa: Tłı̨chǫ Research and Training Institute. May 4 2016.

4.3.2.2 Wildfire

Wildfire is an important natural disturbance agent that shapes and rejuvenates northern boreal (taiga) forests. Wildfire affects barren-ground caribou winter habitat availability and quality by creating a natural mosaic patches of different forest ages; thus wildfire both creates and temporarily disturbs barren-ground caribou winter habitat. As spruce-dominated forests age and become over-mature (130+ years), lichen abundance, the primary winter food source for caribou, can decrease as a result of understory shading (Maikawa and Kershaw 1976). Wildfire is therefore necessary for the renewal of lichen growth. However, caribou are also known to avoid or use recently burned areas (forests less than 50-80 years old) less frequently than mature forests[10] (Schaefer and Pruitt 1991, Anderson and Johnson

[10] Caribou are known to have an acute sense of smell and avoid burned areas for many generations.

2014). A large amount of recently burned area may therefore reduce the carrying capacity of a winter range.

Taiga Shield Wildfire Regime

The Bathurst winter range is mainly within the Taiga Shield ecozone (ESWG 1995), a broad region spanning the northern forested portion of the Canadian Shield, both to the west and east of Hudson Bay. The Taiga Shield is characterized by the iconic, rugged Canadian Shield landscape with many rock outcrops, thin soils, extensive tracts of sparse conifer-dominated spruce forests, and thousands of lakes. The Taiga Shield is commonly broken into two separate areas for fire analysis due to the different climatic conditions between western and eastern Canada (Krezek-Hanes et al. 2011). The western portion of the Taiga Shield has more severe summer fire weather than the east (warm dry summers conducive to the generation of intense lightning storms), resulting in a vigorous fire regime characterized by frequent, large, high intensity wildfires (Stocks et al. 2003; Parisien et al. 2006; Burton et al., 2008), similar to the adjacent Taiga Plains.

Figure 26 shows area burned by fire year for the entire Taiga Shield ecozone. This figure highlights the stochastic and variable nature of wildfire regimes in northern Canada. Based on fire records for the period 1960 to 2000, estimated fire cycles for the Taiga Shield west of Hudson Bay range from approximately 110 to 130 years (these fire cycles equal an annual area burned of 0.91 to 0.77 percent). Parisien et al. (2004) estimated a fire cycle of 113 years (0.88 percent annual area burned) for the Taiga Shield portion of northern Saskatchewan, while Burton et al. (2008) calculated a 120 year fire cycle (0.83 percent annual area burned; 2,632 km^2 area burned per year) for the entire Taiga Shield west of Hudson Bay.

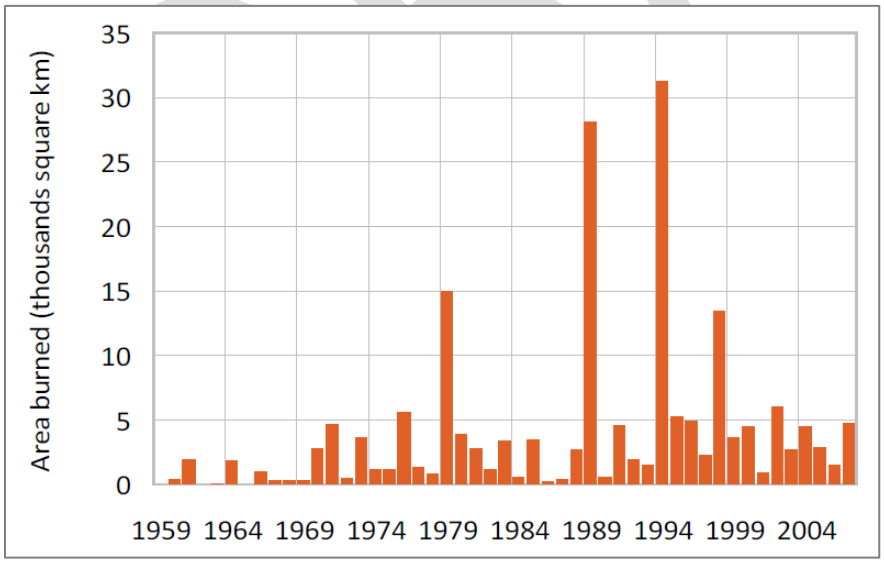


FIGURE 26. ANNUAL AREA BURNED BY LARGE FIRES IN THE TAIGA SHIELD ECOZONE, 1959-2007. (SOURCE: FIGURE 16 FROM KREZEK-HANES ET AL. 2011).

Recent Wildfire Disturbance in the Bathurst Range

The Northwest Territories wildfire history database was used to map and calculate the amount of area affected by wildfire in the planning area for the period 1965-2015. The wildfire history mapping only represents large (>200 ha) wildfires and is known to have reduced fire detection and mapping accuracy in the early period of records (1960s-1970s).

In the Bathurst range planning area, GNWT wildfire mapping indicates that approximately 81,500 km^2 has been affected by wildfire since 1965[11] (**Figure 27**). **Table 6** summarizes results by range assessment area. The area disturbed by wildfire represents 21% of the total range planning area, or approximately 36% of the forested portion of the winter range[12]. This rate of burning over the past 50 years suggests an approximate 120 to 140 year fire cycle for the forested portion of the winter range, which is within the range of the calculated values for the western Taiga Shield. As shown in **Figure 27** and **Table 6**, the majority of recent wildfire activity has affected a disproportionately large area of the central and southern parts of the Bathurst winter range; 36% of RAA4 and approximately 60-70% of the forested portion of RAA5 has been affected by wildfire in the past 50-years, with much occurring since the early-1990s.

[11] 81,500 km^2 represents the total extent of area affected by wildfire; the total area burned calculated from individual fire years is 86,400 km^2, as some recent fire extents overlap with older re-generating burns.

[12] Approximately 30% (28,538 km^2) of RAA5 in the vicinity of Artillery and Whitefish Lakes occurs north of treeline and has experienced limited wildfire since 1965. If this area north of treeline is not considered winter range, the percent of forested winter range affected by wildfire increases to approximately 36%. Including this portion of RAA5 in the area calculations results in 32% of the winter range being affected by wildfire since 1965.

FIGURE 27. AREA AFFECTED BY WILDFIRE BETWEEN 1965 AND 2015. (SOURCE: NWT WILDIFRE HISTORY DATABASE).

TABLE 6: SUMMARY OF RECENT WILDFIRE DISTURBANCE (1965-2015) BY RANGE ASSESSMENT AREA.

Range Assessment Area	Range Assessment Area Size	Recent Wildfire Disturbance (1965-2015)	
	(km^2)	(km^2)	(% of RAA)
Area 1 : Nunavut	75,902 km^2	20 km^2	<1%
Area 2: NWT Central Tundra	56,134 km^2	5 km^2	<1%
Area 3: NWT Winter Range – Northwest	77,001 km^2	15,178 km^2	19.7%
Area 4: NWT Winter Range – Central	84,858 km^2	30,839 km^2	36.3%
Area 5: NWT Winter Range – Southeast *	95,127 km^2	35,459 km^2	* 37.3%
TOTALS	389,022 km^2	81,501 km^2	21.0%

*Note: approximately one third of Area 5 occurs north of treeline. The area burned south of treeline since 1965 represents approximately 60-70% of the forested area.

The area burned by year within the Bathurst range planning area for the period 1965 to 2015 is shown in **Figure 28**. In the Bathurst range two fire years, 1994 and 2014, account for approximately 37% (31,375 km^2) of the total area burned during the 50-year fire record. The summer of 2014 was an exceptional fire season throughout much of central NWT, and can be attributed to specific continental-scale weather conditions with high summer temperatures, low precipitation and abundant lightning ignition sources. The 1979, 1989 and 1994 fire years were large fire years across the entire Taiga Shield (**Figure 26**), but in 1989 very little area burned within the Bathurst winter range.

While uncertain, it is likely the amount of recent wildfire activity on the winter range has also occurred in past times. However, there is evidence suggesting the amount of area burned in northern Canada is increasing in response to a warming climate, and the frequency of large fire years, such as the 2014 fire season, is projected to increase (Flannigan et al. 2000; Flannigan et al. 2005).

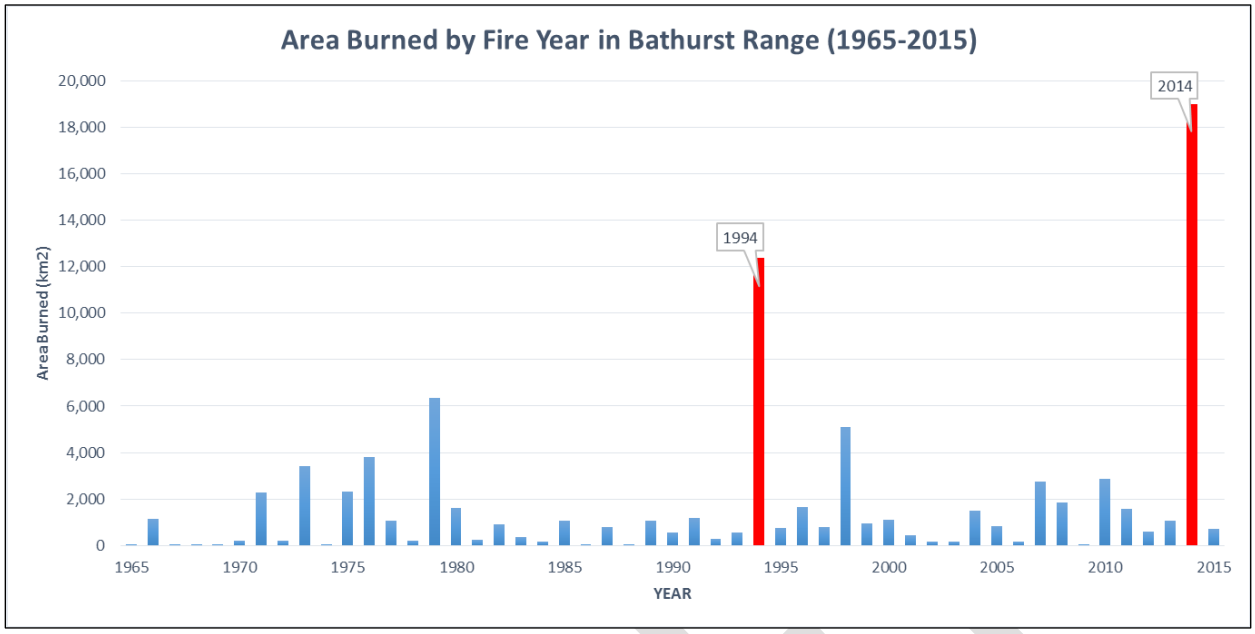


FIGURE 28: AREA BURNED BY FIRE YEAR IN THE BATHURST RANGE PLANNING AREA (1965-2015). SOURCE: GNWT ENR, WILDFIRE HISTORY DATABASE.

Wildfire Effects on Caribou

Community members have become very concerned about the amount of recent wildfire in the Bathurst winter range, particularly resulting from the 2014 fire season. While this amount of wildfire has likely occurred in the past, for many residents it was the most extreme fire season in recent memory. Compounded with human disturbance resulting from mineral exploration and mining, transportation, direct mortality from hunting and predators, and a potentially changing climate, communities are concerned the high level of recent fire has resulted in inadequate suitable winter range habitat to support a recovering Bathurst caribou population. Recent research on the winter range of the Bathurst herd indicated that fire was not considered to be limiting the availability of winter habitat (Barrier and Johnson 2012), but this research was completed prior to the 2014 fire season.

Traditional knowledge suggests that it can take at least 30 years for caribou to return to a burned area, and scientific studies based on radio-collar tracking suggest that caribou may avoid or use recently burned areas less frequently for a period of 50-80 years (Schaefer and Pruitt 1991; Thomas et al. 1996; Joly et al. 2007; Anderson and Johnson 2014).

> *There will be no caribou if there is nothing for them to eat. Moss takes about 30 to 40 years to grow back [from fires] and the trees will grow back in about 25 years but they don't eat the trees the grass will grow back but their main source of food is moss*. -- Denesuline Né Né Land Corporation, 2016: 5

> *Lichen takes 50 years to mature before the caribou stomach can digest that. Now in the 2000's and late nineties this whole area burned in north slave. Caribou moved away because all that food is burnt*. – 6A, BCRP TK Workshop, March, 2016

However, seldom do burns affect the entire burn area; unburned remnants and corridors often remain in large fires, and these unburned remnants can be important for caribou as forage and for movement through burned areas. In the extensive upland jack pine and black spruce forests of the Boreal Shield ecozone in northern Saskatchewan, Kansas et al. (2016) found that on average 19% of the area within wildfire perimeters was composed of unburned residuals. In studies from other western Canadian regions, 5-20% residual retention within wildfire areas has also been reported.

> *A lot of the caribou range is burnt, but there are green strips here and there. And the caribou are following those narrow strips. Some of the strips go along ways near Manchester Lake.* – 6B, BCRP TK Workshop, March, 2016

Documented traditional knowledge suggests that caribou migration is strongly affected by wildfire and resulting burned areas. Knowledge holders report that even after fire-damaged areas along their migration route have recovered and the lichen there has regenerated, caribou do not always return (ACFN 2003).

> *I want to emphasize what Joseph said yesterday that the large fires have changed migratory routes and there is no food for [caribou]. There are only a few areas left that are unburned and those areas should be protected so caribou can come back. — 7C (Thorpe & Barnaby 2016:15)*

> *This summer we were thinking that we want to bring those people over to the place near to where all my [ancestors] come from and study all the food for the caribou and the routes the caribou used but today the caribou don't go the way they used to, the routes are all bushy now. Forest fire areas the caribou used to use those areas for food and now it is all burned so they stay north. — 7A (Thorpe & Barnaby 2016:15)*

With warmer temperatures and longer growing seasons predicted for northern Canada under a climate change scenario, forest fires are expected to increase in frequency, duration and ultimately increase the area burned on an annual basis (Flannigan et al. 2005). The Bathurst caribou herd shifts its distribution in the winter range in response to burns and its ability to move across the landscape to select unburned areas is an important adaptive strategy. It is uncertain how a change in fire frequency, duration and area burned might affect the Bathurst herd in the future.

4.3.2.3 Predation

Barren-ground caribou are part of a natural predator-prey system that has evolved since the end of the last Ice Age, approximately 8,000 to 10,000 years ago. Seasonal migration is thought to be an important strategy used by caribou to avoid predators during different parts of their annual life cycle. Humans, wolf, grizzly bear and wolverine are the most important predators. Traditional knowledge and science tell us that predators are the largest natural source of direct mortality for Bathurst caribou.

> *Traditions nowadays, young people are not trapping anymore. Predators are the most that are killing off the caribou. Too many wolves and grizzly bears back home……In the past I always tell people that we control wolverines, wolves and grizzly bears through use of furs.* – 2B, BCRP TK Workshop, March 2016

Predation by wolves is the predominant source of natural mortality in migratory barren-ground caribou. Due to the continued recent decline of the Bathurst herd and its current critical state, the Wek'èezhìı Renewable Resources Board (WRRB 2016a) recommended that GNWT and Tłı̨chǫ Government conduct a collaborative feasibility assessment of options for wolf management. Tłıchǫ communities have reported that wolves are abundant and increasing in and around communities, and are concerned about potential conflicts with people and pets (including working dogs) as well as high levels of predation on caribou (WRRB 2016d). If conducted effectively for several years and in combination with harvest management and community participation, the rationale for reducing wolves is to increase caribou survival, which would contribute to increased caribou herd growth (WRRB 2016c).

4.3.2.4 Insects and Parasites

Harassment from parasitic insects (i.e., mosquitoes, warble flies, and black flies) may affect activity budgets and habitat use by caribou during late spring and summer, to the extent that in years with high insect harassment caribou have reduced body condition due to less time spent feeding and more energetic costs from walking and running. Community members have commented on how stressful insects can be for caribou, explaining that animals can run around "crazy" until they suddenly collapse. Insect harassment is closely linked to summer temperature, wind conditions, and other environmental variables. Recent studies on the Bathurst range have showed the importance of insect harassment on influencing foraging behavior of caribou (Witter et al. 2012). Combined with variation in summer forage quality, harassment from biting insects is an important natural factor that influences summer body condition and fall pregnancy rates in migratory barren-ground caribou. Traditional knowledge tells us that caribou are skinnier in the years when there are many insects.

4.3.3 Human Factors Affecting Caribou

4.3.3.1 Respect

Respect has always been at the core of the relationship between people and caribou. Recent times have brought a fundamental change in this relationship because caribou are no longer being treated with respect. For example, disrespecting cultural codes around hunting may also lead to a decline in overall fitness or survival of caribou. From a traditional knowledge perspective, a loss of respect by people explains recent changes in well-being and status of the Bathurst herd. The following statements illustrate this point:

> *The problem right now is that we have to go back to our relationship with the caribou. We have to go back to the land with our young generations, teach them and give the culture back*. — 1B, BCRP TK Workshop, March 2016

> *As a native, the way I was taught, the traditional way, respect the animals and respect the land and they will respect us back. Need to pass this onto younger generations. Want caribou for your son or grandson? Then respect the animals. If you like caribou meat and you want your kids to have caribou meat, then respect the wildlife*. — 3A, BCRP TK Workshop, March 2016

> *Way in the past when elders talked to me, if you are taking care of animals right, they will come back in spirit and the spirit will come back to life. If you are not doing the right things, they will not come back. Today we are getting to that. We want caribou and we kill them but bones are going to the dump and the caribou numbers are going down.*
> *— 3A (Thorpe & Barnaby 2016:8)*

> *You cannot hit and you cannot point the paddle to a caribou like a stick. If you do, then the caribou go down. Last time caribou came around 2009? I heard in my community that someone beat up a caribou with a stick. This is how our culture works. This is the way our elders have been telling us. Same with the berries, blueberries, cranberries on the barren grounds cannot be brought back to places like Wekweètì or the caribou will not come back. A lot of people pick berries and bring them back. I say don't do that, there may not be caribou but they don't believe me. We are suffering because we are not following what our elders have told us. A friend of mine says this morning, if you listen to elders what they say is powerful and strong. They don't write, they know. They look way ahead*. — 7A, BCRP TK Workshop, March 2016

Disrespect has threatened caribou well-being and fractured the relationship between people and caribou. Northerners often speak to the importance of healing the relationship between people and caribou and advocated for respect as a key first step:

> *We are talking about how to heal the relationship between people and caribou but I also think we need to heal the relationship between the land and the people. If you look at the map there is stuff all over the place and you see that we haven't respected the land in a way that will sustain caribou. The Athabasca Dene are caribou people, that's who they are, I know there are other communities that are as well. So everyone suffers when the caribou suffer*. — 1A, BCRP TK Workshop, March 2016

When caribou are respected, they will give themselves to people. In many cases, caribou "luck" comes through respect demonstrated towards caribou:

> *The luck has ignored us. We are not taking care of caribou right. In order for me to talk about this and how it will come back and be lucky, it is a lot of work that has to be done*. — 7A, BCRP TK Workshop, March 2016

Traditional knowledge asserts that the relationship between caribou and people is suffering and, there is a need to help people learn and understand the historic relationship between people and caribou and how traditional laws maintained the integrity of that relationship.

> *We don't show the caribou we love them because we don't harvest them anymore*. – Eddie Sangris, BCRP Meeting, April 2015

> *My job is to get the view out that caribou is a person, something that needs to be respected. This used to be caribou habitat, right here. Need to think about caribou as intelligent, sentient beings. Treat the meat, the blood, and the bones with respect because caribou is a smart animal. Caribou will not come to us because it is a smart animal. Talking about it like a person to person. We as persons need to take that upon us. Feed the water, give back to the land. We have been reviving old trails where people used to go to get caribou; where people used to intersect with caribou*. — 7C, BCRP TK Workshop, March 2016.

> *We survive by the animals: all our ancestors lived by the animals on the land, and the animals were healthy. If we don't take care of the animals, if the mining starts up and the animals get contaminated, the people will also (Weledeh Yellowknives Elder Joseph Charlo, Ndilo [Ndılǫdılo [NdNdlo [Ndrlo, Ndilo [Ndo, N*

When caribou are disrespected by people, people are known as "pitiful", lose their caribou "luck" and are not successful in their harvests. Without being able to harvest caribou, people are not "wealthy" in an emotional, spiritual, cultural, materialistic and subsistence way.

> *In my youth, my father would take me to the barrenlands every year just after I got out of school. He said, 'I'm going to teach you, so that you will be knowledgeable. Before you harvest animals, you have to learn to understand them. The way they think, their habitat, the way they live, what they eat. Before you harvest ʔekwǫ̀ you must understand them first. You must understand the names of ʔekwǫ̀ and the reason they're doing what they do, migrating, going to the forest from the Arctic barrenlands and back again.' And there are traditional laws that come with ekwǫ̀ . Every Aboriginal child has to understand the laws pertaining to ʔekwǫ̀ (Fred Sangris 2012: 75).*

> *Long ago, vadzaih [caribou] and men were much closer. Any person, not just a Medicine Man, could talk with vadzaih. When people and vadzaih separated, it was agreed that people could hunt vadzaih; however, a sign of the old relationship remained. Every vadzaih has a bit of ezi, human heart, in him, and every human has a bit of vadzaih heart. People will always know what vadzaih is thinking and feeling, and the vadzaih will have the same knowledge about people. This is why hunting vadzaih is at times very easy, and at other times very difficult (Gwich'in Elders 1997:37).*

> *The caribou will know if a nation took care of them and they will come back, if they were abused they will not come back. If we are going to change the behaviour of the caribou we need to change our behaviour. We need to respect caribou, we can't butcher and get blood all around.*

Traditionally woman couldn't step over caribou blood, the men must ensure that they don't leave blood on the ground (and make things difficult for women) and we must re-establish our traditions of having a sacred place to put the bones (Chief Charlie Football in Barnaby and Simmons 2013: 10).

The disrespect shown to caribou that is responsible for the general and overall decline of caribou and shifts in migration routes, also has direct implications for Caribou People. Today people live in settlements and no longer show the same level of respect to caribou their ancestors exhibited, back when caribou and people could speak the same language. Traditional knowledge holders testify that caribou are creatures of habit, and are so sensitive that any changes within the range and herd are inevitably sources of stress. Because people are caribou and caribou are people, when caribou experience stress, people are necessarily and intimately affected (Dedats'eetsa 2016b).

4.3.3.2 Hunting

In the boreal forest and on the tundra, caribou hunting has been the basis of Aboriginal traditional economy and culture for millennia. Most groups across the range of the Bathurst herd have published their traditional rules around hunting caribou (Legat et al. 2001). As an example, the Athabasca Denesuline rules around hunting caribou are shown in **Figure 29**.

In the modern era, caribou hunting has since become an important part of northern residents' lifestyle, with guide outfitting and non-Aboriginal harvest being important economic and recreational activities. Hunting can be an important source of direct mortality for caribou. Hunting may contribute to herd decline if total harvest is large relative to herd size, is predominantly comprised of breeding females, and if the herd has high natural mortality and low productivity. With the availability of modern firearms and off-road vehicles (including snow machines), hunting pressure is often closely associated with the amount of road and trail access on caribou range.

The Tibbit to Contwoyto Winter Road (TCWR) was originally built in 1982 to supply the Lupin Gold Mine at Contwoyto Lake in what is now Nunavut, and has since become the busiest heavy-haul ice road in the world. In addition to being the only overland supply route for mines in the central barrens, the TCWR also provided unprecedented hunting access to the winter range of the Bathurst caribou herd and facilitated relatively high levels of harvest observed from the mid-1980s to the early-2000s.

As a result of the rapid rate of decline observed in the Bathurst caribou population from 2006-2009, commercial guide outfitting and resident harvest in the Northwest Territories have been closed for the herd since winter 2009. An annual harvest target of 300 caribou was implemented for Aboriginal harvesters in the Northwest Territories from winter 2010 to 2014, and the Bathurst herd has been effectively closed to all hunting since winter 2015; in spring 2016 the WRRB recommended a total allowable harvest (TAH) of zero for the Bathurst herd (WRRB 2016a). In recent years, the annual harvest of Bathurst caribou in Nunavut has been estimated at ~70 bulls taken under a commercial allocation to the community of Bathurst Inlet and used for late-summer sports hunts. In spring 2016, the

Government of Nunavut recommended that the Nunavut Wildlife Management Board (NWMB) establish a Nunavut TAH of 30 male caribou for the Bathurst Herd.

> *For Bathurst herd, if we continue to hunt without respect it will take another 30 years for the population to go up. Elders have to be listened to. – 3A, BCRP TK Workshop, March 2016.*

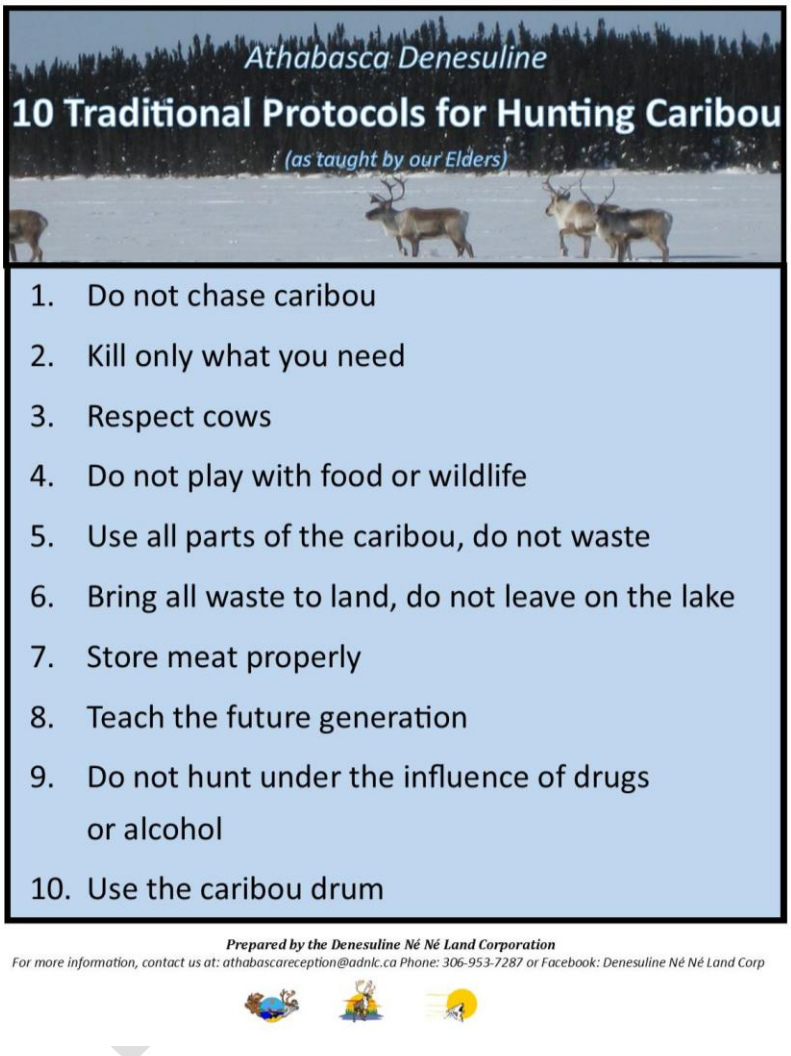


FIGURE 29: TEN TRADITIONAL PROTOCOLS FOR HUNTING CARIBOU, PROVIDED BY ATHABASCA DENESULINE (2016: A-1).

4.3.3.3 Land Use

Human land use includes the physical features that people build and the activities of people on or around them. Traditional and scientific perspectives about how land use affects caribou are quite similar, and each corroborates the other.

Traditional Perspectives

Figure 30 illustrates a traditional perspective of how land use and human disturbance affects caribou. Human disturbance causes caribou to run and gallop, which leads to injuries and the separation of groups of animals. Intense disturbances can cause animals to collapse from exhaustion and stress, potentially leading to death. As groups of animals become split and get smaller, animals are less brave and stay away from people, leading to smaller ranges.

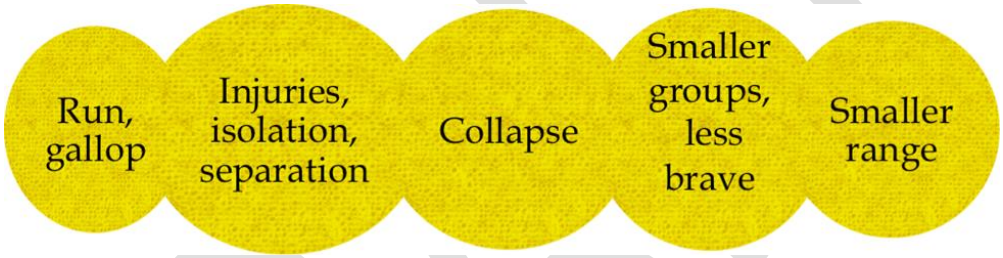


FIGURE 30: TRADITIONAL PERSPECTIVES ON HOW LAND USE AND HUMAN DISTURBANCE AFFECT BARREN-GROUND CARIBOU.

Effects of Development

Throughout the literature community members identify resource exploration, extraction and development (e.g. mining), and their associated infrastructures, as the main sources of impacts on Bathurst caribou. As explained by Dettah Chief Edward Sangris during technical sessions for the Jay pipe environmental assessment held in Yellowknife in April 2015:

> *The caribou don't have a navigational aid like the humans do; we cannot direct them to go here and there. No matter how many precautions they put into the traffic management consideration, it will always have an effect on caribou. In my view the footprint for development is getting bigger and the footprint for caribou is getting smaller (CBC News North 2015).*

Noise, light, dust, pollution, and physical structures, among other impacts, are reported as significant threats to Bathurst caribou causing disturbances, shifts in migration patterns, habitat destruction, injuries, contamination, and changes in the overall health of the herd (KHTO and Golder 2011; Beaulieu

2012; Sangris 2012; EMAB 2012; Parlee *et al.* 2013; GSCI 2015; Trailmark 2015; Dedats'eetsa 2016a, 2016b; LKDFN 2016; NSMA 2016; NWTMN 2016; YKDFN 2016).

> *The Tłı̨chǫ who participated in the study identify the establishment of large-scale mines and associated industrial activities on the Bathurst caribou habitat as the main factor behind caribou health defects and changes to their behaviour and migration. Relying on Tłı̨ç hǫ concepts of the human-caribou relationship, the study has showed how human activities on caribou habitat have negatively affected the herds. In response, caribou have chosen to avoid centers of mining activities, due to poor-quality forage and noise and dust pollution. The activities of the resource extraction industry around the Ek'atì (Lac de Gras) area, have established a "wall" blocking the main caribou migration route, the Ek'atì tataa. Since there are obstructions on their trail, the caribou have chosen to migrate to other areas, and thus the migration routes have divided at Ek'atì. The elders name this avoidance as inǫ̀ dè ʔǫ̀goèhshì which correlates to the zone of influence, as documented in scientific studies. (Dedats'eetsa 2016b: 2)*

Traditional knowledge holders have been able to predict and/or directly attribute impacts to caribou from human development, roads, vehicles and aircraft (Dogrib Treaty 11 Council 2001; Thorpe *et al.* 2001; Kendrick *et al.* 2005; Łutsel K'e Dene First Nation 2005; Legat *et al.* 2008; KHTO and Golder 2011; Judas 2012; LKDFN 2016; NSMA 2016; NWTMN 2016; YKDFN 2016).

> *It's kind of interesting what the elders were predicting in the 1990's and 2000's about the impacts of the mines. It predicts the effects of the mines and the last couple years. We have been documenting the health effects and migration routes and we can see the great correlation between their predictions and what happened. (Petter Jacobsen, BCRP TK Workshop, 2016)*

Knowledge holders explain that human caused disturbances affect caribou because they are symptomatic of the disrespect that has led to population decline, altered migration routes, and diminished health, among other noted impacts (Dedats'eetsa 2016b).

> *When I was a young man I lived in Whatì, there used to be ekwo around there at that time. But someone had hit the ekwo with the stick, and the elders said "if you guys [the older elders] are right, next year there will be lots and lots of ekwo" sure enough that next year there was ever lots of ekwo. But that next year after that, there was no more ekwo. Because the ekwo was hit, that why. Now I'm over seventy years old...From then on [and] for the next 30-40 years thereabouts, only then will the animals return they say. Johnny Eyakfwo, April 17th, 1997 (West Kitikmeot Slave Study Society 2001: 27)*

Human expansion and development across the Bathurst herd range (itself said to be an act of disrespect) has changed the relationship between people and caribou such that caribou fear and are no longer happy to see people. Caribou have started to move away when communities, roads and development came to the North. Traditional knowledge explains that caribou are known to be extremely smart and have learned to avoid stresses but increased development and stress has affected female caribou health and pregnancy rates:

> *All the females are supposed to be having a baby but some of them are not like that, they have no babies! They are supposed to have it but it didn't happen. But before those [mines] being established, almost all the females used to have babies to go back to the Barrenlands. So in that case it's a really big change from those times till today.* -- Jimmy Kodzin, February 12th, 2015 in Dedats'eetsa: Tłı̨chǫ Research and Training Institute. May 4 2016.

Human infrastructure can act as complete or partial barriers influencing or hindering caribou movements and preventing groups of animals from reaching important calving areas or feeding sites, effectively serving as a "wall" (Dedats'eetsa 2016a, 2016b) or "dam" (Thorpe and Barnaby 2016).

> *The migration route has changed. The caribou go northeast now to avoid the disturbances. The roads and the mine sites block their migration routes. The dust from the mines cover the lichen. The dust can easily travel 1—km or more as a result of the wind, which impacts the food supply (NWTMN 2016: 3).*

Traditional knowledge informs WG members' understandings of how and when caribou avoid, are drawn towards, or remain minimally affected or completely unaffected by development. Indigenous community members have reported that mining infrastructure can attract caribou seeking refuge from the sun, predators, and insects or deflect caribou in terms of both their small-scale movements and large-scale migrations (KHTO and Golder 2011). At the same time caribou are known to avoid developments, behavior which causes them to alter their migration routes initially in response, and thereafter out of memory and habit (NWTMN: 2016).

> *After a few years, caribou learn to avoid the mines. They will travel 30 to 50 miles out of their way to avoid disturbances (NWTMN 2016: 3).*

Still, others explain that the instinct to migrate is so strong that nothing gets in the way; caribou simply follow their leaders (Padilla 2012; Padilla and Kofinas 2012). Although not reported as often, some traditional knowledge holders report that the caribou's instinct to migrate drives them through any obstacle:

> *There's no way you can keep an animal out of its migrating route when it's migrating somewhere. It's either going north or coming back south. There was always a different route they use. No matter if there is a tailings line, they'll go over it. Just like the mountains, they go over that mountain. They'll even cross a strong river (John Ivarluk in EMAB 2012: 22).*

Knowledge holders reported that caribou can adapt to physical disturbances on the landscape:

> *These caribou are growing accustomed to mines like a landmark…now they are using them in their travels. (Anonymous in KHTO and Golder 2011)*

There were caribou around the tank farms. They were hanging around in the shade. They love it! Hiding from the big tanks and building, I was surprised. (Colin Adjun in KHTO and Golder 2011)

With human activity, they sometimes change their migration routes. Lac de Gras, before the diamond rush, caribou used to migrate through there in great big herds…today it is totally different. Only a few in a group, not like hundreds. (Anonymous in KHTO and Golder 2011).

In a few years, the caribou will change their route again. They will go a different way; they will be disturbed by the winter road, planes, and blasting. You will see [these changes] in three to five years from now. (Louis Abel of Łutsel K'e in Parlee et al. 2005: 35).

Effects of Roads

Building on living memory of how small camps and other land disturbances affected caribou, traditional knowledge holders today have provided insight into the impacts of roads on caribou. Review of the TK literature indicates that linear features such as roads can affect caribou by increasing disturbance, creating partial barriers to movement, increasing access for harvesting, and altering migration (Parlee et al. 2005; EMAB 2012; Tłı̨chǫ Government 2013; Sangris 2012; Jacobsen 2013; Trailmark 2013; NWTMN 2016).

There's roads and mines and all activities where all the caribou pass, I mean, that block the caribou...elders said that when something like that happens, caribou don't go there again. (Harvester in Parlee and Furgal 2012: 37)

Some Elders suggest the impact may be seasonal; during peak periods of migration, the road may be less of a barrier than during other parts of the year.

Although we have all seen ʔekwö in association with the ice road, the ʔekwö do not like to cross roads unless they are in the migration mode. They become very skittish when trying to cross roads, as they can smell the human scent. When they are not in migration mode and simply foraging during the winter, if the ʔekwǫ̀ sniff our scent, they will turn back (Romie Wetrade of Gameti in Dogrib Treaty 11 Council 2001: 13).

Roads were discussed at length at the TK Workshop for the BCRP (Thorpe and Barnaby 2016) and have been a key issue documented in multiple reports (Kendrik et al. 2005; Parlee et al. 2005; Parlee et al. 2015; Trailmark 2015; AD 2016; Dedats'eetsa 2016a, 2016b; LKDFN 2016; NSMA 2016: NSMNA 2016; YKDFN). Some of the common understandings related to roads and caribou include:

- Caribou avoid busy roads;
- Roads are barriers to migration;
- Roads fragment habitat;
- Caribou won't cross steep snow banks;
- Roads create "easy walking";

- Roads allow good look-outs for predators;
- Roads provide escape from insects due to the wind;
- Caribou behaviour depends on the time of year;
- Roads can open up otherwise undisturbed areas for more hunter access (NWTMN 2016);
- Roads can be areas of noise, pollution and contaminants.

The effects of roads on caribou, particularly within the context of mineral exploration and development have been discussed at length. Community members have either observed direct effects or make predictions on what effects may happen:

> *No matter what you do, caribou will be affected by these mines and roads. The only way to not affect the caribou is to have no mines and roads. If there is a mine, there will be roads. And if you have a road, there will be trucks on it. If they put it through, you can't stop everything for the caribou. But maybe that is what the caribou need. (Pierre Catholique in Parlee et al. 2005: 35)*

> *Now that there are mines with roads and high snow drifts on the sides, the caribou won't cross and their migration route is disrupted. The old people said if you pile up snow into drifts, the caribou would not cross them. They just move alongside of it. This is what is happening with the winter roads. They don't teach kids about this anymore. The white man does not know this. The way the caribou migrate has been disrupted. The roads bisect the migration routes and disrupt the natural behaviour of the caribou. (Liza Enzoe in Kendrick et al. 2005: 183)*

<u>Effects of Aircraft and Vehicles</u>
In addition to roads, vehicles and aircraft are understood to affect caribou through the following ways:

- Caribou become stressed and may run or gallop which can cause injuries or death;
- When caribou have been stressed, the taste of the meat changes;
- Disturbance can cause caribou to become isolated, dispersed or clustered in small groups which can make them more vulnerable to predators or feel more stressed (NWTMN 2016);
- Vehicles can lead to direct collisions causing injury or death.

Given that caribou are sensitive animals and react to noise, smells and movement, community members reported that vehicles and planes can affect caribou.

> *Planes and helicopters are flying too low and scaring the caribou. They are unable to rest and eat properly. They are very sensitive to the noise. This is especially an issue with the magnetometer surveys. They fly at 250 metres and the grids are really tight. This disturbs the caribou when they attempt to feed. This especially impacts the cows. If they don't feed, they don't put on weight which makes it difficult for them to get pregnant and have healthy calves. (NWTMN 2016: 2).*

Long-Term Effects of Land Use

An overarching concern held by many northern Indigenous groups is that mining development will "spoil" or "ruin" the land such that caribou - along with other animals - will never return even long after an area is reclaimed. Calving grounds are particularly sensitive. Reasons suggested for why caribou might not return to a particular migration route or calving ground include landscape changes, contaminants, and disrespect shown to the land. This understanding is typically associated with the recommendation that action must be taken to avoid such impacts:

> *In the North where ʔekwǫ̀ [caribou] are thinning out, we have to take action. We must protect those calving grounds, the home of ekwǫ̀. There are people who are exploring for gold at the calving grounds. If we don't put some kind of protection on the calving grounds, those ʔekwǫ̀ are going to have problems. It's like disturbing a bird nest. If you disturb a bird nest, the birds don't come back. Same thing with ekwǫ̀. If you disturb the calving ground, they'll go elsewhere. They may decide to disappear (Sangris 2012: 78).*

> *The elders suspect that ʔekwǫ̀ have probably gone east because there's been too much exploration or drilling going on in the calving grounds. And at the same time, the calves are not strong. And heavy sports hunting is going on for big game, so for years and years the mature bulls have been taken out. The elders believe the cows might have sensed something is wrong and gone to join other herds (Sangris 2012: 78).*

> *The Tłıchǫ share two concepts drawn from their traditional knowledge that they use to explain and describe the caribou habit of abandoning formerly important places in the range when those places are disturbed or affected by mining. DÈ ɔǪ GOÈHSHÌ means caribou have thrown this land or area away and is generally used to refer to previously important foraging areas that no longer used because the food source is diminished in quality and/or quantity. EKWǪ YEKA AT'Ɉ-LE ADZÀ means caribou do not walk on this land anymore, and refer to areas around mine sites that the caribou no longer go to (Dedats'eetsa 2013: 11).*

Scientific Perspectives

Figure 31 illustrates an impact pathway of how human land use (and other factors) may affect barren-ground caribou. The CARMA caribou computer model (described in **Section 4.3.4**, below) simulates land use effects on barren-ground caribou based on the number of encounters and amount of time that caribou interact with and are influenced by the direct footprint and associated activities of industrial and human activity on the landscape (**Figure 4**). The residency time of caribou within a ZOI[13] (i.e., the number of days a caribou occurs within a ZOI) represents the total time throughout the year when a caribou's daily food intake (i.e., energy and protein intake) and activity budget may be influenced by human-caused disturbance.

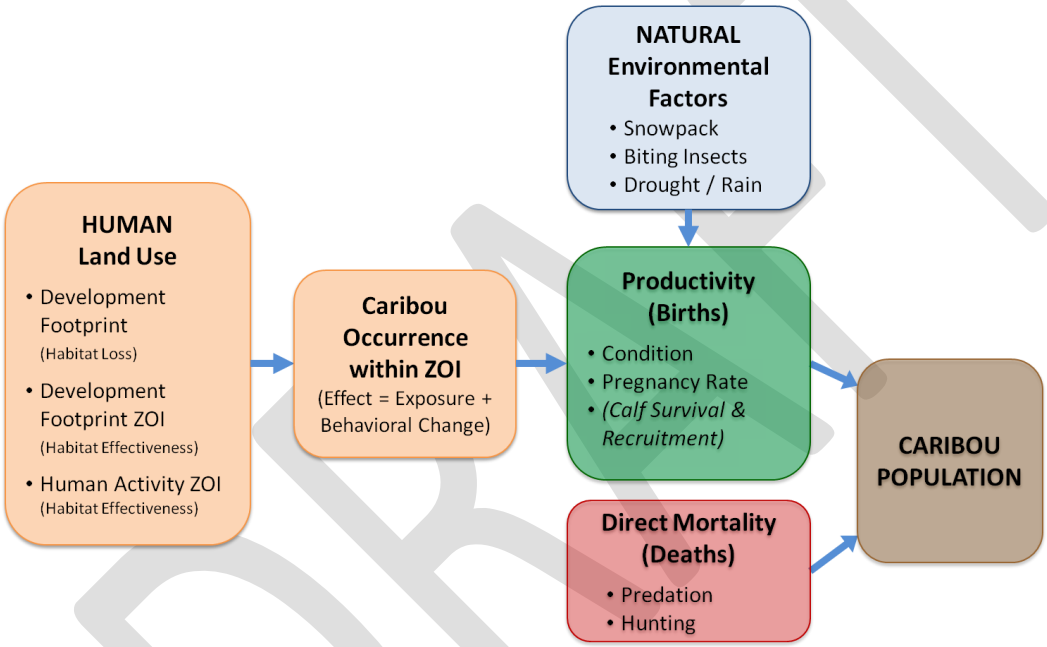


FIGURE 31: A CONCEPTUAL IMPACT PATHWAY OF HOW DISTURBANCE RESULTING FROM HUMAN LAND USE AND OTHER NATURAL AND HUMAN FACTORS INFLUENCE BARREN-GROUND CARIBOU VITAL RATES AND POPULATION HEALTH.

Thus residency time, or exposure of caribou to a ZOI is a key evaluation criterion and input value for the CARMA integrated caribou model, which in turn provides a transparent and logical means of simulating how cumulative effects on daily food intake and activity budgets can influence population productivity through impacts on pregnancy rate and calf survival (**Figure 31**). In addition to evaluating the magnitude of disturbance effects to population productivity, the integrated caribou modeling framework also

[13] From a traditional perspective, the ZOI is the area that caribou have "thrown away" or is "dead to caribou".

permits an assessment of the relative contributions of changing environmental conditions, as well as assumptions about direct sources of mortality that are attributed to predation and/or hunting (**Figure 31**).

4.3.4 How Do Different Natural and Human Factors Affect Barren-ground Caribou Populations?

While traditional and scientific knowledge provide an understanding of the dynamics of caribou populations in the past and present, computer models based on this knowledge provide a way of simulating real world processes to learn how different factors and stressors may influence caribou populations in the future. The BCRP Working Group collaborated with caribou biologists D. Russell and A. Gunn to use the CircumArctic *Rangifer* Monitoring and Assessment (CARMA) integrated computer simulation model (Russell et al. 2015) to explore and understand the relative influence of different natural and human-caused disturbances on Bathurst caribou herd health. The model was initially developed over several decades by D. Russell and colleagues for the Porcupine caribou herd that ranges across Alaska and northern Yukon and has been updated with relevant assumptions for barren-ground caribou in Nunavut and the Northwest Territories. The model is comprised of several interacting components, a movement model, energy-protein model and a population model. Based on available biological data, realistic assumptions for the Bathurst herd were incorporated.

The caribou modelling simulations were conducted in two stages. In the first set of simulations (Scenario Set 1), the following factors were explored:

1. What is the relative importance of initial caribou population size, population trend, and industrial development (amount and location) on a caribou population?
2. How do predation and hunting affect caribou population trend? and
3. How do environmental conditions affect a caribou population?

The second set of simulations (Scenario Set 2) was conducted to describe the relative potential impacts of industrial development and disturbance to caribou based on three refined future development scenarios. The human footprint mapping and its associated ZOI extents, and future development scenarios created as part of the land use assessment were used as inputs for the CARMA computer simulation model (human footprint mapping and ZOI is described in **Appendix C** and **Appendix D**, respectively; future development scenarios are described in **Section 3.4.1**). **Appendix F** provides a summary of key findings and a detailed description of the two sets of computer simulation model assumptions and parameters. Key modelling results are reported below.

4.3.4.1 Scenario Set 1 - Results

Question 1

What is the relative importance of initial caribou population size, population trend, and industrial development (amount and location) on a caribou population?

Based on model runs to address this question, the key finding was increased levels of industrial development reduced population growth by reducing pregnancy rates and herd productivity. This effect was small compared to assumptions on direct mortality rates, but the effect is significant and important especially when a population would otherwise be stable or declining in the absence of industrial development (i.e., during a declining phase of a natural population cycle).

Within a development level, population trend was not affected by initial population size and was driven primarily by mortality levels. Similarly when comparing scenarios across development levels, population trend was not affected by initial population size and was driven primarily by mortality levels. However, development levels had a synergist effect with mortality levels and reduced population trend further, as development levels changed from no development to a future-high scenario (**Figure 32**). This was most clearly shown for populations that had a medium level of mortality where under a no development scenario the population would be increasing. However, when the population was simulated with the same assumptions except that it was in a future-high development scenario, the population switched to a declining trend.

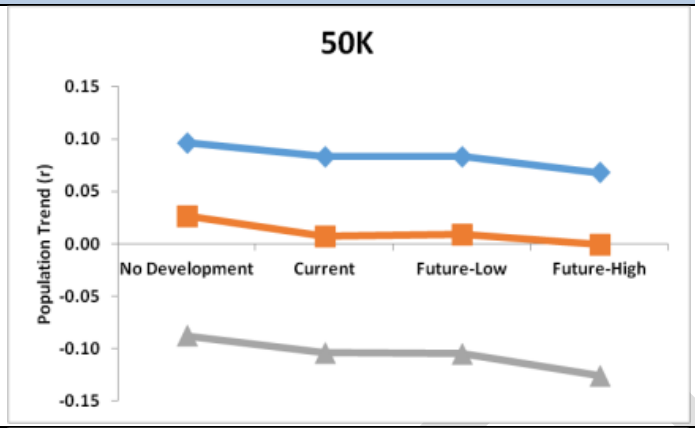
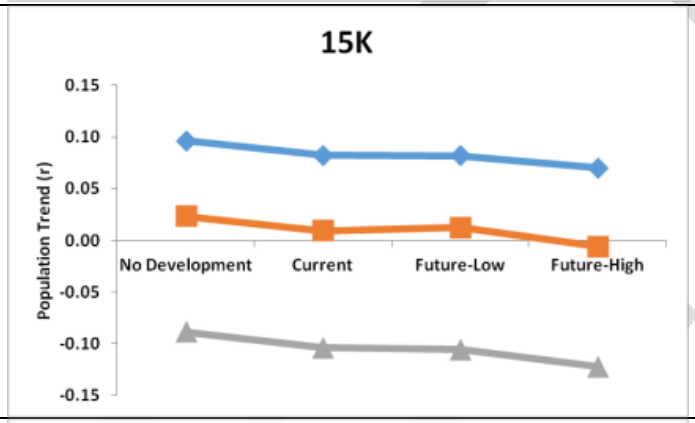
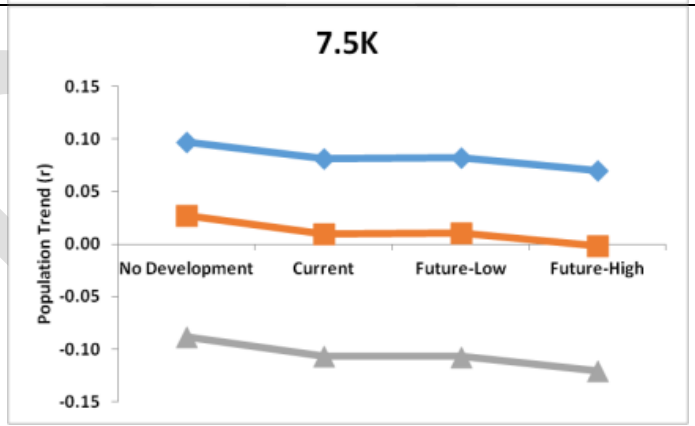
Initial Starting Population	Result
a) 50,000 caribou	
b) 15,000 caribou	
c) 7,500 caribou	

FIGURE 32: INFLUENCE OF INDUSTRIAL DEVELOPMENT LEVELS AND RATES OF NATURAL MORTALITY ON SIMULATED CARIBOU POPULATION GROWTH RATES, WITH SCENARIOS STARTED AT DIFFERENT POPULATION SIZES.

Increased levels of industrial development resulted in incrementally higher encounter rates of caribou with human footprints, which in turn imposed higher energetic costs to adult females and reduced their fall pregnancy rates. The reduction in pregnancy rates reduced overall population productivity and had a synergistic effect with mortality rates, which together resulted in higher rates of population decline in scenarios with more industrial development.

Question 2

How do predation and hunting affect caribou population trend?

The model simulations used to explore this question provided three key findings:

a) Predation and hunting may have additive effects on population health by increasing total mortality in a caribou herd. In the simulation model, the additive effect of hunting may accelerate a decline for a population that has pre-existing medium and/or high rates of natural mortality from predation (and other causes).

b) A harvest that removes the same number of animals annually may accelerate a rate of decline as the population gets smaller, because a constant harvest rate may result in an increasing proportion of animals that are removed as a population declines.

c) High and selective harvest mortality of females may have strong additive and negative effects on population trend because it not only contributes to increasing mortality rates, but also reduces future rates of productivity (i.e., numbers of newborn calves).

The additive and interactive effect of hunting with natural mortality rates is illustrated in **Figure 33**, which summarizes scenarios that applied three harvesting strategies to two populations with different initial sizes and contrasts three levels of mortality. The overall patterns are consistent between the two starting populations and show that the rates of mortality had the strongest overall influence on population trend. For example under the assumption of low mortality a population will continue to grow under both harvesting strategies regardless of whether the initial population size is 15,000 or 7,500 caribou, while the high harvest strategy had the greatest influence on reducing population growth rate (r). Under medium mortality assumptions and no hunting the population increased at ~2% per year (i.e., r = 0.02). Population growth rate decreased when the low hunting strategy was applied, and shifted to a declining trend for the small initial population (**Figure 33b**). In comparison, the high hunting strategy shifted both scenarios (with different initial population sizes) to a declining trend. Under high mortality assumptions and no hunting, the population was declining at ~ -9% per year (i.e., r = -0.09). Under this mortality assumption, both the low and high hunting strategies increased the rate of decline. In the scenario with a small initial population size, the low hunting strategy had a greater additive effect on the rate of decline because the constant annual harvest rate of 200 became an increasingly larger proportion of the small population as it declined over the 16-year simulation period.

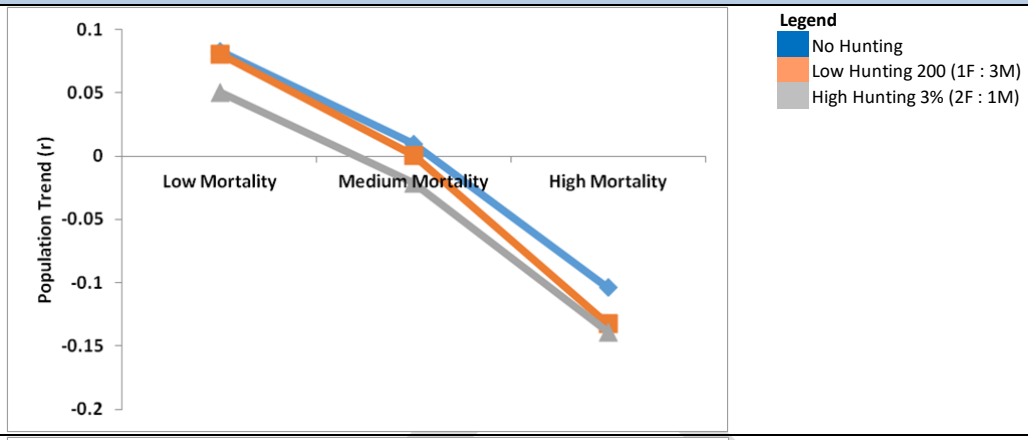
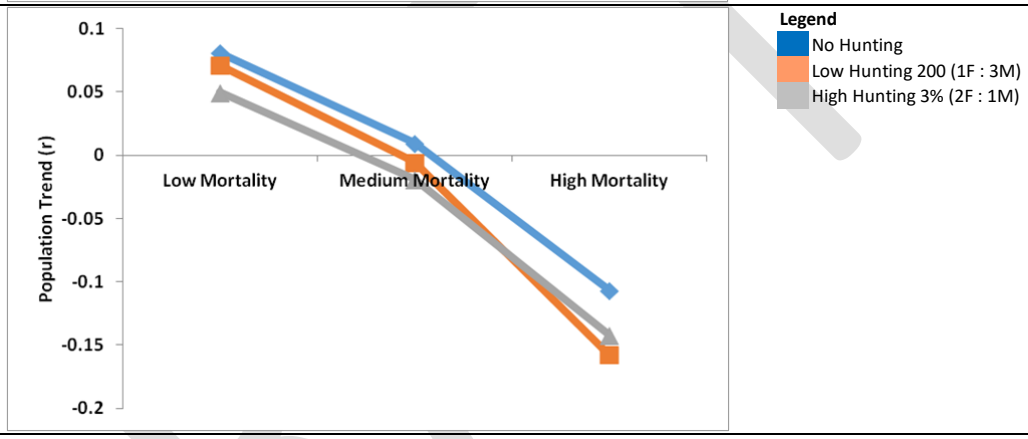
Initial Starting Population	Result
a) 15,000 caribou	
b) 7,500 caribou	

FIGURE 33: COMPARING THE INFLUENCE OF MORTALITY AND HUNTING LEVELS ON POPULATION RATE OF GROWTH WITH INITIAL POPULATION SIZE AT A) 15,000 CARIBOU AND B) 7,500 CARIBOU.

Question 3

How do environmental conditions affect a caribou population?

The model simulation results used to explore the influence of environmental conditions on caribou population suggest that environmental variability influences caribou population productivity, but to a lesser degree than direct mortality. Environmental conditions affect caribou through changes in nutrition (i.e., timing of plant green-up which provides early nutrition for lactation and re-gaining body condition, drought impacts on plant biomass and nutritive quality), and activity budgets (i.e., environmental conditions may increase harassment from biting and parasitic insects, which can reduce foraging time and increase energy expenditures).

Figure 34 illustrates the relative costs of development and environmental conditions by comparing the numerical difference in caribou population trends at the end of the 16-year simulation period. The middle bar represents the number of caribou that declined over the simulation in comparison to a reference case with identical assumptions except that there was no anthropogenic footprint on the range. **Figure 34** expresses the opportunity costs between different scenarios as the number of caribou that were foregone either due to increased development, or the costs associated with the influence of environmental factors.

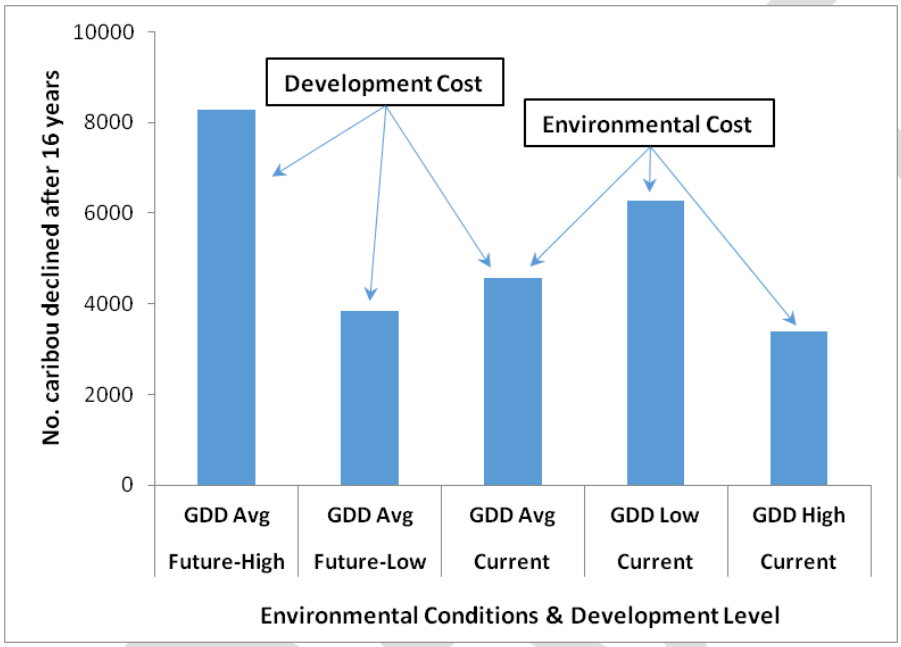


FIGURE 34: RELATIVE DECLINE IN CARIBOU ABUNDANCE AFTER 16-YEAR SIMULATION PERIOD COMPARED TO A REFERENCE CASE SCENARIO WITH AVERAGE MORTALITY ASSUMPTIONS, AVERAGE GROWING DEGREE DAYS (GDD) ENVIRONMENTAL CONDITIONS, AND NO DEVELOPMENT FOOTPRINT.

4.3.4.2 Scenario Set 2 – Results

Scenario Set 2 examined the relative effects of the three BCRP future development scenarios (Case 1--declining development, Case 2—continuing development, and Case 3—increasing development) on the population-level response of caribou. Please see **Appendix F** for a detailed discussion of results and assumptions. Key findings are as follows:

1. Caribou average encounter rates with human development ZOI increased with increasing development footprint (i.e., encounter rates were lowest in Case 1 and highest in Case 3).
2. Female caribou pregnancy rates declined inversely to increasing average encounter rates (**Figure 35**), but the amount of decline was small (expected pregnancy rates declined from 90% under a 'No Development' scenario to approximately 87.5% under Case 3).
3. Each development case scenario results in a lower rate of population growth compared to a 'No Development' scenario, but the relative decline is smaller than the effect of direct mortality (**Figure 36**).

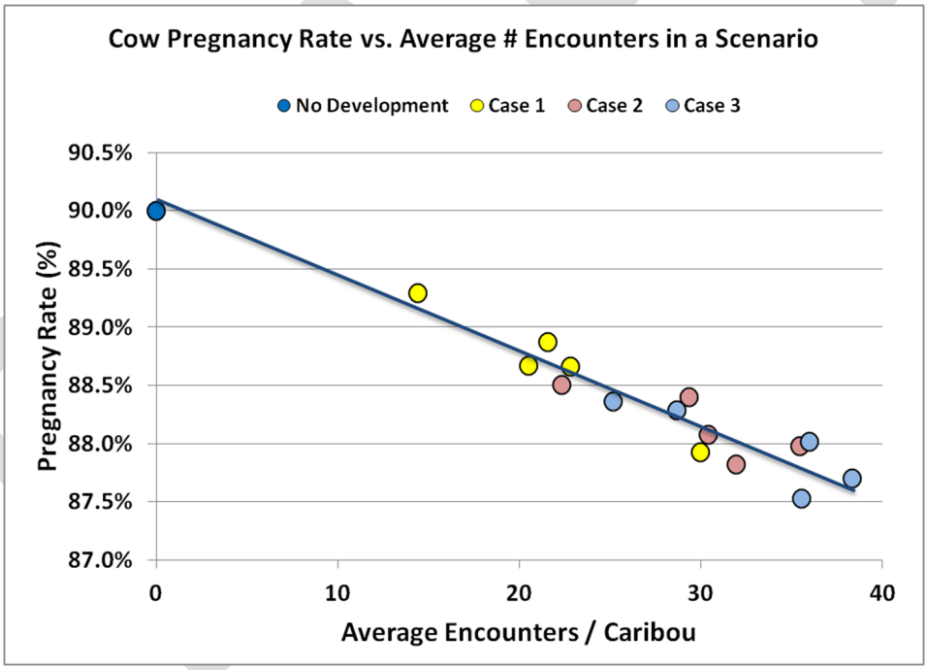
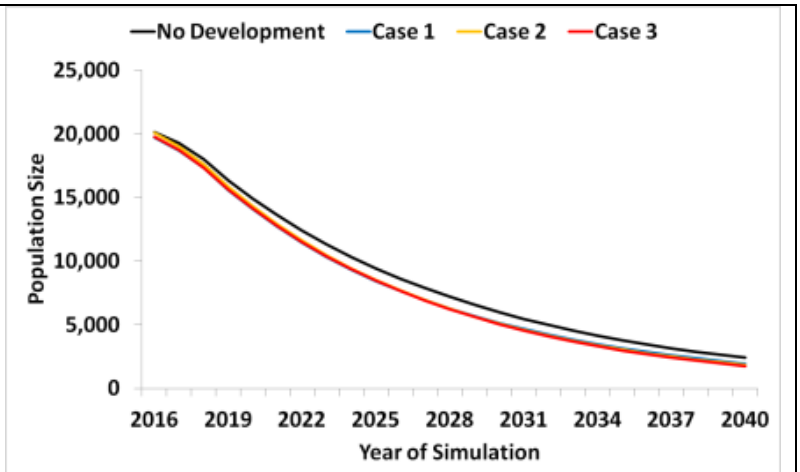
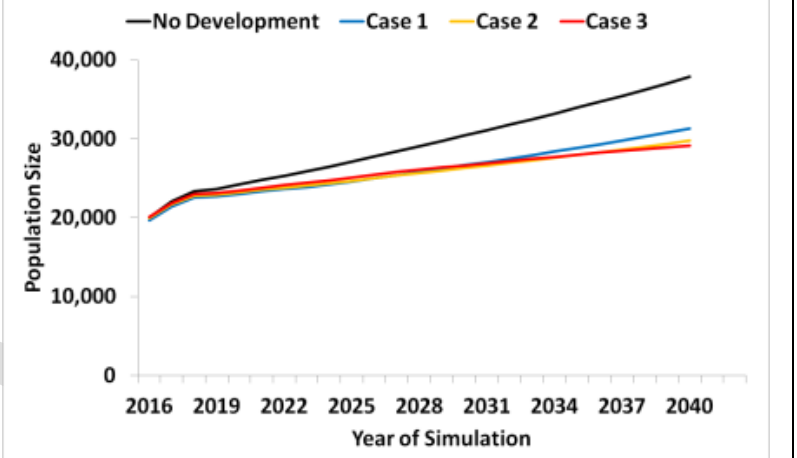


FIGURE 35: RELATIONSHIP BETWEEN EXPECTED PREGNANCY RATE AND AVERAGE ANNUAL ENCOUNTER RATE OF A BATHURST CARIBOU COW WITH ANTHROPOGENIC FOOTPRINTS ON THE ANNUAL RANGE.

a) High mortality



b) Medium mortality



c) Low mortality

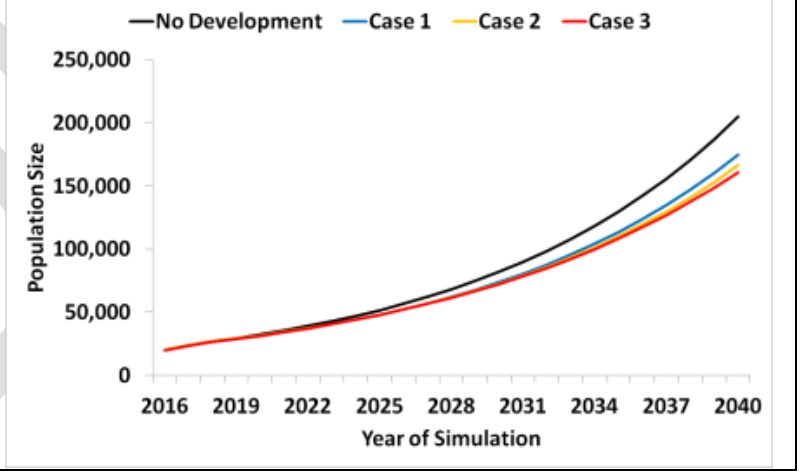


FIGURE 36: COMPARATIVE POPULATION TRENDS OF BATHURST CARIBOU STARTING FROM AN INITIAL SIZE OF 20,000 ANIMALS AND SIMULATED 24-YEARS IN TO THE FUTURE BASED ON THREE DIFFERENT INDUSTRIAL DEVELOPMENT CASE SCENARIOS (CASE 1-3), AND ORGANIZED BY (A) HIGH, (B) MEDIUM, AND (C) LOW RATES OF NATURAL MORTALITY.

4.4 Sensitive Areas and Important Habitats for Bathurst Caribou

Important or sensitive areas for caribou are considered to be parts of the annual range that are critical to individual caribou or population-level health, or where and when caribou are most sensitive to sensory disturbance. Sensitive areas were identified through the combined analyses of range utilization, range sensitivity, traditional knowledge, and existing literature.

Important habitats refer to place-specific locations and were identified through traditional knowledge and available literature. Given the landscape-level focus of the BCRP, site-level habitat quality and selection (e.g., specific vegetation communities or esker landforms) was not formally considered as part of the important habitat identification.

4.4.1 Sensitive Areas with High Caribou Use

In an attempt to integrate the concepts of range use and range sensitivity drawing from scientific findings and community input, the BCRP Working Group developed a range utilization map weighted by seasonal sensitivity (**Figure 37**). This approach builds on the seasonal sensitivity ranks where the calving and post-calving and summer ranges were determined to be the most sensitive parts of the Bathurst range (see Section 4.2.2.1, above). In **Figure 37**, darker areas on the map indicate areas of higher use and higher sensitivity. This map highlights the concentrated use of the calving and post-calving, and summer ranges by Bathurst caribou, and the heightened sensitivity of caribou to disturbance during these periods.

The weighted seasonal sensitivity map was created using annual and seasonal range use patterns analysed by Caslys Consulting based on available satellite and GPS collar data (1996-2013). Kernel analyses were used to define the utilization distributions (UD) of collared caribou, where a UD is defined as a probability density that gives an animal's relative frequency of occurrence. Multiple probability density levels (50%, 80%, 90%, 95%, and 99% UDs) were generated based on a composite of available collar data for the 17-year period, as well as analyses that aggregated data at 3-year intervals.

The spatial data from Caslys's five composite seasonal range were subsequently combined by weighting the seasonal range areas by their UD values and respective overall sensitivity scores. The sum of products of the UD values and sensitivities scores were normalized and used to develop a single utilization-sensitivity layer that maintained the information of all seasonal spatial layers over each location of the annual range. The normalized utilization-sensitivity data were depicted at frequency distribution categories of 0.2, 0.4, 0.6, and 1.0, which resulted in a map that showed caribou range utilization weighted by seasonal range sensitivity (**Figure 37**).

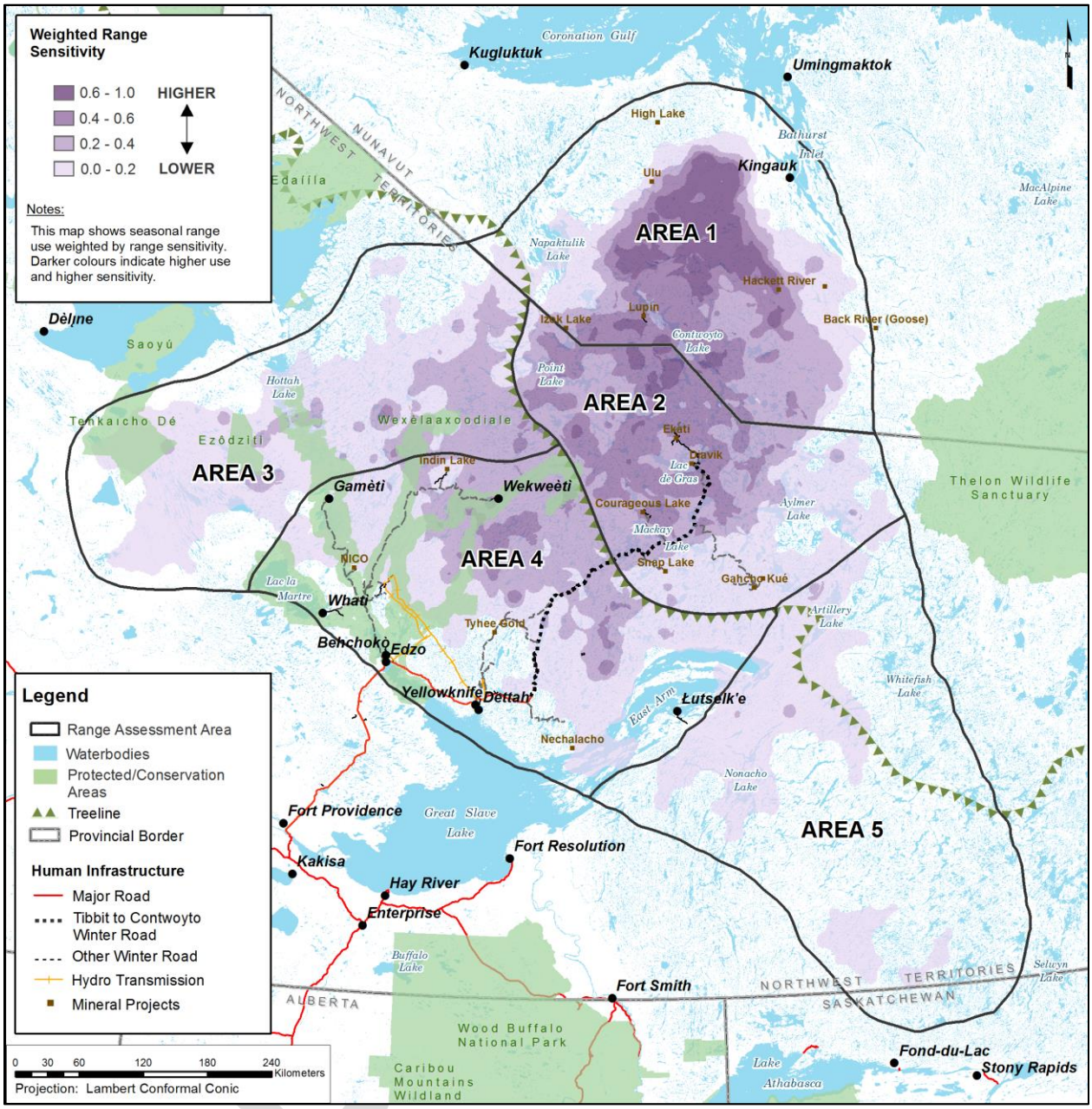


FIGURE 37: BATHURST CARIBOU RANGE USE WEIGHTED BY RANGE SENSITIVITY. DARKER COLOURS SHOW AREAS WITH HIGHEST USE WITHIN THE MOST SENSITIVE SEASONAL RANGES.

4.4.2 Important Habitats

In addition to the calving and post-calving and summer ranges, water crossings, land bridges and unburned winter range have consistently been identified as important habitat features on the Bathurst range. Some water crossings and land bridges are used relatively consistently, and some have been used for very long periods of time—potentially thousands of years. As indicated by the numerous archaeological sites located near these crossing locations, many traditional and cultural values are associated with these features. Water crossings and land bridges allow caribou to pass over or around large water bodies or other physical barriers, allowing movement between their different seasonal ranges during the annual caribou-cycle. Mature forests within the winter range provide adequate forage and cover for caribou to persist through the long northern winter. These important habitats are described below.

4.4.2.1 Water Crossings

Water crossings identify specific locations where caribou swim or wade across rivers or lakes. In the Bathurst range, water crossings have been identified and recorded through a number of different traditional knowledge (e.g. Tłı̨chǫ Research and Training Institute 2016) and scientific sources (e.g., Williams and Gunn 1982). **Figure 38** shows water crossings identified by traditional knowledge in the central part of the range. **Appendix G** provides a detailed description of selected locations. Based on field surveys in the Thelon river area, caribou most frequently cross at narrows caused by peninsulas or other shoreline irregularities, or where there is water turbulence or exposed rocks and gravel bars in the water (Williams and Gunn 1982).

Well marked harvesting trails clearly follow migration routes and effectively link important places and critical habitat for caribou, such as water crossings, land bridges and calving and post-calving areas.

> *People used to camp at water crossings. They knew the [caribou] would come that way. For example, an area where there are two big lakes, the animals will cross at the narrowest spot between them (NWTMN 2016: 5).*
>
> *The people would continue on to Wekweeti, unsing birch-bark canoes along here [checking the spot where caribou swim across the lake] and on to Be?aiti searching. If they did not find anything, they would go north to [check the water crossing at] Ts/oti [and from there they would travel to] they would go towards Deehhaatidethti… Again if there was nothing to be found there, they would proceed along the great route leading to Sodee … then the people would go north to Deehaati – all the way to Kwik….. They would continue to search hoping to find caribou. Then they would all assemble at one place by canoe. … Once they have canoed to one area and assembled and having said that they wanted to go to the great lake, my father said they would go to … Yabahti …. And they would camp and live at various bays, points, and along channels between islands. . .. Then at channels were the caribou swam across, the caribou would be killed by spearing. (Louis Whane 1995 in Dogrib Treaty 11 Council 1998: 13)*

> *Every time there was a portage there would be caribou trails. It is assumed they swam across at select places. Sometimes places where caribou would be killed would be called ?edah [304 Living/Alive]. At Saemiti, Saemiti there is a place called ?edah. Our people worked in those areas where ?edah are located before us. My uncle Monfwi spoke this when he told us stories. He said that there are a lot of ?edaeti [307 Living Lakes]. There an ?edaeti is located; that is called ?edaeti ?Edaeti is called that because caribou swim across all those kinds of lakes, so he said (Moise Martin 1996 in Dogrib Treaty 11 Council 1998: 14).*

Given the long-term, consistent use of some water crossing locations, maintaining these areas relatively free of human infrastructure and disturbance is important to successful migration. At this time, identified water crossings have not been ranked in terms of importance to caribou but several important areas are known to be in the Courageous Lake [?ewaa nit'iitì], Lac de Gras, Contwoyto Lake, Mackay Lake [No?dìikahtì] and Artillery Lake areas. One such crossing of the Coppermine, known as "the Narrows," was described by Pike 1892 (67) as "an important spot in the history of [both] the Dog-Ribs and Yellow Knives."

> *It has always been a favourite swimming-place for the caribou, and many a struggle took place for the possession of this hunting-ground in the old days when there was continual warfare between the two tribes. At present day it is a breach of etiquette for any Indians to camp here, as it is supposed that if the caribou are once headed back at this point they will not come south of Mackay Lake. This rule had evidently been broken lately, as we found signs of a recent encampment, and King considered that this amply accounted for our not finding the caribou before we reached the Lac du Rocher. (Pike 1892:67)*

More than a century later, many community members continue to recall this crossing as critical and worthy of protection:

> *The Narrows must be avoided by the mining companies. At the Narrows, the place is so old that even the rocks are all worn out (from the caribou crossing). (Alfred Baillargeon, March 24, 2015 in YKDFN 2016: 17)*

This important crossing continues to be the subject of discussion and concern amongst knowledge holders, particularly because of its location at the center of the NWT's diamond mining activities. A major concern by community members regarding the location of the diamond mines in the Lac de Gras area is the blockage of some important water crossings and land bridges, much like 'a dam or fence', resulting in changes in caribou migration routes.

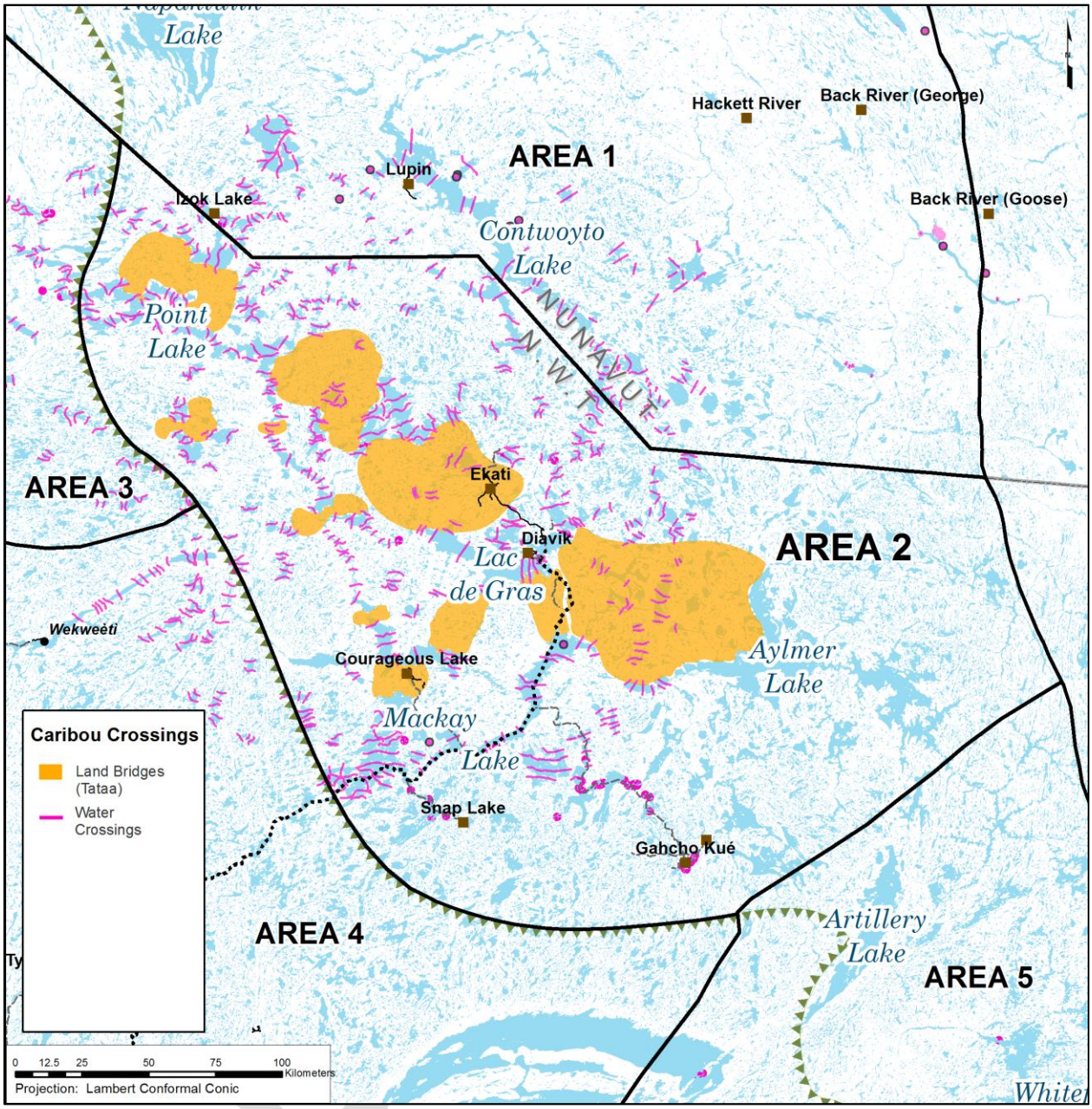


FIGURE 38: WATER CROSSINGS AND LAND BRIDGES IDENTIFIED BY TŁĮCHǪ AND KITIKMEOT INUIT ASSOCIATION TRADITIONAL KNOWLEDGE IN THE CENTRAL BATHURST RANGE. MANY CROSSING LOCATIONS OUTSIDE OF THIS AREA ARE ALSO KNOWN BUT ARE NOT CURRENTLY AVAILABLE FOR DISPLAY.

4.4.2.2 Land Bridges

Land bridges refer to areas where caribou pass between major lakes. The Tłı̨chǫ word for land bridge is tataa. Many communities talk about the importance of migration corridors that connect crossings and these are best described by Dedats'eetsa 2016:

> *The elders explain how the caribou has a different way of knowing, and that all caribou have "one mind." As explained above, the caribou have a good memory of their land and of their migration routes. The herds know which tataa they must travel on to reach certain locations. Tataa are important corridors for them to follow on their way to better feeding grounds. Thus, the herds know the conditions on their migration routes and on their feeding grounds. (Dedats'eetsa 2016b: 37)*

Figure 38 shows major land bridges identified by Tłı̨chǫ traditional knowledge in the central Bathurst range (Tłı̨chǫ Research and Training Institute 2016). Similar to water crossings, maintaining these areas relatively free of human infrastructure and disturbance is important to successful migration. The location of tataa in RAA2 highlights the importance of this central tundra area for movement between the spring calving and post calving, summer and winter ranges. Selected land bridges are described in **Appendix G**.

4.4.2.3 Unburned Winter Range

In the past decades, RAA4 and RAA5 have been affected by high levels of wildfire (**Figure 27**, above). Approximately 36% and 60-70% of the forested portions of RAA4 and RAA5, respectively, have been affected by wildfire in the past 50 years. In RAA4, almost half of the recently burned area resulted from the 2014 fire season, while a large proportion of RAA5 was burned in 1994 and older fires from the 1970s. RAA5 has received limited use by Bathurst caribou over the past decade, potentially in response to the large amount of area burned. In comparison, RAA3, the northeastern part of the winter range, has received a much lower amount of wildfire (20% burned in past 50 years) and has received increasing use by Bathurst caribou. Caribou have been observed to use recent burns less frequently than unburned areas (Joly et al. 2007; Anderson and Johnson 2014), and community members are concerned the declining amount of unburned forest in the winter range may be contributing to the population decline of the Bathurst caribou herd.

4.5 Summary

4.5.1 Population Status

The Bathurst caribou population is currently estimated to be approximately 20,000 animals (19,769 ± 7,420) (Boulanger et al. 2016), representing a decline of over 96% from a mid-1980s population estimate of approximately 450,000. Such dramatic population declines are also being experienced by some other Canadian barren-ground caribou herds, resulting in COSEWIC recently designating barren-ground caribou as a threatened wildlife species.

4.5.2 Range Disturbance

Combining the results of the human disturbance mapping from **Section 3.3.2**, and the wildfire mapping from **Section 4.3.2.2**. **Table 7** summarizes the current level of human, recent wildfire and total disturbance within the Bathurst range planning area. Total disturbance represents the extent of non-overlapping total human and recent wildfire disturbance. Key results are as follows:

- At approximately 17%, RAA4 has the highest level of total human disturbance and the second highest area of recent wildfire disturbance. Combined, almost 50% of RAA4 is affected by human disturbance and recent wildfire.
- RAA5 has the highest level of recent wildfire disturbance. In total, 37% of RAA5 has been affected by recent wildfire but approximately 60-70% of the area south of treeline has been burned since 1965.
- RAA3 and RAA5 have very low levels of current human disturbance.
- Approximately 12% of RAA2 is affected by human disturbance. RAA2

Given the large areas affected by wildfire disturbance on the taiga winter range, it is important to separately consider the tundra (RAA1 and RAA2) and taiga (RAA 3, 4 and 5) portions of the annual range when calculating total disturbed area.

TABLE 7. CURRENT LEVEL OF HUMAN, WILDFIRE AND TOTAL DISTURBANCE IN THE BATHURST RANGE PLANNING AREA, REPORTED BY RAA.

Range Assessment Area	Range Assessment Area Size	Direct Human Development Footprint	Total Human Disturbance (includes ZOI)	Recent Wildfire Disturbance (1965-2015)	Total Disturbance (total human disturbance + wildfire) *
	(km^2)	(% of RAA and km^2)	(% of RAA and km^2)	(% of RAA and km^2)	(% of RAA and km^2)
Area 1 : Nunavut	75,902 km^2	<1% (20 km^2)	1.4% (1,080 km^2)	<1% (20 km^2)	1.4% (1,063 km^2)
Area 2: NWT Central Tundra	56,134 km^2	<1% (70 km^2)	11.8% (6,610 km^2)	<1% (5 km^2)	11.7% (6,568 km^2)
Area 3: NWT Winter Range - Northwest	77,001 km^2	<1% (<1 km^2)	<1% (<1 km^2)	19.7% (15,178 km^2)	19.7% (15,169 km^2)
Area 4: NWT Winter Range – Central	84,858 km^2	<1% (90 km^2)	16.6% (14,120 km^2)	36.3% (30,839 km^2)	47.4% (40,223 km^2)
Area 5: NWT Winter Range – Southeast **	95,127 km^2	<1% (<1 km^2)	<1% (88 km^2)	37.3% ** (35,459 km^2)	37.3% (35,482 km^2)
TOTALS	389,022 km^2	<1% (181 km^2)	5.6% (21,898 km^2)	21.0% (81,501 km^2)	25.3% (98,580 km^2)

** Note: Due to overlap, total disturbance does not equal the sum of total human and recent wildfire disturbance.*

***Note: approximately one third of Area 5 occurs north of treeline. The area burned south of treeline since 1965 represents approximately 60-70% of the forested area.*

4.5.3 Factors Affecting Caribou

A number of factors affect caribou populations. Natural factors include climate, wildfire, predation and insects and parasites. Human factors include respect, hunting and land use. Traditional and scientific perspectives have similar views on how land use affects caribou. Based on caribou simulation modelling results, the relative importance of different factors affecting caribou can be described as follows:

- Caribou mortality rates (predation or hunting) appear to have the strongest overall influence on caribou population trend.
- Environmental variability (climate, insects and diseases, green-up) influences caribou population productivity, but to a lesser degree than direct mortality.

- Increasing levels of land use (i.e., increasing levels of development footprint and associated ZOI) result in incremental reductions in herd productivity, largely through a reduction in expected female caribou pregnancy rates.
- Lower pregnancy rates reduce overall population productivity, and have a synergistic effect with mortality rates. Combined, these two factors result in higher rates of population decline in scenarios with higher levels of industrial development.
- The relative effect of wildfire on population performance was not able to be directly assessed. However, the boreal woodland caribou recovery strategy (ECCC 2012) considers wildfire disturbance as a factor in determining disturbance management thresholds.

4.5.4 Sensitive Areas and Important Habitats

Major findings regarding sensitive areas and important habitats are as follows:

- The calving and post-calving period is considered the most sensitive and important part of the Bathurst annual range. Most of this area is in RAA1 (Nunavut).
- The summer range is considered the second most sensitive and important part of the range. The core summer range is located within RAA1 (Nunavut) and RAA2 (NWT Central Tundra).
- In addition to the sensitive range areas, water crossings, land bridges and unburned parts of the winter range have been consistently identified as important places for caribou that require special management consideration.

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5 Summary

This report and the supporting appendices describe the methods and information used to develop the *Interim Discussion Document* (Bathurst Caribou Range Plan 2016). Topics addressed include the caribou herd and its habitat, people living within the range and engaging with the Bathurst herd, important land use and economic activities occurring within the range, levels of range disturbance, and how different natural and human factors may affect caribou. Key findings and management concerns are summarized below.

5.1 Management Considerations by Range Assessment Area

Table 8 summarizes the major management considerations and factors contributing to them for each range assessment area in the BCRP planning area.

TABLE 8: SUMMARY OF CARIBOU HABITAT AND RANGE USE, DISTURBANCE, AND MANAGEMENT CONSIDERATIONS BY RANGE ASSESSMENT AREA.

RAA	Caribou Habitat and Range Use	Human Land Use and Disturbance	Wildfire Disturbance	Management Considerations	
				Current Situation	Future Situation
Area 1: Nunavut 75,902 km^2 (20% of planning area)	• The most sensitive parts of the Bathurst annual range, the calving and post-calving area, is in RAA1. • RAA1 is also important summer habitat. • Parts of RAA1 may also be used in winter by other caribou herds (Dolphin and Union, and Beverly-Ahiak).	• There is currently a low level of human land use with limited winter road access	• Wildfire is not a major source of disturbance on the tundra.	• There are few current management concerns related to human land use and disturbance. • The Draft Nunavut Land Use Plan (2016) proposed land use designation requires consideration.	• RAA1 has the potential to experience the largest increase in new mine and transportation infrastructure development, all within the most sensitive part of the Bathurst range • A new all-season road spanning from the Arctic Coast to near Contwoyto Lake is being considered, and multiple large mine projects have been proposed.
Area 2: NWT Central Tundra 56,134 km^2 (14% of planning area)	• RAA2 is central to the Bathurst herd annual range, with summer, fall and spring migration all occurring in this area. • Much of the most sensitive summer range is in RAA2	• The four diamond mines developed since the late-1990s are located in RAA2. • Current human disturbance is estimated to affect 12% of RAA2. • The Tibbit to Contwoyto Winter Road provides annual winter	• Wildfire is not a major source of disturbance on the tundra.	• The combined effects of multiple mines, other exploration projects and the Tibbit to Contwoyto Lake winter road has contributed to relatively high levels of human disturbance. • The location of mines in the Lac de Gras area, on or around land bridges and water crossings, has influenced caribou	• The level of future development and resulting human disturbance is uncertain. • If existing mines are closed in the coming 10-15 years without new mines being developed, disturbance levels will decline. • If new mines are developed to replace

RAA	Caribou Habitat and Range Use	Human Land Use and Disturbance	Wildfire Disturbance	Management Considerations	
				Current Situation	Future Situation
		access.		migration paths.	the existing mines, disturbance levels will remain similar to current, or increase. • A new all-season road to the southern fringe of RAA2 is being considered, which would facilitate year-round human access to parts of the central tundra.
Area 3: NWT Winter Range - Northwest 77,001 km^2 (20% of planning area)	• RAA3 has been used as winter habitat by Bathurst caribou with increasing frequency over the past decade, potentially in response to high levels of wildfire in other areas. • The Bathurst and Bluenose East herds overlap in this wintering area.	• RAA3 currently receives low levels of human land use. • Winter roads in RAA4 provide access to parts of RAA3.	• Wildfire has been less active in this part of the winter range. • Approximately 20% of RAA3 has been affected by wildfire since 1965.	• There are few current management concerns related to human land use and disturbance. • In the past, overlap with the Bluenose East herd has resulted in harvest concerns.	• The amount of future human disturbance is anticipated to remain low. • The amount of future wildfire is uncertain but is anticipated to be similar to current, or increase.
Area 4: NWT Winter Range - Central 84,858 km^2	• This part of the winter range has received consistent winter use by Bathurst caribou.	• RAA4 has the highest amount of human disturbance in the Bathurst range. • The City of Yellowknife, all of	• A large part (18%) of RAA4 was burned in 2014, with approximately 36% of the area being affected by wildfire since 1965.	• RAA4 has the highest level of human (17%) and combined human and wildfire disturbance (47%) in the Bathurst annual range.	• Given the large amount of permanent infrastructure and communities, in the future RAA4 is anticipated to continue to have the highest

RAA	Caribou Habitat and Range Use	Human Land Use and Disturbance	Wildfire Disturbance	Management Considerations	
				Current Situation	Future Situation
(22% of planning area)		the communities, Hwy 3 and Hwy 4, a number of winter roads, and the Snare and Bluefish electrical transmission lines are all in RAA4.		• RAA4 also has the highest amount of winter and all-season roads, facilitating high levels of human access into this part of the Bathurst winter range.	level of human disturbance within the Bathurst range. • A new all-season road to replace the southern part of the Tibbit to Contwoyto Lake winter road is being considered. The new all-season road would facilitate year-round human access to parts of RAA4 and RAA2.
Area 5: NWT Winter Range - Southeast 95,127 km^2 (24% of planning area)	• This part of the winter range has received lower use by caribou in recent years. • RAA5 is also part of the winter range of the Beverly-Ahiak herd. Occasional and variable overlap between Bathurst and Qamanirjuaq caribou have also occurred in this area.	• RAA5 currently receives very low levels of human land use.	• RAA5 has experienced many large wildfires over the past decades; 60-70% of the forested area south of treeline has experienced a burn since 1965.	• There are few current management concerns related to human land use and disturbance. • The large amount of wildfire may be affecting Bathurst caribou use in this part of the winter range.	• In the future, human land use is anticipated to remain low. • The amount of future wildfire is uncertain but is expected to be similar to or greater than current.

5.2 Key Range Planning Issues

Based on the above information, the following topics are suggested as key issues requiring consideration in the BCRP planning process[14].

5.2.1 Cumulative Range Disturbance

The environmental assessment of the Gahcho Kué Project highlighted ongoing concerns voiced strongly by Aboriginal communities that numerous impacts on Bathurst caribou are not being addressed by any regulator or government other than through harvest restrictions. Correspondingly, one of MVEIRB's (2013) recommendations was a measure for governments to establish and implement a cumulative effects monitoring and management framework so that cumulative effects on caribou could be managed and mitigated effectively.

Similarly, with the Jay Project, the Review Board recommended measures to manage "cumulative impacts of development and other human activities that are otherwise likely to combine with the cumulative effects of the Jay Project to worsen the situation," (p. 136, MVEIRB 2016). It suggested that the BCRP Working Group produce interim thresholds for development and other human activities within the range of the Bathurst caribou herd.

> *The elders do not see these as separate projects [minesites] because combined, the sites and the associated activities form a "wall" surrounding the Ek'atì area that blocks ek'atì tataa, the Bathurst caribou herd's main migration route (TRTI 2013). Hence, the elders prefer to view the resource extraction industry as one activity that cumulatively impacts caribou health, behaviour, population dynamics and migration patterns. Dedats'eetsa: Tłı̨chǫ Research and Training Institute. May 4 2016: 18*

Leaders, elders, hunters, and other community members as well as wildlife biologists explain that barren-ground caribou habitat quality and amount is declining due to climate change, wildfire, and human development and land use. The cumulative impact of these activities on caribou habitat has not gone unnoticed by people who share their lands, waters, and world with barren-ground caribou (Trailmark 2015; AD 2016; Dedats'eetsa 2016b LKDFN; 2016; NSMA 2016; NWTMN 2016; YKDFN 2016). People recognize that have caribou have and can adapt, and those born recently have never known migration routes without disturbance. It is their ability to learn that explains how caribou can adapt to a changing landscape, although there are said to be limits (i.e. thresholds) to how much change caribou can handle (Golder 2011; Thorpe and Barnaby 2016).

[14] Predation and hunting are direct sources of mortality that affect caribou populations but are outside of the approved scope of the BCRP.

The land use and wildfire disturbance assessments allowed the amount of natural and human disturbance within the Bathurst range to be estimated. The current level of human, wildfire and total disturbance within the range planning area is summarized in **Table 7**. Estimates of potential future levels of disturbance resulting from three development scenarios have also been made (**Section 3.4.2**). Results of the CARMA integrated caribou modelling suggest that human development has a negative incremental effect on caribou productivity (primarily through a reduction in pregnancy rates), with the magnitude of effect related to the amount of human disturbance the population is exposed to, as expressed as average encounters with human development and associated ZOI (**Section 4.3.4**). As a higher proportion of the range becomes influenced by human disturbance, the probability of caribou encountering this disturbance increases. Modelling results did not identify any clear breakpoints in the level of acceptable human disturbance, but did identify an incremental negative relationship between disturbance levels and population performance. Developing interim thresholds for human development (direct and indirect disturbance) will therefore be challenging, and may need to consider multiple approaches and balance multiple perspectives.

As the BCRP Working Group explores approaches for identifying potential cumulative disturbance thresholds, the following points will require consideration:

- The Bathurst range is composed of two very different areas – the tundra biomes in Nunavut and central NWT, and the taiga biomes in southern NWT. The taiga forests constitute the winter range. These two areas have very different ecological conditions and range sensitivities, which need to be considered when exploring and potentially identifying human disturbance thresholds.
- In the taiga winter range, both human and wildfire affect caribou habitat—should the disturbance framework consider both sources of disturbance, similar to the critical habitat definition for boreal woodland caribou? (ECCC 2011 and 2012)

5.2.2 Calving and Post-calving Range

The BCRP will need to consider the potential benefits and challenges associated with different management options and opportunities in the calving and post-calving range of RAA1. The calving grounds are considered to be the most sensitive part of the range and have a strong spiritual standing for Caribou People. It is for this reason that many communities have called for a ban on land use activities within the calving grounds, dating back to the 1990s.

> *Weledeh Yellowknives Elders strongly recommend that all caribou calving grounds become Protected Areas (YKDFN 1997a, #2-B-11: 88).*

While applying a protected area to the calving grounds would afford the highest level of protection to calving caribou and their newborn calves, the Bathurst calving grounds have also shifted over time. Applying a fixed protected area to the calving grounds may therefore be challenging, and may also preclude future economic opportunities. Other options for reducing human-caused disturbance in the

calving and post-calving range could include mobile protection measures, seasonal timing-windows or more place-specific protection measures.

The Draft Nunavut Land Use Plan (2016) has suggested that protected areas be established in the recently used Bathurst calving grounds, as well as over known freshwater crossings in the entire Contwoyto Lake area (**Figure 39**). Other groups have suggested that mobile protection measures or other more flexible options applied during the late-spring and summer period would be adequate to mitigate potential impacts of human land use activity on caribou in the calving and post-calving range.

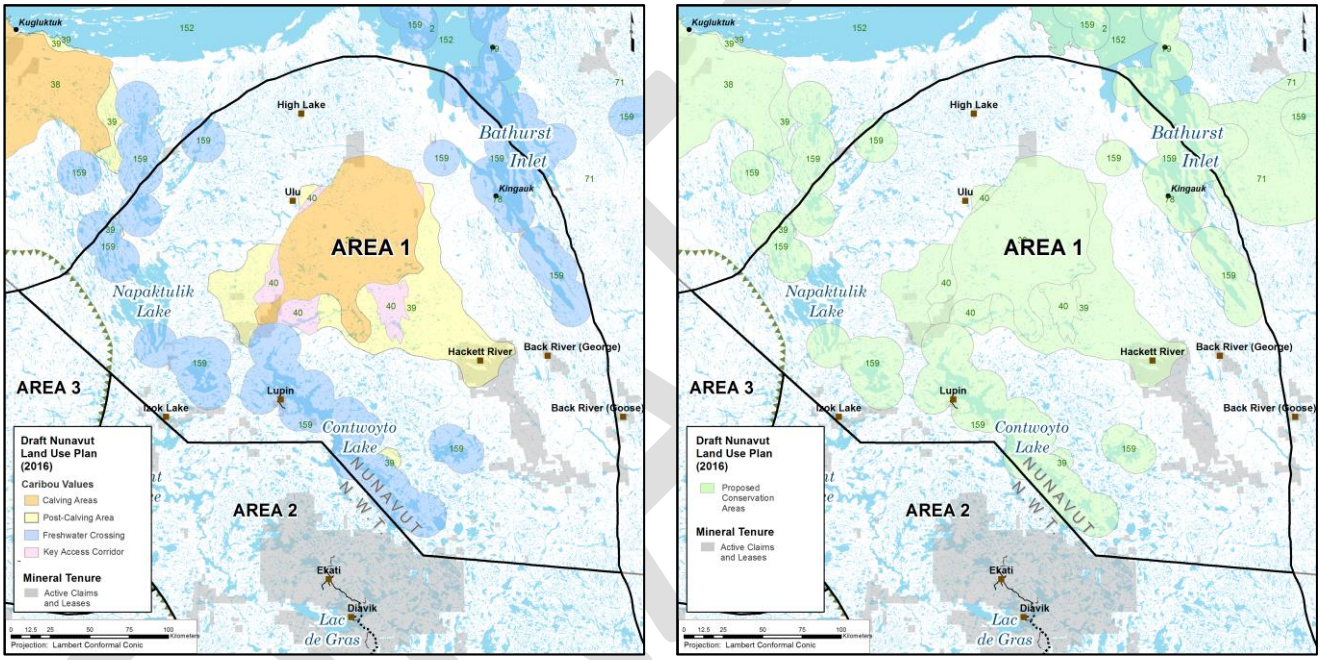

FIGURE 39: DRAFT NUNAVUT LAND USE PLAN (2016) IDENTIFIED CARIBOU VALUES (LEFT MAP) AND PROPOSED PROTECTED AREAS FOR CARIBOU VALUES (CALVING, POST-CALVING AND WATER CROSSINGS) (RIGHT MAP) IN THE NUNAVUT PORTION OF THE BATHURST RANGE (RAA1).

5.2.3 Summer Range

After the calving and post-calving area, the summer range is considered the second-most sensitive part of the Bathurst annual range. The summer range is important for caribou feeding and represents the 'cross-roads' between the calving grounds in Nunavut and the winter range in NWT. This area contains the largest concentration of known water crossings and land bridges in the Bathurst annual range (**Figure 40**, left map).

While this part of the range is important for Bathurst caribou, it is also a critical economic driver for the NWT. The summer range is part of the central Slave Geological Province, an area containing some of the highest mineral potential in Northwest Territories (**Figure 40**, right map). The three producing diamond

mines (and Snap Lake, currently under care and maintenance) are located in the central summer range, as well as other advanced exploration properties and past mines. The producing mines and associated support activities are responsible for a large proportion of the NWT's GDP, and since opening have generated nearly $10 billion in NWT business contracts, including over $4 billion with Aboriginal-owned businesses (NWT Industry, Tourism and Investment 2012).

Given the relatively large amount of existing mine infrastructure, high mineral potential, and ongoing exploration interest in RAA2, developing management options for the summer range will be challenging. The diamond mines already implement a number of innovative best practices and management approaches to reduce disturbance effects on caribou from their operations. Larger protected areas would provide landscape-level areas free of human disturbance but would also reduce the amount of land available for mineral exploration. Applying seasonal timing windows, or full protection, to smaller, place-specific locations (e.g., specific water crossings or land bridges within the summer range) may be other options.

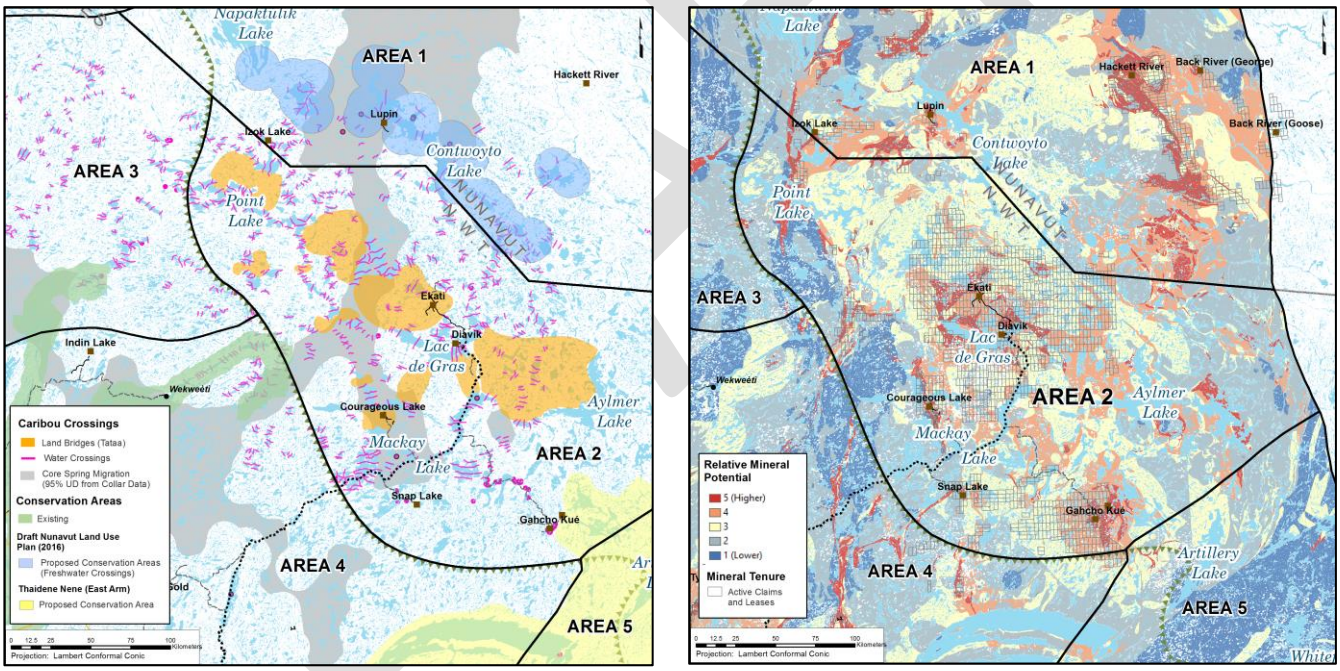

FIGURE 40: (LEFT MAP) IDENTIFIED WATER CROSSINGS AND LAND BRIDGES IN THE CENTRAL BATHURST RANGE, AND THE CORE SPRING MIGRATION CORRIDOR (SHOWN IN GREY). EXISTING AND PROPOSED PROTECTED OR CONSERVATION AREAS ARE ALSO SHOWN. (RIGHT MAP) RELATIVE MINERAL POTENTIAL AND ACTIVE MINERAL CLAIMS AND LEASES IN THE CENTRAL BATHURST RANGE.

5.2.4 Water Crossings and Land Bridges

Water crossings and land bridges have been consistently identified as some of the most important place-specific habitats for barren-ground caribou. **Figure 40** (left map) illustrates the location of some water crossings and land bridges identified through Tłı̨chǫ and Kitikmeot Inuit Association traditional knowledge. While many water crossings are identified (see **Appendix G**), others may not be known or recorded. Given the large number of crossings, it is also difficult to prioritize which may be the most important, as maintaining options for long-term caribou movement and migration across the range is necessary.

If some crossings or land bridges can be prioritized, establishing small, place-specific conservation/protected areas me be practical, or it may be possible to use timing windows so human land use activities avoid times when caribou are using these areas. Williams and Gunn (1982) report that previously, land use related activities were prohibited within a 5 km radius of 27 designated water crossings in the Beverly and Qaminuriak herd ranges from May 15 to September 1. However, given the large number of water crossings currently identified, applying such approaches may be challenging.

5.2.5 Unburned Winter Range

Wildfire is a natural part of the taiga biome. However, large parts of the central (RAA4) and southeastern (RAA5) winter range have burned in the past decades—approximately 36% of RAA4 and 60-70% of the forested portion of RAA5 have burned since 1965. Community members are concerned the declining amount of unburned forest in the winter range may be contributing to the population decline of the Bathurst caribou herd. Caribou have been observed to use recent burns less frequently than unburned areas (Anderson and Johnson 2014).

While the amount of area recently burned in the Bathurst winter range is large, the rate of burning appears to be similar to other areas of the Taiga Shield ecozone. However, combined with the relatively high amount of human disturbance in the central winter range, the total disturbance represents almost 50% of RAA4. Given this, community members and resource boards have questioned whether wildfire should be actioned in the remaining unburned areas of RAA4, and potentially RAA5.

> *I am just thinking about what the forest fires left behind. In the Tłı̨chǫ area, we can't always just look at forest fires in the summer time and try to only protect the places. We should talk about it and protect all the green ones that the animals can use and let it go the burned part so that should be relooked at. It should be protected, ... There are some areas that caribou use a lot and we don't want the caribou food to be gone so we should really look at that.* 7A, BCRP TK Workshop, March, 2016

Given the vast areas and distances involved, it may not be feasible to protect unburned parts of the winter range from future wildfire—the amount of financial resources needed to marginally increase fire suppression effectiveness is likely prohibitive, and under extreme fire weather conditions would likely ineffective (and these conditions account for the majority of the total burned area). Also, in the long-

term, there may be negative ecological consequences to attempting to maintain old forests. The BCRP range planning process will need to consider these multiple perspectives.

5.2.6 Human Access within the Winter Range

The large amount of road and trail access in the central part of the winter range (RAA4) makes the Bathurst herd one of the most accessible herds of barren-ground caribou in the NWT. Roads and trails facilitates human access into new or difficult to travel to areas, and generally results in higher hunting pressures on wildlife populations. Construction of the Tibbit to Contwoyto Lake Winter Road in the mid-1990s resulted in increased hunting pressures on the Bathurst herd, and likely contributed to its rapid population decline. The construction of new roads or routes may also have a similar effect.

How best to manage the number and location of roads and trails on the Bathurst range, and peoples use of those features, is a challenging question. Seasonal winter access roads are often used to mitigate potential negative effects on wildlife populations. However, in the Bathurst winter range, this is also the same period as when Bathurst caribou are in the taiga forests. Similarly, there are few effective ways to manage people's use of roads and trails—once a road or trails is built and can be accessed, it becomes difficult to limit people's use of that feature.

The BCRP planning process should consider ways to manage people's use of roads and trails, and how this may affect other values or activities. In addition to regulations, other options may include community-based monitoring, awareness campaigns or similar measures.

5.3 References

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