Bathurst Caribou Range Plan

Interim Discussion Document

For WG Discussion

December, 2016



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Disclaimer

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Executive Summary

Something that we need to do, healing the caribou and trying to work with these animals, we have to do it all together: that's the only thing that we can do. — 7A in BCRP TK Workshop, March 2016

See separate Plain Language Summary.

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1 Introduction

1.1 What is this Document About?

A range plan for the Bathurst caribou herd is being developed with representation of multiple interests across the entire Bathurst range in Nunavut, Northwest Territories (NWT) and northern Saskatchewan. The process supports group development and evaluation of potential range-scale management and guardianship actions.

Aboriginal peoples living throughout the Bathurst range face a cultural dilemma, knowing that the strong relationship between caribou and people depends on the ability of people to respectfully harvest a healthy caribou population, and for caribou to offer themselves to people. They also recognize that mining and other industrial activities provide some needed economic opportunities and capacity-building within northern communities.

The caribou is really important. The caribou doesn't talk for itself and we have to talk for him. How can we help in any way? We put something there for our future generation. If you have seen this, you follow the way. Then you can live with the caribou a long time. That's the way I was looking at it. By listening to others, leave them alone but not forever. — 7A in BCRP TK Workshop, March 2016



This document describes progress toward development of the Bathurst Caribou Range Plan (BCRP). It presents important considerations and questions for guiding community and decision-maker engagement.

Sections 1 and 2 describe the need for a range plan, who is involved, and what is being considered. Section 3 introduces the underlying principles guiding development of the BCRP, while Section 4 proposes the fundamental goal and objectives of the BCRP.

Section 5 summarizes the range-scale management tools and approaches under consideration, and Section 6 describes progress toward developing and assessing the implementation of these tools across the various parts of the range. Key considerations are highlighted, some involving tough choices among competing values, and discussion questions are proposed for engaging with communities and other decision-makers. Finally, Section 7 summarizes at a high level the potential implications from various viewpoints.

The perspectives and understandings presented in this document come from traditional, local and scientific knowledge. This discussion document presents information from each of these forms of knowledge unless otherwise stated.

A supporting document – *Bathurst Caribou Range Plan: Range Assessment and Technical Methods Report* – is available that describes the methods and information that are being used to support the ongoing development of the BCRP, including information about the people living within the range and utilizing the Bathurst herd, the caribou herd and its range, and important land use and economic activities occurring within the range.

Development of the BCRP continues as a work-in-progress. Efforts to date have focused on:

- Gathering and integrating traditional, local and scientific knowledge and developing a GIS database;
- Development of future development scenarios to help explore the potential implications of implementing range-scale management actions;
- Modelling the potential response of caribou to these scenarios, and most importantly;
- Fostering deep conversations about the Bathurst caribou range, and the socio-cultural, environmental and economic implications of implementing range-scale management actions.

The focus in early 2017 will be on engaging with communities, governments and other interested parties on the current content and direction of the BCRP. Following that, the BCRP Working Group and Project Team will re-convene to adjust direction based on the input provided and address outstanding range planning topics (e.g., community-well-being, the exploration phase of mineral development, etc.).

1.2 Why a Range Plan?

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 the tundra and taiga biomes of Nunavut and the eastern NWT. In previous years, its winter distribution had also extended into 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. Due to road and trail access across the winter range, the Bathurst herd is considered to be one of the most accessible herds of barren-ground caribou in the NWT.

Within the last 30 years, community members and biologists alike have noticed a decline in Bathurst caribou. Community members report fewer caribou, less 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. Following management intervention, 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. Overall the herd has decreased 96% since the peak population in 1986. During this period of decline, there was also an unprecedented increase in mineral exploration activity on the annual range of the Bathurst herd. This was followed by the approval and development of three diamond mines (Diavik, Ekati and Snap Lake) between 1996 and 2003 (CEAA 1996, CEAA 1999, MVEIRB 2003). A fourth mine (Gahcho Kué) approved in 2013 (MVEIRB 2013) is now operational, and the Jay Project expansion of the Ekati diamond mine was approved in 2016 (MVEIRB 2016).

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 any 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 Range Plan WG produce interim thresholds for development and other human activities within the range of the Bathurst caribou herd.

In response to this context and concerns regarding the cumulative effects of mineral exploration and development on the Bathurst range, the Government of Northwest Territories (GNWT) initiated a range planning exercise to provide guidance on ways to manage and reduce disturbance to caribou and caribou habitat resulting from human land use and associated activities.

1.3 Where is the range planning area?

The BCRP requires a well-defined area to focus efforts. Traditional knowledge (TK) tells us the range of the Bathurst herd has always been dynamic, at times growing larger and smaller, depending on available food, herd numbers, wildfires, winter snow conditions, and influence of caribou leaders on migratory routes. The BCRP process adopted a planning area based on the annual range of the Bathurst herd derived from radio collared female caribou from 1996-2014 (as described by Nagy 2011) and modified by slightly (Figure 1). This boundary allows the range plan to accommodate herd recovery and growth relative to its current status. While the areas used by Bathurst caribou since 1996 are the focus of planning efforts, the historical range provides the context of more varied range use over a much longer time period. The range plan is intended to be a living document and thus the range planning area may be revisited in the future as conditions change.



FIGURE 1: THE BATHURST CARIBOU RANGE PLANNING AREA AND HISTORICAL RANGE AS IDENTIFIED BY TK

1.4 Who is involved?

The range plan is being developed by a Working Group (WG) made up of representatives from federal, territorial and Aboriginal Governments, industry, Aboriginal and non-government organizations. Membership is comprised of the following:

1. Wek'èezhiı Renewable Resources Board	13. Chamber of Mines - Exploration	
2. Tłįchǫ Government	14. Government of Nunavut – Environment	
3. Łutsel K'e Dene First Nation	15. GNWT - Department of Lands	
4. Yellowknives Dene First Nation	16. GNWT - Department of Industry, Tourism and	
5. NWT Métis Nation	Investment (ITI)	
6. North Slave Métis Alliance	17. GNWT - Department of Environment and Natural Resources (ENR)	
7. Athabasca Denesuline	18. Aboriginal Affairs and Northern Development	
8. Kitikmeot Regional Wildlife Board	Canada - Nunavut	
9. Kugluktuk Hunters and Trappers Organization	19. NWT Wildlife Federation	
10. Kitikmeot Inuit Association	20. Barren-ground Caribou Outfitters Association	
11. Nunavut Tunngavik Incorporated	21. Canadian Parks and Wilderness Society	
12. Chamber of Mines – Industry		

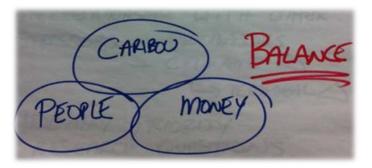
A Steering Committee, comprised of Government, Aboriginal and industry leadership, is overseeing the WG and is regularly updated on their progress. The Steering Committee and WG are supported by a Project Team of consultants (Compass Resource Management Ltd., EcoBorealis Consulting Inc., S. Francis Consulting Inc., and Trailmark Systems Inc.) and GNWT Department of ENR staff.

The Bathurst caribou range planning process started in the fall of 2014 and will continue through to March 2018. To date, the BCRP WG has held nine meetings and provided three updates to the Steering Committee. The GNWT, Department of ENR is sponsoring the range planning process with funding support from the federal Department of Aboriginal Affairs and Northern Development Canada, Polar Knowledge Canada.

1.5 What is being considered?

To balance caribou habitat conservation, cultural and economic values, the WG is exploring:

- 1. Caribou, ranges and habitats;
- 2. Traditional use and values; and
- 3. Economic development



Recommendations will focus on managing or reducing the level of disturbance (human and wildfire) affecting caribou and caribou habitat¹. Range-scale effects and management strategies are being prioritized over project-scale operating practices. A major purpose of the Range Plan is to provide greater clarity for land use decision-making across the range and as a starting point to heal the relationship between people and caribou.

Harvest and other sources of mortality are being considered, but harvest levels and allocation, predator control, climate change adaptation and land use planning will not be directly addressed (Figure 2). Recognizing the complexities and scope of all factors affecting Bathurst caribou and habitat, recommendations on these topics are intended to provide guidance to communities as well as relevant regulatory, management and planning bodies.

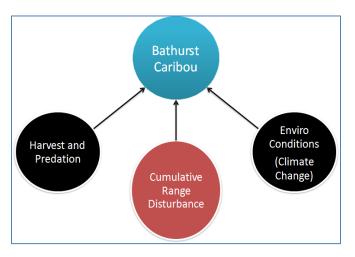


FIGURE 2: THE SCOPE OF THE BATHURST CARIBOU RANGE PLAN (IN RED)

¹ 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.)

2 Principles

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 in BCRP TK Workshop, March 2016

Building on community and Steering Committee direction, the four main principles guiding development of the Bathurst caribou range plan are:

- 1. **Respect Caribou:** Recognize and acknowledge the intrinsic value and importance of caribou as part of the northern ecological, cultural and socio-economic system; acknowledge respect as the basis for a sustainable relationship that connects people and caribou in the past, present, and future. Disrespect threatens caribou well-being and causes fractures in the relationship between people and caribou.
- 2. Interweave Traditional, Local and Scientific Knowledge: Bring together multiple sources of knowledge to inform our collective understanding of caribou, caribou habitat, and the various factors affecting caribou, other wildlife and the land. Appreciate (honour) the range of elements, understandings and perspectives related to caribou that comes from each knowledge source. Provide a robust information base for community and government decision-makers.
- 3. **Practice Guardianship, Stewardship and Management to Care for Caribou:** Regardless of whether one understands their role or relationship with caribou as one of guardianship, stewardship, or management, we must work together for the well-being of caribou. Whether it is through studying caribou population numbers, carrying out community-based monitoring, or sharing TK about ways to respect caribou, these are all part of a larger imperative to look out for caribou well-being.
- 4. Achieve Balance: Consider ecological (caribou), cultural, social and economic values in decision-making about range use. Acknowledge that achieving sustainable development across the range will require explicit tough choices about ecological, cultural and economic values in order to achieve balanced outcomes that are acceptable to all participants.

3 BCRP Goal and Objectives

Barren-ground caribou are an ecological keystone species because of their simultaneous roles as large migratory grazers and primary prey for carnivores. They are a cultural keystone species because they have shaped the cultural identity of First Nations, Inuit, and Métis peoples over millennia. Mobility is the ultimate adaptation of migratory barren-ground caribou (see Bergerud et al. 1984), which is illustrated by their need "to seek space to cope with an every-changing extrinsic environment" and is highlighted by the size of a herd's annual range, spatial extent of its seasonal movements, and the gregarious behaviour of breeding females during calving. This adaptation is said to be driven in response to various factors such as the availability of forage, or the need to escape from predators. From a cultural perspective changes in distribution are a result of whether people are treating caribou according to traditional laws.

The annual range of the Bathurst caribou herd includes multiple ecosystems and habitats, and a range of native biodiversity that interact through socio-cultural, biological and physical processes across large spatial scales. Landscape resilience is the ability of the annual range to sustain and provide migratory barren-ground caribou with adequate space to meet their biological needs (i.e., food and nutrition, insect relief, predator avoidance, etc.) under changing environmental conditions and despite multiple stressors and uncertainties, including human land use. A resilient landscape for caribou describes the capacity of ecosystems to tolerate natural and human disturbance without changing to a qualitatively different state that is controlled by a different set of processes (sensu Holling 1973, and see Standish et al. 2014). TK tells us that respect is at the core of resilience and that any upset in the socio-cultural, biological and physical processes that alters respect also affects resilience, or the ability of either the herd or its habitat to adapt.

BCRP MANAGEMENT GOAL:

Maintain the Bathurst caribou herd annual range in a resilient landscape condition.

The future-oriented management goal and objectives presented here are reflective of caribou as both an ecological and cultural keystone species.

This goal acknowledges that northerners have a role as caribou guardians and habitat disturbance must be managed to allow a healthy Bathurst caribou herd population, which is subject to cycles in abundance and distribution, to maintain themselves in an ever-changing environment. This means we must take care of the land to take care of caribou.

Four specific management objectives to achieve this goal are:

OBJECTIVE 1 – Maintain the amount of human disturbance below threshold levels.

The Bathurst caribou's use of space across its extensive annual range is a key adaptive behaviour that needs to be conserved to ensure viability and persistence of the herd in the future. Community members have observed this cyclic use of space since time immemorial.

Establishing disturbance thresholds and managing overall human disturbance within those limits provides a key fundamental step towards maintaining landscape resilience.

OBJECTIVE 2 – Maintain connectivity between seasonal ranges.

Conserving caribou migrations requires that connectivity – the ability to move freely between core seasonal ranges – is maintained through identification and management (including protection) of important areas used consistently during migration such as water crossings and land bridges. Knowledge of these areas has long guided community members in where to locate their camps and communities to support harvesting opportunities.

TK tells us that caribou are able to adapt to changing conditions by shifting their migration routes or acclimating to some disturbances, but only to a point. Ensuring connectivity across seasonal ranges and habitat areas facilitates the continued ability of Bathurst caribou to shift range use in response to changing future environmental conditions.

OBJECTIVE 3 – Maintain the integrity of sensitive habitats.

Calving and post-calving areas are considered the most sensitive habitats to disturbance followed by summer range areas. Similarly, caribou cows and calves are considered to be the most sensitive to sensory disturbance during those times of the year. Community members know this time as one to leave the caribou alone and to honour the calving grounds as caribou nurseries.

An objective of maintaining integrity is to maintain the natural structure and function of sensitive habitats such that habitat condition reflects natural evolutionary and biogeographic processes with little or no influence from direct human actions.

OBJECTIVE 4 – Manage human access.

Construction and use of winter and/or all season roads on the Bathurst caribou range is fundamentally important for economic development of the region because road access facilitates construction and operation of mines.

However, newly constructed roads into previously remote wilderness areas also have unintended consequences. The primary one is increased access to harvesting wildlife, which, for caribou, can have significant and lasting impacts.

Consequently, effective access management is an important objective which requires consultation and collaboration among appropriate governments, boards, agencies, organizations, companies, communities and users, as well as regular compliance and community-based monitoring.

4 Range-Scale Management Tools and Approaches

The primary focus of management tools in this process is at the range-scale of the Bathurst caribou herd (Figure 3). At the individual project scale, regulatory tools aim to ensure that industry appropriately mitigates projectspecific effects on caribou. Nonetheless, as the level of cumulative disturbance associated with land use increases, so does demonstrated incremental impact on herd population well-being. There are also associated implications for food security, cultural well-being, harvest and traditional practice, and community requests for limiting the types and total amount of disturbance at any given time.

Range Level	 Cumulative Disturbance Thresholds Protected / Conservation Areas Land Use Activity Restrictions Access Management Planning
Project Level	 Best Management Practices: Dust control Light / noise control Progressive reclamation Off-road vehicle use Spill Management Etc.

FIGURE 3: SPECTRUM OF MANAGEMENT TOOLS AND APPROACHES

Each of the management tools and approaches

discussed in this document are grounded in local, traditional and scientific knowledge and can be implemented through multiple means including:

- 1. Land Use Planning: Establishing land use zone designations with specific terms and conditions that support landscape-level caribou management.
- Environmental Assessment: Using cumulative disturbance thresholds to assess project contributions to cumulative effects on caribou; making consistent recommendations to developers and land / wildlife managers to mitigate project specific effects on caribou and caribou habitat.
- 3. Land and Water Board Permitting: Setting terms and conditions in land use permits for protecting caribou and caribou habitat from disturbance.
- 4. **Wildlife Management Boards**: Making recommendations to government for caribou and caribou habitat management.
- 5. **Wildlife Legislation**: Using tools to protect habitat and create conservation zones; ensuring project specific mitigation measures are included in wildlife management plans that are approved and enforced.
- 6. Community Guardianship: Policies, actions, rules, practices and influences that communities have in place to safeguard caribou or affect human behaviour. For example, the Athabaskan Denesuline speak of the "Ten Caribou Commandments" (AD 2016), and the Kitikmeot Inuit implement "pitquhiit" (Thorpe et al. 2001), while the Gwich'in know this as "ways we respect caribou" (Wray and Parlee 2012).
- 7. **Industry Protocols**: Actions that industry project operators and proponents can proactively take upon themselves, such as sharing research, monitoring and assessment results, contributing to community or government-led cumulative effects efforts.

The following four management tools and approaches are being considered for managing disturbance

at the range-scale for the Bathurst caribou herd:

- 1. Cumulative Disturbance Frameworks
- 2. Protected / Conservation Areas
- 3. Land Use Activity Guidance
- 4. Access Management and Planning

4.1 Cumulative Disturbance Frameworks

Cumulative disturbance frameworks (CDFs) based on tiered disturbance thresholds (i.e., limits) and corresponding management responses can be implemented to manage overall disturbance levels across the Bathurst caribou range. The disturbance thresholds reflect limits of acceptable change, based on consideration of multiple values and perspectives – ecological (caribou), cultural, social and economic.

Setting cumulative disturbance thresholds has been a central request by environmental review boards and is viewed as an important range scale cumulative effects management lever.

I think industry will have to come up with ways of slowing down a bit. The stuff that you mine will be there for thousands of years, come back to stable conditions. That's what we tried to do with the mines at least one mine working at a time and learned from them. Maybe we should be looking at ways of slowing down a bit.... -- Bobby Algona in TCS 2014

Further, many community members have called for setting disturbance limits to guide the number of mines operating at any given time into the future. Depending on how much disturbance is on the landscape relative to the thresholds and how the caribou population is faring, different management and mitigation actions are required.

Benefits

- Establishing disturbance thresholds on a regional scale will clarify requirements for project assessment and mitigation and guide future land use planning.
- Assessing cumulative effects on a regional scale rather than a project-by-project basis will improve efficiency and reduce costs in the review and assessment of resource development projects.
- The concept of thresholds or limits has long been advocated for by community members and so this action demonstrates response to community direction.
- Most community members think in terms of future generations such that the concept of thresholds allows for making trade-offs today for the benefit of caribou and people in the future.

Challenges

- Establishing disturbance thresholds requires an evaluation of (and sometimes a difficult balancing between) deeply held caribou, socio-cultural and economic values.
- Implementation may require transboundary political and regulatory coordination and agreements between GNWT, GN and Aboriginal governments.

4.2 Protected / Conservation Areas

There are a variety of planning, policy and regulatory tools that can be applied to formally protect important migration corridors and sensitive habitats. These include:

- Establishing long-term protected areas through land, resources, and self-government agreements (e.g., Akaitcho Treaty 8, NWTMN, NSMA and Athabasca Denesuline Main Table Negotiation Processes)
- Considering shorter-term protected areas (i.e. amending current interim land withdrawals) as part of negotiations for land, resources, and self-government agreements
- Establishing conservation zones through land use planning designations,

Also in Nunavut we strongly feel about protecting the calving area. The hunters and trappers organization, the Inuit Regional office in the Kitikmeot region, tourism, exploration camps, supporting us and Nunavut [Wildlife] Management Board is supporting us. We have to work together and it takes hard work to get to that goal but we cannot give up it is our main food. — 3A in BCRP TK Workshop, March 2016

- Establishing management zones or conservation areas under territorial Wildlife Act legislation,
- Establishing wilderness or cultural conservation areas under federal or territorial Parks Act legislation.

Protected or conservation areas, depending on how they are implemented, are spatially explicit and can be either permanent (e.g., a land use protected area zone) or flexible (e.g., mobile conservation areas to manage harvest/disturbance). They can be located in areas to achieve multiple conservation goals for numerous species as a part of conservation network or protected area planning. Permanent protected areas offer the least flexibility to respond to changing future conditions (e.g., climate change, major resource discoveries, etc.), and potential changes in future patterns of land use by caribou.

Benefits

- Effective directly addresses concern of human-caused habitat disturbance.
- Conservation Zones in land use plans are often reviewed every 5 years and can be amended on an as-needed basis (pending approval from signatories to a plan), and thus offer flexibility that may be required to manage land for the migration patterns of the Bathurst Caribou herd.
- Can be developed to provide permanent protection of an area to support regeneration even during times when not being used as caribou habitat.

Challenges

- Locations of important areas for caribou (e.g., annual calving grounds) will shift over time and occur outside a designated conservation area.
- Negotiations to establish long-term protection takes a long time (10+ years), which does not address the immediate land management requirements for the Bathurst Caribou herd.
- Not every region in the Bathurst Caribou range has a land use plan or a land use planning process in place. Regional land use planning typically takes 10-20 years.
- Establishing conservation areas may have implications for traditional practices.

4.3 Land Use Activity Guidance

In addition to traditional cultural rules held by communities that have respect as the basis for people's relationship with the land and with caribou, there are a variety of planning, policy and regulatory tools that can be applied to manage human land use activities to reduce the direct impact on caribou when they are in certain areas at certain times (e.g., Wildlife Act, Forest Management Act, Mackenzie Valley Resource Management Act, Commissioner's Land Act, etc.). While this type of guidance is already implemented on an *ad hoc* basis, establishing a consistent approach for managing/restricting timing and location of human land use activity would provide clearer guidelines for industry and provide a basis for managing habitat effectiveness at a range scale. Further, sharing traditional rules around caribou with industry would assist in providing some of the necessary context for these guidelines (e.g. why it is important not to have activity near crossings) and may even lead to such rules being operationalized.

Guidance can be provided to inform land use planning on effective conditions, directives and conformity requirements that guide land use activities as they relate to caribou ecology.

Fixed seasonal timing windows can be used to reduce or stop activity during sensitive time periods when caribou are typically in a prescribed development area. Fixed seasonal timing windows may be most effectively applied during the exploration phase of mineral development, which generally has more flexibility in the scheduling of on- site activities.

Benefits

- Directly addresses concern of sensory disturbance during sensitive time periods
- Predictable timing restrictions may lead to practices that further reduce potential for disturbing caribou (e.g., hauling schedules are timed so that road traffic for incoming (fuel) and/or outgoing (mineral ore) resources do not conflict with expected timing of caribou movements in the area)
- Easy to implement

Challenges

- Does not address direct habitat loss or disturbance (e.g., construction of roads, mines, location of exploration camps, etc.)
- Timing and location of caribou may change or occur outside of fixed season window.

• Potentially imposes a high cost for projects that would have reduced/restricted activities whether caribou are in the local area or not.

Mobile Caribou Conservation Measures can be used to temporarily halt on-site operations or reduce the intensity of activity when caribou enter a prescribed development area. These measures may be applied to increase flexibility to development projects, by only imposing operational restrictions when caribou are on-site or move within a predefined distance from a project area. For example, Dominion Diamond currently implements road management measures

Wherever there is human activity, the caribou are aware of their surroundings. Some do become skittish, while some become used to human development and it doesn't bother them (Anonymous in KHTO et al. 2011).

that curtail road use and activity based on the number of caribou present and their distance.

Benefits

- Maintains flexibility for industry because operations are unaffected when caribou are not within the development area.
- Directly addresses concern of sensory disturbance to caribou during sensitive time periods.
- Supports opportunities for community-based monitoring.

Challenges

- Requires real-time monitoring of caribou relative to project areas, and hence is difficult and costly to implement.
- Does not address direct habitat loss or disturbance (e.g., construction of roads, mines, location of exploration camps, etc.).
- Results in unpredictable (and therefore costly) restrictions to work scheduling for industry.
- Compliance mechanisms need to be developed.
- Community-based monitoring programs would need to be coordinated among Aboriginal communities.

4.4 Access Management and Planning

Human access is a key issue in some areas of the Bathurst caribou range. Roads and trails provide routes into previously remote areas of the range which may lead to sensory disturbance from road traffic and increased harvest opportunities (i.e., when harvest is reinstated for the Bathurst herd). Roads with high traffic volumes can restrict the ability Being caribou guardians requires that people listen to caribou, manage themselves, accept sacrifices, and breathe life into traditional laws: the true challenge is to "manage" people and the way they use the land and treat animals.

of caribou to move from one area to another resulting in habitat fragmentation.

Access management and planning approaches could address issues like construction methods and route orientation to reduce barriers to movement, consolidating routes among multiple users to reduce

fragmentation and using seasonal roads vs. all-season roads to minimize/control the timeframe over which disturbance might occur.

Benefits

- Providing access is a cornerstone of supporting economic development in remote areas.
- Access management planning can be effective in reducing both direct mortality and indirect sensory disturbance to caribou.
- Roads provide opportunity for community-based monitoring.

Challenges

- Once a road is in place, effectively managing its use has proven difficult in all jurisdictions.
- Consolidating routes among multiple users is difficult without knowing which minerals/commodities may one day be feasible to develop/extract.
- Winter roads are becoming less viable with changing climate conditions and warmer winters.

4.5 Range Assessment Areas

Different types and levels of land use occur in different parts of the range, and the amount of human use and access varies greatly. At the range scale, the planning area is comprised of tundra (~33%) and taiga (~66%) biomes, with the latter being subject to naturally occurring wildfires.

To better understand the potential land use and management issues affecting caribou in different parts of the range planning area, the BCRP WG divided the planning area into five different range assessment areas (RAAs). The five RAAs were created by considering traditional territories, human land use patterns, administrative boundaries, and Bathurst caribou range use and habitat conditions (Figure 4).

Table 1 provides a summary of Bathurst caribou habitat and use in the five BCRP RAAs and Appendix C provides an overview summary of land status and important caribou values for each RAA.

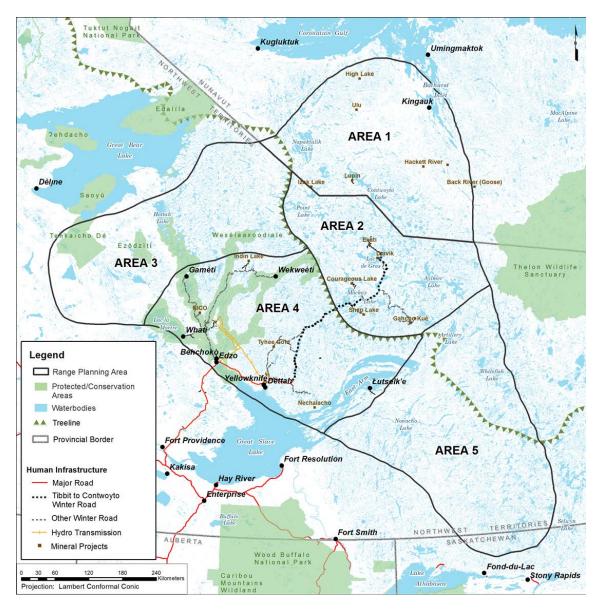


FIGURE 4: RANGE ASSESSMENT AREAS IN THE BATHURST CARIBOU RANGE PLANNING AREA.

Range Assessment Area	Caribou Habitat and Range Use		
Area 1: Nunavut	 The Bathurst caribou herd calving ground is in this area. This area is also important post-calving and summer habitat. 		
	• Wildfire is not a major source of natural disturbance on the tundra.		
	 Parts of the RAA may also be used in winter by other caribou herds – Dolphin and Union, and Beverly-Ahiak. 		
Area 2: NWT Central Tundra	• This area 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.		
Area 3: NWT Winter Range - Northwest	• This area has been used as winter habitat by Bathurst caribou with increasing frequency over the past decade.		
	• Wildfire has been less active in this part of the winter range.		
	• The Bathurst and Bluenose East herds overlap in this wintering area.		
Area 4: NWT Winter Range - Central	• This area 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 Area 4 was burned in 2014, with approximately 36% of the area being affected by wildfire in the past 50-years.		
Area 5: NWT Winter Range - Southeast	• This part of the winter range has received lower use by caribou in recent years.		
	• This area experienced many large wildfires over the past decades, and most (80%) of the forested area south of treeline has experienced a burn in the past 50-years.		
	• The area is part of the winter range of the Bathurst and Beverly-Ahiak herd. Occasional and variable overlap with Bathurst and Qamanirjuaq caribou have also occurred in this area.		

4.6 Current and Future Land Use and Disturbance Scenarios

A more complete description of the status of the range and the technical approach to planning is provided in the companion document: *Bathurst Caribou Range Plan: Range Assessment and Technical Methods Report*.

To help assess the potential opportunities, benefits and challenges of implementing range-scale management tools and approaches into the future, the mineral task group of the BCRP WG defined three future development scenarios to explore plausible patterns and amounts of disturbance footprint within the Bathurst range (see Appendix A). The three scenarios over the period 2016 to 2040 were developed to reflect basic assumptions consistent with these basic themes:

- **Case 1 Declining Development**. Assumes the existing operating diamond mines and the Tibbet to Contwoyto Winter Road cease operations by 2040, and that no new mines are brought to production.
- **Case 2 Continuing Development**. Assumes a similar level of mineral 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 Tibbet to Contwoyto Winter Road is replaced by an all-season road.
- **Case 3 Increasing Development**. Assumes there is an increasing level of development with new all-season road infrastructure in Nunavut and several new mines being developed, both in Nunavut and NWT.

5 Development and Assessment of Potential Range-Scale Management Recommendations

This section describes how the range-scale management tools and approaches (Section 4) could be applied to achieve the goal and objectives for the BCRP (Section 3) across the five RAAs (Figure 5). The intention of the BCRP is that all tools and approaches be implemented collectively to achieve all objectives and ultimately the goal of maintaining a resilient landscape for caribou.

A discussion of important considerations and questions to guide discussions within communities and organizations involved in the development of the BCRP is provided.

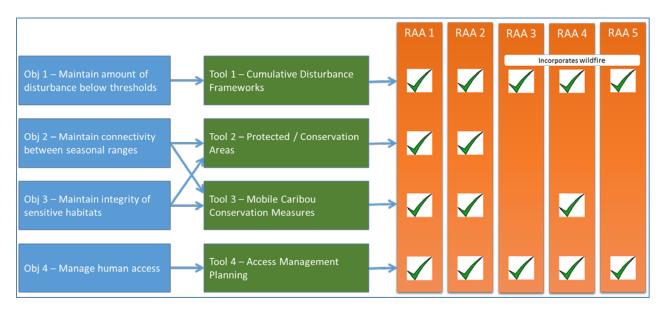


FIGURE 5: RANGE-SCALE OBJECTIVES AND MANAGEMENT TOOLS / APPROACHES FOR EACH RAA.

5.1 Maintaining the amount of human disturbance below threshold levels

TK tells us that people can disturb caribou through their actions, thoughts, words, and more. Managing the total amount of human disturbance across the Bathurst herd's annual range is the first priority means of achieving landscape-scale resiliency.

When considering the current and future development scenarios (see Appendix A), the key interest of WG members regarding <u>the amount</u> of human disturbance is to establish clear disturbance thresholds that guide management responses and set limits on habitat loss during this current period of severely low population levels. While community members have observed many years when caribou numbers were low, it is reported that numbers today are lower than in living memory. Indeed, much like community members talk of environmental change being unpredictable and unprecedented, so too is

the caribou population. "What the heck is going on with caribou today" is uncharted territory and so calls for a different way of doing things (Anablack in KHTO 2012).

Human disturbance can be maintained below identified threshold levels by implementing Tool #1

Cumulative Disturbance Frameworks (CDFs).

The Draft BCRP CDFs, as currently envisioned, would incorporate different thresholds for the Tundra and Taiga biomes to reflect the differences in ecology. In particular, the draft thresholds for the Taiga biome incorporate wildfire disturbance. The draft thresholds are adjusted for each RAA to account for the differences in spatial size and Bathurst caribou range use weighted by seasonal sensitivity (see *Bathurst Caribou Range Plan: Range Assessment and Technical Methods Report*).

Management responses in the CDFs are tiered, meaning that additional and increased levels of management response are added as disturbance levels in a RAA cross from *Desirable* to *Cautionary*, or *Cautionary* to *Critical* (Table 2). This approach aims to address the question asked by community members: "how much is enough?"

5.1.1 Rationale

The thresholds that have been proposed for the five Bathurst RAAs aim to provide regulatory limits (sensu Kennett 2006) to manage the cumulative magnitude and extent of human footprints and development projects on the annual range of Bathurst caribou. The threshold levels are proposed as decision or management thresholds (sensu Martin et al. 2009), which reflect a balance of the ecological, cultural, and socio-economic values of the WG. As such, the threshold values are as much based on cultural considerations as they are on ecological considerations. The level of socio-cultural / ecological risk and landscape change that communities, governments and industry consider to be acceptable may change over time as values and circumstances change.

Important considerations in the development of the CDFs include:

• The Bathurst caribou herd is currently considered to be in a state of serious conservation concern due to its small population size (estimated at ~19,800 + 3,500 in June 2015), continuing high rate of decline in breeding females (estimated to be ~ -23% per year between 2012 and 2015), and the damaged relationship between people and caribou and the reported "stress" being felt by the herd. COSEWIC has recently assessed barren-ground caribou, including the Bathurst herd, as *Threatened*. The overall and immediate conservation concern, coupled with concerns of future uncertain climate change impacts, justifies a precautionary approach to management.

TABLE 2: BCRP CUMULATIVE DISTURBANCE MANAGEMENT RESPONSES

Desirable Level

Site-specific Best Management Practices (BMPs) – these include traffic management (e.g., haul truck convoying, short or long-term road closures), which may create breaks in traffic to let caribou (leaders and groups) pass, enhanced dust suppression on roads, minimizing noise from blasting, reducing activity when caribou are in the area, construction of caribou-friendly roads and berms, etc.

Protect/Maintain Key Habitats – key habitat features (i.e., water crossings and migration corridors) would be identified through TK and seasonal range analysis (i.e., telemetry data), and may be protected by restricting disturbance and activity within a specified distance of the defined feature(s).

Minimize Sensory Disturbance of Caribou – these practices would be designed to minimize sensory disturbance to caribou during specific time periods based on sensitivity rankings. Management actions would be implemented – in addition to site-specific BMPs – as land use activity restrictions (i.e., Mobile Caribou Conservation Measures) for a prescribed area.

Community-based Monitoring Programs – monitoring programs would be funded, developed, and implemented in partnership with local communities that are subject to impact benefit agreements. Some recent examples include a) TK and IQ studies on impacts of industrial development to caribou and wildlife, b) On-the-Land project-based monitoring of caribou behavioural responses to development, and c) caribou health monitoring based on field observation and non-lethal sampling protocols, and d) health and condition monitoring based on samples and observations of hunter-killed caribou.

Cautionary Level

Compensatory mitigation - the predicted impacts to caribou must be offset⁺ to the extent that the demonstrated net effect is neutral through on-site and/or off-site mitigation practices. Some examples for Bathurst caribou include:

- accelerated progressive reclamation (i.e., prior to mine closure) through vegetation, rock cover, and appropriate drainage
- reduction of zone of influence (ZOI) through enhanced BMPs and wildlife-friendly design (e.g., inuksuit)

• development and application of new mitigation techniques (based on research results) etc. In addition to mitigation actions, increased monitoring and research efforts may include:

- enhanced community-based adaptive monitoring and/or guardianship programs
- enhanced monitoring and determination of project based impacts
- focused research into impact pathways and potential mitigation techniques

Enhanced Cumulative Effects Assessment – Additional detail and rigour must be applied (using novel tools and approaches) in the cumulative effects analysis for caribou during the EA process.

+ "Offset" means a measure to counteract, or make up for, a residual impact on a caribou component after measures to avoid, minimize and restore are considered.

Critical Level

No New Disturbance – New projects resulting in new disturbance are not allowed until existing active disturbances are minimized or removed.

- All harvest including hunting by Aboriginal people has essentially ceased² and a feasibility
 assessment of wolf management actions is being undertaken. In the broader context, harvest
 closure in the NWT and reduction of wolves on the Bathurst range are management levers that
 focus on improving caribou survival.
- The linkages between habitat disturbance, land use activity and caribou population health were evaluated based on computer modeling of the three future case land use scenarios (see Appendix A and the *Range Assessment and Technical Methods Report*). Modeling results indicated that incremental disturbance on the range leads to an increase in the rate that caribou encounter and become exposed to human disturbance. This result was estimated from the intersection of movement paths from collared caribou cows and the human disturbance for each of the three future case land use scenarios. The computer modeling showed that the cumulative effect of increased encounter rates of caribou to human disturbance reduced body condition and pregnancy rates of adult females, with an associated reduction in early calf survival. The overall effect of increased human footprint and disturbance was a reduction in productivity of the caribou herd, which in turn contributed to lower growth rates and population levels. The reduction in herd productivity due to encounters with human disturbance resulted in a population effect that was additive to the direct mortality effects of predation and hunting.
- Aboriginal community members and TK holders have long stated that there is a link between increasing levels of industrial development on the range and declines in herd size. In the 1990s, one of the strongest concerns expressed during the environmental review of the first diamond mines was for the Bathurst herd that ranges across most of the staked kimberlite deposits. Today, the concern that too many mines operating too closely together are effectively creating a "dam" or "fence" resulting in changes to caribou migration and overall well-being,

They could have smaller mines for a longer time. Why take all the resources at once? There is a certain amount of wage economy that is needed but also to continue they're way of life, at one time and it's slowly going to take over every community if we are not careful. 50 years from now there won't be anything left for anyone. — 6B in BCRP TK Workshop, March 2016

has added to this original concern. Subsequently, there have been many formal requests to implement land disturbance thresholds to manage the level of human development on the range. With declining caribou populations, there have been parallel declines in the traditional economy, food security, connection to the land, and ultimately cultural identity.

• Implementation of the CDFs is considered to be a useful way to manage the cumulative and incremental impacts from development at the range scale, which result from: a) direct loss or

² In June 2016, the Government of Nunavut recommended that the Nunavut Wildlife Management Board establish a Nunavut total allowable harvest of 30 male caribou for the Bathurst herd. In September 2016, the WRRB determined a total allowable harvest of zero to be implemented for all users of the Bathurst herd within Wek'èezhìı for the 2016/17, 2017/18, 2018/19 harvest seasons.

fragmentation of habitat, b) indirect loss in habitat effectiveness due to the ZOI associated with development, c) barrier effects of single and/or multiple developments that may disrupt or deflect migratory movements and alter the behaviour of caribou, d) sensory disturbance to caribou that may affect behaviour and energetic balance at critical times in their life cycle, and e) a changed relationship between caribou and people.

• At the same time, CDFs provide management direction on acceptable levels of range disturbance and human activity that support sustainable development.

5.1.2 Tundra Cumulative Disturbance Frameworks (NOTE³)

The draft disturbance thresholds in the Tundra biome, RAA1 and RAA2, are based on the total disturbance footprint associated with human activities (which includes the ZOI). See Table 3 and Figure 6.

Based on the rationale and considerations above, along with the experience of the recent Jay Project Environmental Assessment, the NWT Central Tundra RAA2 was first deemed to be within the Cautionary Level. The current total disturbance footprint of around 6,600 km² lies below the critical threshold, which is set at 9,000 km². The cautionary threshold is set at 50% of the critical threshold at a level of 4,500 km².

The Nunavut Tundra RAA1 area was then benchmarked to the RAA2 thresholds to account for the difference in spatial size and Bathurst caribou range use weighted by seasonal sensitivity, resulting in a critical threshold of 7,000 km². The current total disturbance of nearly 1,000 km² in RAA1 lies well below the cautionary threshold, which is set at 50% of the critical threshold at a level of 3,500 km².

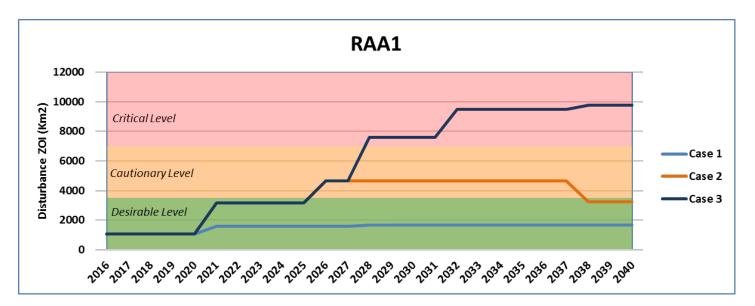
Figure 6 shows how total disturbance is projected to change over time in each of the Tundra RAAs relative to the thresholds based on the assumptions for each of the three future case scenarios described in Appendix A.

³ IMPORTANT NOTE: All disturbance areas and methods are approximate and under review

Risk to Caribou &/or Habitat	Assessed Level	RAA1 * Total Disturbance (ZOI) Criteria	RAA 2 * Total Disturbance (ZOI) Criteria	Management Responses
High	Critical	ZOI > 7,000 km ²	ZOI > 9,000 km ²	 No new disturbance until current disturbances are minimized or removed
Moderate	Cautionary	3,500 km² < ZOI < 7,000 km²	4,500 km² < ZOI < 9,000 km²	 Compensatory mitigation Enhanced cumulative effects assessment (CEA)
Low	Desirable	ZOI < 3,500 km ²	ZOI < 4,500 km ²	 Site-specific Best Management Practices Protect/maintain key habitats Minimize sensory disturbance of caribou Implement community-based monitoring programs

TABLE 3: BCRP DRAFT CUMULATIVE DISTURBANCE FRAMEWORK FOR RRA1 AND RAA2 IN THE TUNDRA BIOME

* RAA2 thresholds set to acknowledge current status within the moderate risk / cautionary management level. RAA1 thresholds benchmarked to RAA2 thresholds to account for the difference in spatial size and Bathurst caribou range use weighted by seasonal sensitivity (see *Bathurst Caribou Range Plan: Range Assessment and Technical Methods Report*).



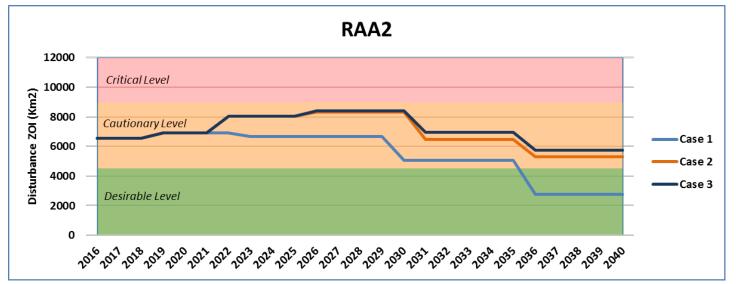


FIGURE 6: PROJECTION OF POTENTIAL DISTURBANCE ZOI FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1 AND RAA2.

5.1.3 Taiga Cumulative Disturbance Frameworks (NOTE⁴)

The total disturbance thresholds in the Taiga biome, RAA3, RAA4 and RAA5, are based on the human disturbance (which includes the zone-of-influence) plus non-overlapping wildfire disturbance that has occurred within the last 50 years (see Table 4 and Figure 7). Wildfire is included as a contributing factor to disturbance thresholds because it is considered a primary natural disturbance regime in the boreal forest and has been of great concern for community members. This preliminary approach to incorporate wildfire is based on forest age-class distributions with assumptions that the fire cycle in the Taiga portion of the Bathurst range is ~140 years, and the average natural range of variation (NRV) for forest stands \leq 50 years is ~35%.

Clearly, the uncertainty and variability in the wildfire assumptions, and how to implement them as part of the CDF threshold approach, requires further consideration by the BCRP WG. See below for further discussion of key considerations and proposed next steps, and Section 5.5 for implementation implications as part of an adaptive management system.

Based on the rationale and considerations above (Section 5.1.1), the NWT Central Winter Range RAA4 was first deemed to be within the upper Cautionary Level. The critical threshold, which is set at 45,000 km² is based on a human total disturbance component of 15,000 km² plus a wildfire component of 30,000 km². The wildfire component is based on the NRV assumption that 35% of the total RAA4 area is comprised of forest stands that are \leq 50 years old, and the cautionary threshold is set to this average wildfire NRV level of 30,000 km². The current (2016) total disturbance of 44,500 km², which includes the human disturbance plus wildfires burned in the last 50 years, lies just below the critical threshold.

The NWT Northwest Winter Range RAA3 was then benchmarked to the RAA4 thresholds to account for the difference in spatial size and Bathurst caribou range use weighted by seasonal sensitivity. This results in a critical threshold again of 44,000 km², which is based on a human total disturbance component of 17,000 km² plus a wildfire component of 27,000 km². The wildfire component is based on a natural range of variation amount of 35% of the total RAA3 area, and the cautionary threshold is set to this average wildfire NRV level of 27,000 km². The current (2016) total disturbance footprint plus wildfire of around 15,200 km² lies well below the cautionary threshold.

The NWT Southeast Winter Range RAA5 was similarly benchmarked to the RAA4 thresholds to account for the difference in spatial size and Bathurst caribou range use weighted by seasonal sensitivity. This results in a critical threshold of 48,000 km², which is based on a human total disturbance component of 26,000 km² plus a wildfire component of 22,000 km². The wildfire component is based on a natural range of variation amount of 35% of the RAA5 Taiga area, and the cautionary threshold is set to this average wildfire NRV level of 22,000 km². The current (2016) total disturbance plus wildfire of 33,090 km² lies above the cautionary threshold.

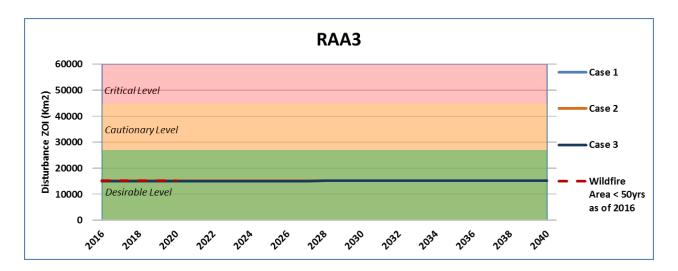
⁴ IMPORTANT NOTE: All disturbance areas and methods are approximate and under review

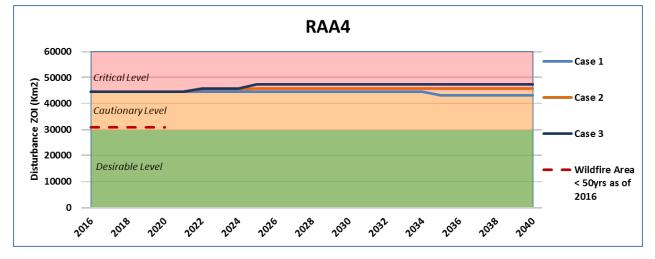
Figure 7 shows how the total disturbance footprint is projected to change over time in each of the Taiga RRAs relative to the thresholds based on the assumptions for each of the three future case scenarios described in Appendix A.

Risk to Caribou &/or Habitat	Assessed Level	RAA3 * Total Disturbance (ZOI ^{WF}) Criteria	RAA4 * Total Disturbance (ZOI ^{WF}) Criteria	RAA 5 * Total Disturbance (ZOI ^{WF}) Criteria
High	Critical	ZOI ^{WF} > 44,000 km ²	ZOI ^{WF} > 45,000 km ²	ZOI ^{WF} > 48,000 km ²
Moderate	Cautionary	27,000 km ² < ZOI ^{WF} < 44,000 km ²	30,000 km² < ZOI ^{WF} < 45,000 km²	22,000 km ² < ZOI ^{WF} < 48,000 km ²
Low	Desirable	ZOI ^{WF} < 27,000 km ²	ZOI ^{WF} < 30,000 km ²	ZOI ^{WF} < 22,000 km ²

TABLE 4: BCRP DRAFT CUMULATIVE DISTURBANCE FRAMEWORK FOR RAA3, RAA4 AND RAA5 IN THE TAIGA BIOME

* RAA4 thresholds set to acknowledge current status within the moderate risk / cautionary management level. RAA3 and RAA5 thresholds benchmarked to RAA4 thresholds to account for the difference in spatial size and Bathurst caribou range use weighted by seasonal sensitivity (see *Bathurst Caribou Range Plan: Range Assessment and Technical Methods Report*).





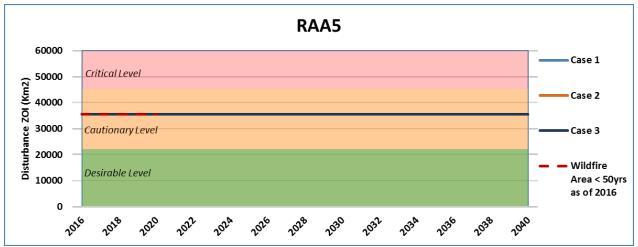


FIGURE 7: PROJECTION OF POTENTIAL DISTURBANCE ZOI FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA3, RAA4 AND RAA5

The current status of each RAA is shown in Table 5 and Figure 8. In summary:

- RAA1 Nunavut Tundra is currently in the desirable level. Depending on project size, this range area could support one or more mineral development projects before triggering the cautionary level. Mineral development proposals as significant as those suggested by Case 3 the 'increasing development' future scenario would trigger the critical level.
- RAA2 NWT Central Tundra is currently in the cautionary level with three active mines. The projections for mineral development under the future development scenarios Case 2 and Case 3 would make this area remain in the cautionary level well into the future.
- RAA3 in the NWT winter range is currently in the desirable level and would remain so for all future development scenarios.
- RAA4 is currently in the cautionary level. Depending on project size and the level of future wildfire disturbance, any future developments proposed in RAA4 could trigger the critical level.
- Finally RAA5 in the NWT winter range is currently in the cautionary level, almost entirely due to wildfire burn area.

Range Assessment Area	Size	Current Disturbance Footprint	Total Disturbance (includes ZOI)	Current Wildfire Disturbance	* Disturbed (Total disturbance + Wildfire)/Size	Current CDF Status
Area 1: Nunavut Tundra	75,902 km ²	20 km ²	1,080 km ²	20 km ²	1.4 %	Desirable
Area 2: NWT Central Tundra	56,134 km ²	70 km ²	6,610 km ²	5 km ²	11.7 %	Cautionary
Area 3: NWT Winter Range - Northwest	77,001 km ²	< 1 km ²	<1 km ²	15,178 km ²	19.7 %	Desirable
Area 4: NWT Winter Range - Central	84,858 km ²	90 km ²	14,120 km ²	30,839 km ²	47.4 %	Cautionary
Area 5: NWT Winter Range - Southeast	95,127 km ² (approx.: 1/3 Tundra & 2/3 Taiga)	< 1 km ²	88 km ²	35,459 km ²	37.3 %	Cautionary

TABLE 5: CURRENT CDF STATUS OF EACH RANGE ASSESSMENT AREA

* Disturbed area was calculated as the sum of non-overlapping total disturbance (which included direct footprint and associated ZOI) and area burned by wildfire in the past 50 years.

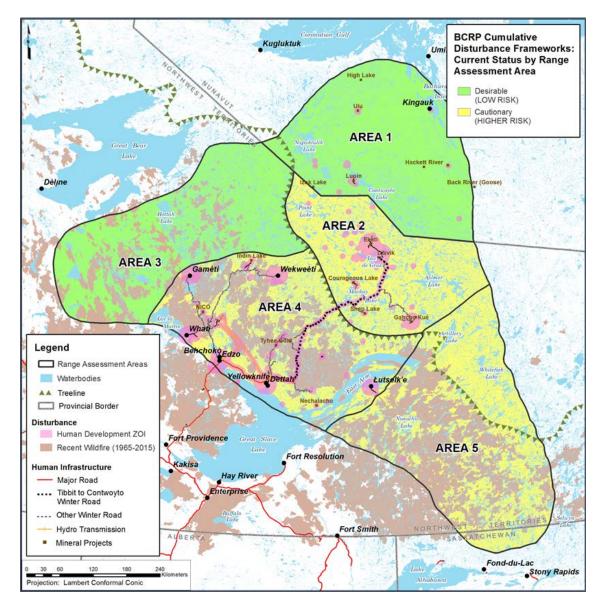


FIGURE 8: CUMULATIVE DISTURBANCE FRAMEWORK CURRENT STATUS BY RANGE ASSESSMENT AREA

5.1.4 Important considerations and next steps

Important considerations:

• The cumulative disturbance frameworks are an important part of the overall approach to maintaining a resilient landscape for caribou while considering the community concerns around limits. Setting thresholds across large landscapes the size of the RAAs is viewed as one component of the overall habitat protection system. Other components as discussed in the sections below address more specific habitat features (i.e., migratory corridors, important seasonal ranges).

- From a traditional / cultural identify perspective, once CDFs are established, community members will have a clearer understanding on the level of development allowable at any one time and can better plan their use of the land.
- From a mineral economic development perspective:
 - On the one hand, the CDFs once established, can lead to improved certainty regarding the levels of development that will be supported (e.g., through future land use planning), and improves certainty on the types of mitigations that will be required (e.g., through environmental assessment and land use permitting).
 - On the other hand, implementation of the CDFs could have an impact on the potential opportunity for economic development. Any development proposal triggering the cautionary disturbance threshold within an RAA would impose increased costs in terms of the requirements for compensatory mitigation and enhanced cumulative environmental assessment. Any limit to mineral development triggered by the critical disturbance threshold would have a cost in terms of lost GDP (tax revenues to governments) and employment opportunities (see Appendix B for examples). Experience has shown that projects that get deferred, either as a result of regulatory requirements or commodity prices, may take decades to re-surface.

Proposed next steps include:

- Further development of the CDFs will occur following a formal period of community and decision-maker engagement by WG and Project Team members in early 2017. The expectation is that at minimum, the following next steps will be considered:
 - Development of a methodology for a range-wide threshold or range-wide status reporting.
 - Detailed requirements for all proposed management responses, for example the requirements for compensatory mitigation and enhanced cumulative environmental assessment at cautionary level.
 - Detailed description of how to account for 'inactive' or 'reclaimed' areas and their contribution to CDF management thresholds as part of the disturbance monitoring protocols.
 - More detailed economic impact modelling (e.g., Territorial Input/Output modelling).
- If wildfire disturbance is confirmed to be an important contributing factor in setting disturbance thresholds (as per discussion question below), then the following steps should be considered:

- Ecologically defendable NRV estimates of young and old-age class forests in the Taiga Shield portion of the Bathurst range should be further developed. The NRV estimates would be used to establish the average area of young forest (i.e., <50 years) and provide a basis for an expected amount of natural disturbance within an RAA. General methods to estimate NRV have used a stochastic landscape simulation model to estimate an average or historic "fire cycle" based on available fire history data. These data must be overlain with TK of fire behaviour, periodicity, etc.
- Confirm and develop a standardized approach for estimating the annual amount of wildfire disturbance on the Taiga range (e.g., Rickbeil et al. 2016). Wildfires in the NWT have generally been mapped based on perimeter outlines of wildfires. This approach overestimates the area affected by wildfire because it assumes that the entire area has been burned.
- Based on steps summarized above, further refine rationale and methodology for defining cautionary and critical thresholds of total disturbance relative to average or historic "fire cycle". For example, it would be useful to establish whether the mean, median, or upper 95-99 percentile of the NRV for young forest should be incorporated into disturbance threshold definitions. Based on literature review and expert opinion, confirm the forest age that should be used to define "young forest". For example, Anderson and Johnson (2014) observed that collared Bathurst cows "generally avoided burns ≤40 years old and many targeted stands 41–44 years post-fire, however, they also selected sparsely vegetated stands." These data confirm what has already been shared through TK that it can take 50 years for caribou to return to a burned area.

5.1.5 Discussion questions

- Would these disturbance thresholds represent an appropriate balance between achieving a resilient landscape and supporting sustainable economic development activities?
- Are the management responses suitable at each level? Can you suggest additional options or requirements for compensatory mitigation or enhanced cumulative effects assessment?
- How would these thresholds respect caribou and the relationship between caribou and people? Are there other ways that they may affect cultural and traditional economies?
- Is wildfire disturbance an important contributing factor to total disturbed area in the Taiga range areas, and should it be incorporated into the development and implementation of disturbance thresholds?

5.2 Maintaining connectivity between seasonal ranges

Mobility is the ultimate adaptation of migratory barren-ground caribou. Migration allows barrenground caribou to access resources, adopt different survival strategies in different parts of their range to cope with environmental change, and avoid or minimize predation. While maintaining that barrenground caribou are sensitive, they are known to be able to adapt to changing conditions within limits. TK speaks to how caribou survive through years when thick ice covered their lichen or an early frost took too many new calves. Both ways of knowing assert that the Bathurst herd's ability to migrate between seasonal ranges is required to maintain landscape-scale resiliency.

When considering the current and future development scenarios (see Appendix A), the key concern raised by WG members regarding connectivity is that ongoing human development along important migratory corridors and at specific water crossings and land bridges could result in movement barriers to Bathurst caribou. Caribou are then forced to take different migratory paths which may be longer, more dangerous, or lead them away from preferred parts of their seasonal ranges. Such concerns have also been expressed repeatedly during environmental assessments for the existing diamond mines and other projects in both NWT and Nunavut. These key crossings and land bridges are known to community members and have names that often translate to include the word "caribou" or "crossing" so important are they to Caribou People.

The objective of maintaining connectivity between seasonal ranges can be achieved by implementing either *Tool #2: Protected / Conservation Areas* or *Tool #3: Mobile Caribou Conservation Measures*.

5.2.1 Status assessment

Efforts are ongoing to gather and assess available information regarding migratory routes, water crossings and land bridges – see Figure 9.

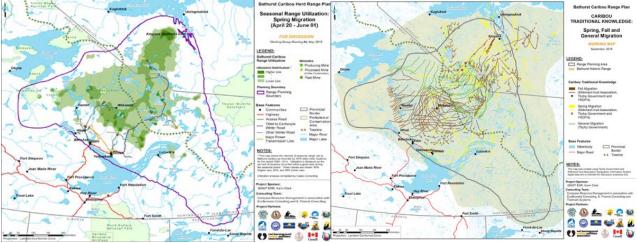


FIGURE 9: EXAMPLES OF MIGRATION PATTERNS RECORDED FROM CARIBOU COLLARS AND TK.

While there are many identified water crossings and land bridges, BCRP WG members have identified the following locations as being particularly important:

• The Contwoyto Lake-Lac de Gras area is the cross-roads between the calving grounds and fall and winter ranges; it is also the summer range. Both important water crossings and land bridges (areas between major lakes) are in this area (Figure 10). The Ekati and Diavik diamond mines are located on or around Lac de Gras.

• Tha K'ai Tué (MacKay Lake), pedacho kué (Artillery Lake), and Leryahda (Aylmer Lake) are other important crossings to be further confirmed during community consultations.

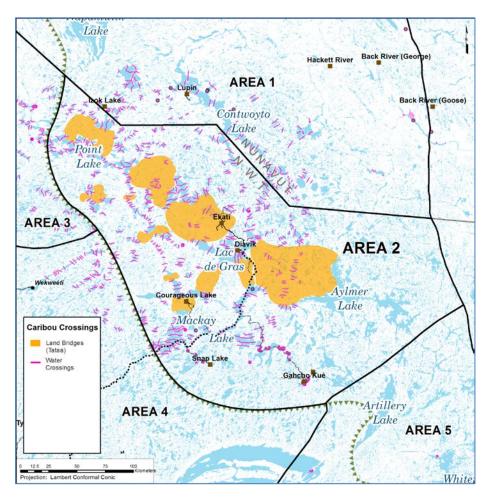


FIGURE 10: CARIBOU WATER CROSSINGS AND LAND BRIDGES IN THE CENTRAL PART OF THE BATHURST RANGE IDENTIFIED FROM TK.

Table 6 highlights the potential options, benefits and challenges of implementing each of the proposed management tools for maintaining connectivity.

TABLE 6: OPTIONS, BENEFITS AND CHALLENGES OF MAINTAINING CONNECTIVITY.

Protected / Conservation Areas	Mobile Caribou Conservation Measures
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 Option Identify specific areas in key migration corridors and/or water crossings and land bridges (e.g., Contwoyto Lake area) to receive protected / conservation area status. 	 Option Implement mobile caribou conservation measures (timing windows) around key migration corridors and/or water crossings and land bridges (e.g., Contwoyto Lake) to avoid disturbance during migration periods.
 Benefits They are the most effective form of protection as they would prohibit both development and disturbance. They can be defined spatially and are simple and efficient to administer. They can simultaneously protect key cultural sites located at crossings of important areas along caribou migration routes. 	 Benefits They can be effective at limiting disturbance to caribou during key periods They provide flexibility in timing and location of activities – if caribou are not present, timing restrictions are not required.
 Challenges They may preclude future economic development or transportation opportunities. They are not as flexible as mobile caribou conservation measures. 	 Challenges Mobile protection measures do not preclude development of physical infrastructure; physical barriers to migration may still occur. Monitoring caribou locations must occur to determine when mobile measures are needed—ongoing monitoring costs may be prohibitive.

5.2.2 Important considerations and next steps

Important considerations:

- The Draft Nunavut Land Use Plan (DNLUP) has proposed Protected Areas for an extensive area of freshwater crossings in RAA1 (see Figure 11). At this time, the DNLUP planning process is at an important stage of development and many BCRP WG members are actively engaged in the planning process independent of the BCRP.
- The amount of area that would be affected by establishing protected/conservation areas on a large number of identified water crossings or land bridges could be substantial.
- Protected / conservations areas surrounding water crossings and land bridges may help to address concerns that multiple clustered developments form a "wall" or "dam" for caribou migration.

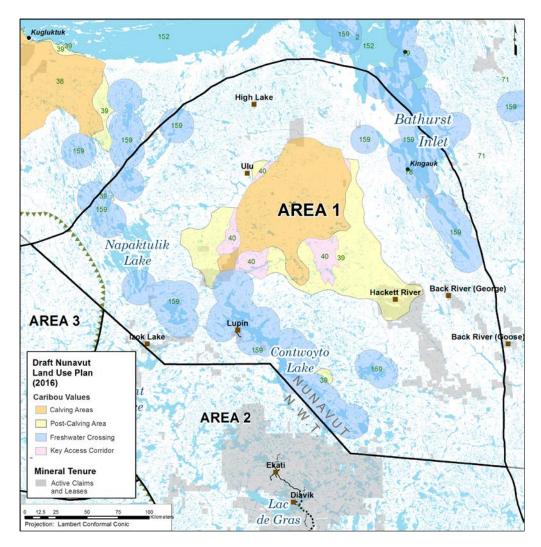


FIGURE 11: PROPOSED PROTECTED AREAS BASED ON CARIBOU VALUES IN THE BATHURST CALVING GROUNDS AND CONTWOYTO LAKE AREA INCLUDED IN THE DRAFT NUNAVUT LAND USE PLAN (2016).

Proposed next steps include:

- Work with community members to identify and prioritize the most important migratory corridors including water crossings and land bridges.
- Develop and refine a methodology to integrate TK and empirical (collar) datasets to further key into important crossings.
- Gather additional detail on how each management tool can be implemented in each jurisdiction.

5.2.3 Discussion questions

- Under what conditions is each of the two management tools (protected / conservation areas vs. mobile caribou protection measures) preferred? Under what conditions could these two tools be implemented simultaneously?
- What is an appropriate buffer size around migratory corridors, water crossings and land bridges to protect caribou and caribou habitat? Why?
- How can transboundary coordination be faciliated to improve the protection of migratory corridors?
- What would the implications be to community members?

5.3 Maintaining the integrity of important habitats

Important habitats are parts of the annual range that are critical to individual caribou or populationlevel health, or where and when caribou are most sensitive to sensory disturbance. Minimizing direct habitat loss and sensory disturbance to Bathurst caribou in important habitats is a priority for achieving landscape-scale resiliency.

When considering the current and future development scenarios (see Appendix A), the key concerns identified by BCRP WG members included:

- Sensory disturbance to caribou at important or sensitive life stages;
- Direct habitat loss;
- Reduced habitat effectiveness; and
- Habitat fragmentation

Such concerns have also been raised repeatedly during environmental assessments for the existing diamond mines and other projects in NWT and Nunavut. The objective of maintaining the integrity of important habitats can be achieved by implementing either **Tool #2: Protected / Conservation Areas** or **Tool #3: Mobile Caribou Conservation Measures**. Other management options for the winter range have also been considered.

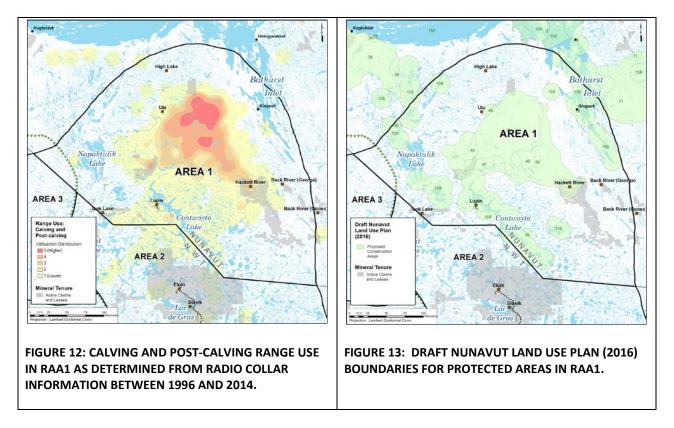
5.3.1 Status assessment

Tundra Biome

In the Tundra biome, BCRP WG members have focused on two important seasonal ranges: The Calving / Post-Calving Range in Nunavut (RAA 1), and the Summer Range, which includes parts of Nunavut (RAA 1) and NWT (RAA 2). These two ranges were ranked as being the most sensitive parts of the Bathurst

annual range—caribou are most sensitive to noise, visual stimuli and smells during these periods, and these areas/time periods are very important for caribou reproduction and nutritional success. The calving grounds are also considered sacred places in Aboriginal culture.

In Nunavut (RAA 1), the Draft Nunavut Land Use Plan (2016) has recognized the importance of the Bathurst calving grounds and is proposing the recently used (mid-1990s to current) calving and post-calving areas should be protected (Figure 12 and Figure 13). Other protected areas are proposed for important freshwater crossings, for their importance to migration and movement (see Section 5.2, above).



<u>Taiga Biome</u>

BCRP WG members have identified concerns regarding the amount of wildfire on the winter range, and how this may be impacting caribou. In the Taiga biome, forests that have not been affected by wildfire for a period of 50 years or greater are considered to be the most important parts of the winter range. Large patches of older forest are considered to be the most important, but it is also recognized that unburned forest remnants within larger burns may be important for caribou movement and feeding. Over the past three decades, a large part of the central (RAA 4) and southern (RAA 5) winter range has been affected by wildfire (Figure 14). While uncertain, this level of fire is likely to have also occurred in the past.

In central NWT, the Tłįcho Land Use Plan has designated protected areas for much of their lands. In addition, there are other smaller protected areas in the central and northern part of the winter range

(e.g., *Ezòdziti, Wexèlaxoodiale*), and the East Arm of Great Slave Lake (*Thaidene Nene*) protected area proposal is in an advanced state (Figure 15).

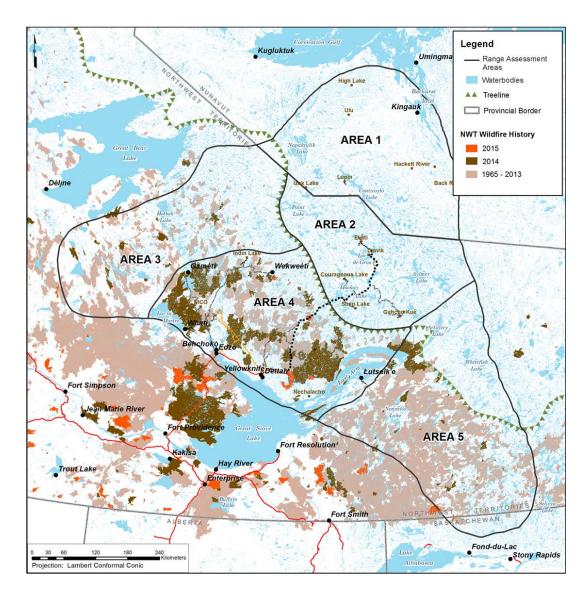


FIGURE 14: WILDFIRE HISTORY IN THE BATHURST CARIBOU WINTER RANGE.

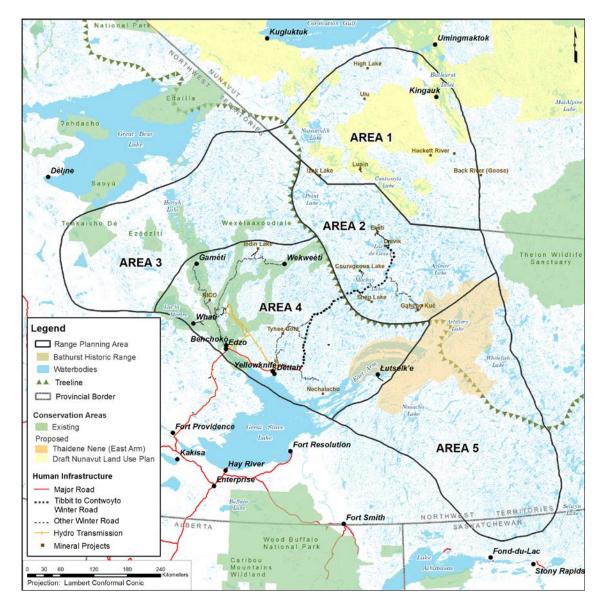


FIGURE 15: EXISTING AND PROPOSED PROTECTED / CONSERVATION AREAS IN THE BATHURST RANGE PLANNING AREA.

Table 7 highlights the potential options, benefits and challenges of implementing each of the proposed management tools to address habitat integrity in the Tundra biome.

TABLE 7: OPTIONS, BENEFITS AND CHALLENGES FOR MAINTAINING THE INTEGRITY OF CALVING AND POST-CALVING, AND SUMMER HABITATS.

Protected / Conservation Areas	Mobile Caribou Conservation Measures		
 Option Identify specific areas in the calving and post-calving and summer ranges to receive protected / conservation area status. 	 Option Implement mobile caribou conservation measures (timing windows) in the tundra ranges to avoid creating sensory disturbance during the early and mid- summer periods. 		
 Benefits They are the most effective form of protection as they would prohibit both development and disturbance. They can be defined spatially and are simple and efficient to administer. 	 Benefits They can be effective at limiting disturbance to caribou during key periods They provide flexibility in timing and location of activities – if caribou are not present, timing restrictions are not required. 		
 Challenges They may preclude future economic development or transportation opportunities. They are not as flexible as mobile caribou conservation measures. While an important calving and post-calving area can be defined, identifying important parts of the summer range may be more challenging. 	 Challenges Mobile protection measures do not preclude development of physical infrastructure; habitat loss and fragmentation can still occur. Monitoring of caribou locations must occur to determine when mobile measures are needed—ongoing monitoring costs may be prohibitive. 		

Table 8 highlights the potential options, benefits and challenges of implementing each of the proposed management tools to address habitat integrity in the Taiga biome.

TABLE 8: OPTIONS, BENEFITS AND CHALLENGES FOR MAINTAINING THE INTEGRITY OF THE BATHURST WINTER RANGE.

Wildfire Management	Habitat Restoration		
 Options Wildfire and forest conditions are dynamic establishing protected areas to protected older patches of forest as a	 Option Re-forestation (tree planting) could be used to speed up recovery of recently burned areas. 		
 Benefits Increasing the amount of older forest within the winter range may provide near- term benefits to caribou. 	 At this time, the benefits of such an approach are uncertain. Forests naturally-regenerate following wildfires. 		
 Challenges Unless wildfire suppression budgets were increased dramatically, it may not be possible to increase wildfire suppression effectiveness, especially under extreme fire weather conditions. Due to remoteness, logistical and financial constraints, increasing wildfire suppression efforts in the Bathurst caribou winter range may not be feasible. Creating older forest conditions may increase fuel loading which may contribute to larger and more intense wildfires in the future. 	 Due to remoteness and the scale of burned areas, the logistical and financial constraints to attempting this strategy are likely prohibitive. 		

5.3.2 Important considerations and next steps

Important considerations:

• The Draft Nunavut Land Use Plan (2016) is currently under review. If the draft land use plan is approved without modification, protected areas will be established for much of the calving and post-calving range, and parts of the summer range (including freshwater crossings).

- The proposed *Thaidene Nene* protected area is expected to cover a large area of with winter range around the East Arm of Great Slave Lake.
- The amount of future wildfire cannot be predicted accurately but is expected to remain similar or at higher levels than experienced in the recent past.

Proposed next steps include:

- Monitoring the status of the Draft Nunavut Land Use Plan (2016) review and approval process, and the *Thaidene Nene* proposal.
- Further developing wildfire management concepts and better understanding the potential effects of wildfire on range condition and population health.

5.3.3 Discussion questions

- Should protected areas be established in the calving and post-calving and summer ranges to assist in maintaining the integrity of these important habitats? Is it possible to identify locations for protected areas for the summer range, when caribou are mobile?
- Are there areas of winter habitat that should be included in ENR's Fire Values at Risk database? Where are they?
- Should ENR investigate the feasibility of habitat restoration (e.g., planting trees in recently burned areas to accelerate recovery) in the winter range? Are there areas of particular importance?

5.4 Managing human access across the Bathurst caribou range

Roads and trails facilitate human travel and access into new areas. While new road access may have many economic benefits, increasing human access may facilitate increased harvest opportunities and create new sensory disturbance on caribou and other wildlife. Planning for and managing human access is therefore another means of achieving landscape-scale resiliency.

Access management is a challenging issue which requires consultation and collaboration among appropriate governments, boards, agencies, organizations, companies, communities and users, as well as regular compliance monitoring. When considering the current and future development scenarios (see Appendix A), the key concerns identified by BCRP WG members included:

- Development of new roads and other linear developments;
- Sensory disturbance to caribou resulting from people's use of roads and trails; and
- Increased harvest opportunities, harvest by inexperienced hunters or those unfamiliar with traditional laws, and the potential for over-harvesting.

Community members have pointed out concerns regarding human access in detail over the years.

What it does is opens up the country to everybody. You just go down the highway until you see the tracks... people don't realize it. It's going to change the way we do things so much, right, from cutting wood to... your peace and quiet on the land is not going to be there anymore. ...10 years ago, when they put the coal plant between here and Good Hope, they made that winter road all the way down to Thunder River. Everybody was on there that had a 4x4, hauling wood. And many caribou were shot, many, (James First in GSCI 2015: 50).

People shoot off the road or they will take a snowmobile or walk into the bush to find and kill caribou. People will also go by snowmobile to non-highway accessible areas on trails once travelled by dog team and snowshoe. Observations of caribou made while hunting and carrying out other activities on the land are a major source of information about caribou for Fort McPherson hunters. (Wray 2011: 51-52)

In addition to these widely-observed impacts, people draw from their lifetime of observing caribou on the barrens to predict and/or infer how caribou will react to indirect impacts from linear features. For example, people report first-hand knowledge of how caribou respond to loud sounds (e.g. caribou "get spooky") and so predict that caribou will similarly respond to vehicular or aircraft noise (KHTO and Golder 2011; EMAB 2012; GSCI 2015).

Likewise, people know that caribou often prefer the easy walking along an esker or the escape from insects that it offers and so predict that caribou will alter their migrations by traveling along elevated roads or linear landscape features (Thorpe et al 2001; BHP Billiton 2007; Parlee et al. 2013). Community members have observed that caribou seek out roads for insect relief and ease of travel (KHTO and Golder 2011; Thorpe et al. 2001; GSCI 2015). Parlee et al. (2013: 56-69) provide a complete review of available traditional knowledge relating to linear features and migration, as cited below.

Roads built to mine resources are interpreted as a significant problem for barren-ground caribou. Many elders have described the roads in the Bathurst and Beverly range as contributing to changes in caribou movement and migration. While some elders think there are ways of technically managing the impact (e.g., by limiting the height of roads), other elders perceive a negative effect on caribou as inevitable.

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 '\ekwö in association with the ice road, the '\ekwö 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 '\ekwö sniff our scent, they will turn back (Romie Wetrade of Gameti in Whaehdôö Naowoo Kö [Dogrib Treaty 11 Council 2001: 13). Such concerns have also been raised during environmental assessments for the existing diamond mines and other projects in NWT and Nunavut, and have been discussed by communities and wildlife management boards.

The objective of managing human access into the Bathurst caribou range can be achieved by implementing *Tool #4: Access Management and Planning*.

5.4.1 Status assessment

<u>Tundra Biome</u>

Currently, human access in the tundra portion of the Bathurst range is limited. The Tibbit to Contwoyto Lake winter road provides the main seasonal access to the central NWT portion of the range (RAA 2), servicing the existing diamond mines between January and early-April of each year. The main winter road is not active while caribou are on the summer range. Currently there are no established winter roads in Nunavut as the Tibbit to Contwoyto Lake winter road has not been used to the Lupin mine site for many years. Some all-season roads exist on or around existing mine sites, with the Misery road at the Ekati diamond mine being the most significant.

The current best management practices (BMPs) at mine sites or other developments include: i) Cariboufriendly road construction techniques to assist in mitigating the potential impacts of all-season roads, ii) Temporary road closures implemented when caribou are in the area, and iii) Convoying of industrial traffic. Community concerns about dust spread to caribou habitat nearby has also led to watering of roads during the summer. TK has contributed much in this regard particularly around the importance of letting the leaders pass, what kind of gravel / material is suitable for caribou hooves, what slopes caribou prefer, and more. These BMPs should be better documented and implemented consistently and universally across the entire range.

In Nunavut, different winter and all-season road proposals have been suggested to provide access from the Arctic Coast (e.g., Gray's Bay) or Bathurst Inlet to potential inland mine developments (see Appendix A).

<u>Taiga Biome</u>

The central part of the Bathurst winter range (RAA 4) has the highest level of human access in the range planning area. The only major all-season roads within the annual range are located here, including the main highway network along the north shore of Great Slave Lake and around the City of Yellowknife. Additionally, there is a large network of winter roads and trails, including the Tibbit to Contwoyto Lake winter haul road and the winter roads to the Tłichǫ communities. The Snare Lake power grid and transmission lines are also in RAA 4. The northwestern (RAA 3) and southeastern (RAA 5) parts of the winter range are remote and have no established all-season or winter roads. However, all parts of the winter range become accessible by snow machines and other all-terrain vehicles during winter and an extensive network of routes and trails exists in and around communities and established roads.

Various options are being investigated to replace the southern part of the Tibbit to Contwoyto Lake winter road with a new all-season road between Tibbit and Lockhart Lake. On the periphery of the winter range, an all-season road is expected to be constructed between Highway 3 (south of Behchokò) and Whatì.

Table 9 highlights the potential options, benefits and challenges of implementing access management in the Tundra biome. Table 10 addresses options for the Taiga biome.

TABLE 9: OPTIONS, BENEFITS AND CHALLENGES FOR MANAGING HUMAN ACCESS IN THE TUNDRA BIOME (BATHURST CALVING AND POST-CALVING, AND SUMMER RANGES).

Access Management (Tundra)

Option

 Winter roads should be used preferentially over all-season roads to access existing or new potential mine sites.

Benefits

- Winter roads greatly reduce direct habitat disturbance.
- In the tundra, winter roads avoid the period when Bathurst caribou are on the calving and post-calving, and summer ranges—this removes the potential for sensory disturbance to impact caribou.

Challenges

- Once a road is built, it is very difficult to manage people's use of and activities on the road. There are no effective means to regulate or prohibit people's use of the road.
- Some types of mineral development or other land use activities may require all-season roads to be economically viable—winter only access may preclude some types of economic opportunities.

TABLE 10: OPTIONS, BENEFITS AND CHALLENGES FOR MANAGING HUMAN ACCESS IN THE TAIGA BIOME (BATHURST WINTER RANGE).

Access Management (Taiga)

Options

- Winter roads should be used preferentially over all-season roads to access existing or new potential mine sites.
- Community guardianship programs could be used to reduce disturbance and potential over-harvesting risks as well as to rebuild the use of traditional laws and respect given to Bathurst caribou. On-the-land programs may assist with promoting respect.

Benefits

- Winter roads greatly reduce direct habitat disturbance.
- Once a road is built, there are few effective means to regulate or prohibit people's use of the road. Community guardianship may provide effective ways to manage people's use and activities along designated roads or trails, and could be used to encourage or reinforce desired behaviours.

Challenges

- Some types of mineral development or other land use activities may require all-season roads to be economically viable—winter only access may preclude some types of economic opportunities.
- Where roads run through overlapping traditional territories, community co-ordination would have to be strengthened.

5.4.2 Important considerations and next steps

Important considerations:

- Given the existing road and trail network, the Bathurst caribou herd range is the most accessible barren-ground caribou range in the north.
- Once a road is built, there are few effective means to regulate or prohibit people's use of the road, or their activities on it.
- Winter roads are generally preferable to all-season roads. However, in the Bathurst winter range, caribou are on their winter range at the same time as winter roads are in use. Therefore, winter roads may have a similar impact on caribou as all-season roads in this part of the range.
- During the winter season, much of the landscape becomes accessible to people through the use of snow machines and other types of all-terrain vehicles, allowing people to travel great distances away from communities and all-season or established winter roads. The current map of all-season and winter roads does not reflect this situation.
- The Draft Nunavut Land Use Plan (2016) recognizes the value of winter road-only design to access mineral development in the tundra biome.

- In the future, due to a changing climate the use of winter roads as an access management tool may be reduced, at least in some parts of the range. As an example, the operating season of the Tibbit to Contwoyto Lake winter road (and other winter roads in southern NWT) has decreased on average 20 days per year compared to when the road was initially used in the mid-1990s.
- As youth become further disconnected from Bathurst caribou through the ban on caribou harvest, the opportunity to practice traditional ways of living and strengthen cultural identity lessens. Community-based monitoring, implementing and enforcing traditional laws around caribou become even more important to Caribou People in maintaining connection.
- Community members have called for community-based monitoring including on roads. Such monitoring programs would ideally assist with limiting access and encourage the following of traditional laws through, for example, monitoring-mentoring programs. These programs have and could continue to serve as important knowledge transfer and capacity-building opportunities for communities, for example, where TK of caribou behaviour and habitat can be observed, discussed and shared.
- Community members are best positioned to implement these programs, not only given their traditional territories, but also owing to the guardianship role many Aboriginal peoples embody when it comes to caribou. Several programs are ongoing in this regard including the NWMB Community-Based Monitoring Network and the Lutsel K'e and Dehcho Guardian programs, modeled from other Canadian examples such as the Haida Watchmen, Coastal Guardian Watchmen Network and the Innu Environmental Guardians.

Proposed next steps include:

- Further explore opportunities for community guardianship to be used as an effective access management tool in some parts of the Bathurst range planning area.
- Consider winter-only access in the tundra and effects this may have on mineral development in the calving and post-calving, and summer ranges.
- Assemble guidance on best practices related to caribou-friendly road construction techniques.

5.4.3 Discussion questions

- Could community guardianship be used as an effective access management tool in some parts of the Bathurst range planning area? How might this work? What would some of the benefits and challenges be?
- Are winter roads an effective management tool in the Bathurst winter range?
- Are other approaches to managing human access possible?

5.5 Research, Monitoring, and Adaptive Management

5.5.1 Research and Monitoring

BCRP planning efforts to date have highlighted several key uncertainties that will need to be the focus of ongoing research and monitoring, including:

- Tracking disturbance (both human and wildfire),
- Refining understanding and management assumptions regarding the ZOI,
- Building a knowledge base regarding the effectiveness of different mitigation measures,
- Tracking how environmental conditions and socio-economic behaviours adjust to a changing climate,
- Improving understanding of the natural range of variation (NRV) for wildfire area burned, along with the caribou use of burned areas as they regenerate, etc.

With specific regard to the implementation of the cumulative disturbance frameworks, the implementation of disturbance thresholds in the Tundra and Taiga RAAs requires a monitoring system that regularly evaluates disturbance amounts on the landscape. Key elements of an annual monitoring system should include:

- 1. Detection and tracking of new sources of disturbance that would be counted as increases to disturbance amounts:
 - New human disturbances could be compiled through ENR's Cumulative Impact Monitoring Program Inventory of Landscape Change, perhaps supplemented with a standardized method based on remote sensing analysis.
 - New wildfire disturbances in Bathurst caribou range could be tracked and mapped through coordination with Forest Management Division's current monitoring system. Fire disturbances would be estimated based on areas of mapped fire perimeters, plus remote sensing methodologies that can also estimate burn severity.
- 2. Applying criteria to known existing disturbances to establish whether those features would continue to contribute to disturbance amounts at the landscape scale:
 - Human disturbances that are no longer in use or have been determined to be restored and reclaimed, may have ZOI assumptions reduced. Alternatively, reclamation of disturbances result in a reduction or removal of the previously defined direct footprint.
 - Known-aged wildfires that become older than a minimum age-class criterion (e.g., 50 years) would be removed as a source of disturbance in the Taiga. Alternative or complementary approaches could be developed that are based on methods from satellite imagery.

Given their role as guardians and their profound relationship of respect with barren-ground caribou, Aboriginal people living throughout the range of the Bathurst caribou are well positioned to initiate, design and carry-out community-based research and monitoring programs.

A key next step in the development of the BCRP will be to further identify and prioritize the most important uncertainties as the focus for ongoing research and monitoring.

5.5.2 Adaptive Management

Range-scale planning and management must allow for and encourage adaptive management to adjust for changes in economic, socio-cultural and environmental conditions. All ongoing research and monitoring should be integrated into a formal adaptive management approach to improving and adjusting range management approaches over time (see for example Failing and Beaudrie 2015).

An adaptive management approach for the BCRP is currently envisioned as providing a link between a) annual activities focussed on tracking and assessing disturbance levels, and b) longer term activities that occur at 5-year intervals that provide regular review and renewal of the Range Plan elements and results. Elements of the range plan to be reviewed and renewed may include threshold levels and management objectives, as well as methodologies and associated assumptions and criteria. Renewal of the Range Plan would be based on a review of results, which would be reflected by key management recommendations and decisions on land use and cumulative effects management made during the preceding 5-years.

A key next step in the development of the BCRP will be to further develop and refine the approach to long-term adaptive management.

5.5.3 Discussion questions

• How do you see your community / organization being involved in ongoing research and monitoring activities?

6 Summary of Potential Implications

6.1 Caribou

To support the recovery of barren-ground caribou, human activities and land use should be managed to account for natural cycles in abundance. Range-scale strategies for managing cumulative effects from land use and habitat disturbance are implemented to achieve objectives over longer timeframes, while management actions dealing with harvest and other influences are designed to be responsive to annual changes in caribou population dynamics.

The permanent or semi-permanent nature of many human disturbances in the north provides strong rationale for a precautionary approach for managing cumulative habitat disturbance and maintaining a resilient landscape condition. Resilient landscape conditions are especially important during low cycles of abundance when caribou may be more vulnerable to the additive effects of human disturbance, and are also important for facilitating population recovery.

In essence, range-scale habitat management for landscape resilience provides a long-term foundation for other population management levers, such as harvest or predator management, that may be implemented over shorter time frames and are designed to be responsive to monitored changes in caribou population health.

6.2 Communities

In the words of a participant at the BCRP TK Workshop, "The caribou is a long story." Community members today worry about such low numbers of caribou and have called for action to rebuild populations. Caribou are food security, a foundation of the traditional economy, the tether of cultural identity and more. Within the context of the BCRP, community members are weighing threats to

If there is no more caribou we are really going to suffer. We are going to have to do our utmost to prevent [the population] from declining. — 4A in BCRP TK Workshop, March 2016

these important cornerstones with the potential benefits that industrial development can provide during a time when many community members suggest that a threshold has already been exceeded. This is the difficult discussion that communities must have.

Aboriginal people continue to express deep respect, gratitude and reverence for caribou and understand that they must be guardians to safe-guard caribou well-being. Although people are not as dependent on country foods as they were in the past, people continue to depend on caribou for their cultural identity. Elders have been known to slip into depression and lose their health without caribou, not only from the absence of caribou meat in their diet but also because they "miss being with them" spiritually. Caribou have always a provided a connection to the land and to traditional territory. This connection, for many, remains part of cultural identity.

Aboriginal people within the range of the Bathurst herd have long respected and depended on caribou for subsistence and sustenance, extending back to the time when caribou and people could speak to one another and people could become caribou. The years when caribou migration routes came close to camps or communities meant health (mentally, spiritually, physically) and wealth (clothing, tools, leisure). Alternatively, the years when caribou didn't come were difficult and often tragic. The application of cumulative disturbance frameworks, protected/conservation areas, mobile protected measures and access management can be understood as a way to respect caribou and caribou well-being.

6.3 Mineral Economic Development

The mining industry in the north, including all phases of development from prospecting, exploration and construction, to operations, remediation and closure, has been the backbone of the economy for many decades. Benefits that flow from mining activity include socio-economic and participation/impact benefits agreements; training and employment opportunities; business development; community development; social programs; royalty payments; and taxation.

Implementation of the BCRP will influence the mineral economic development sector. Setting cumulative disturbance thresholds and establishing protected/conservation areas may reduce the opportunity for achieving future long-term socio-economic benefits, while the implementation of increased requirements to guide land use activities and access management may impose unnecessary increased cost if not done in an effective manner.

Ongoing development of the BCRP must continue to formally assess the potential implications on the entire mineral development economic cycle.

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Appendix A – Current and Potential Future Land Disturbance across the Bathurst Range

Current Situation

Using available mapping, the BCRP WG determined that less than 0.05% (179.5 km2) of the Bathurst annual range is currently affected by direct footprint. Some of the disturbance is seasonal. For example, the Tibbit to Contwoyto Winter Road (TCWR) 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 and may increase. The BCRP WG has estimated that approximately 5.6% (21,895.6 km2) of the Bathurst range is currently affected by direct and indirect human disturbance (direct footprint with associated ZOI). The highest levels of human disturbance occur in the NWT, in the central winter range and the central tundra around the current operating diamond mines (Figure 16). TK suggests that this clustering of development is much like a dam or fence, causing significant changes in migration routes. Although they may have a relatively small direct footprint, linear features are a major contributor to total human ZOI on the Bathurst annual range.

Future Scenarios

Future land use scenarios provide insight into the amount of human-caused change that may occur in different parts of the range in the future. With the assistance of a mineral task group, the BCRP WG defined three future development scenarios to explore plausible patterns and amounts of development footprint within the Bathurst range (Figure 17). 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). CASE 1 represented a situation of declining development, where the existing operating diamond mines and TCWR cease operations by 2040, and no new mines were brought to production. CASE 2 projected a similar level of development projects in the coming decades, and the southern part of the TCWR is replaced by an all-season road. CASE 3 represented an increasing level of development with new all-season road infrastructure in Nunavut and several new mines being developed, both in Nunavut and NWT. Figure 18 shows the results of each scenario on the range map at year 2040.

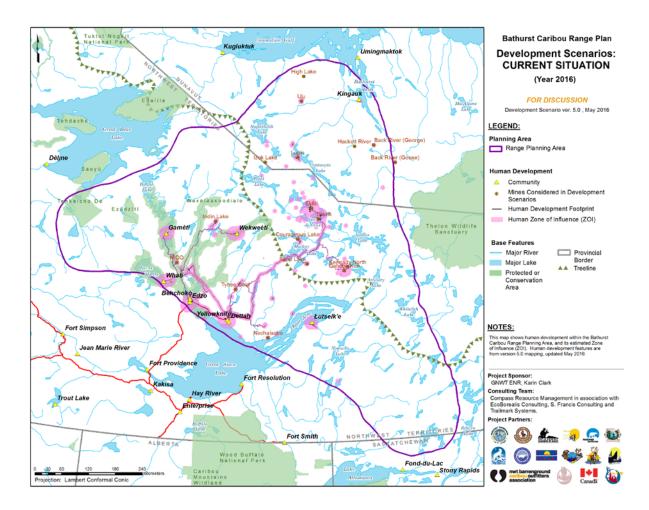
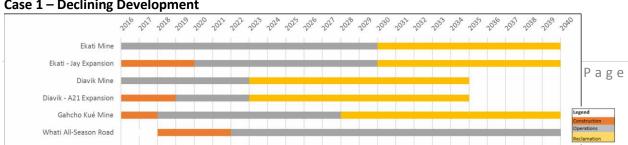
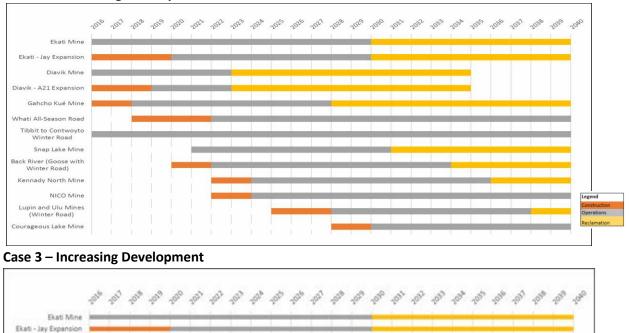


FIGURE 16: CURRENT DIRECT AND INDIRECT HUMAN DISTURBANCE IN THE BATHURST RANGE



Case 1 – Declining Development



Case 2 – Continuing Development

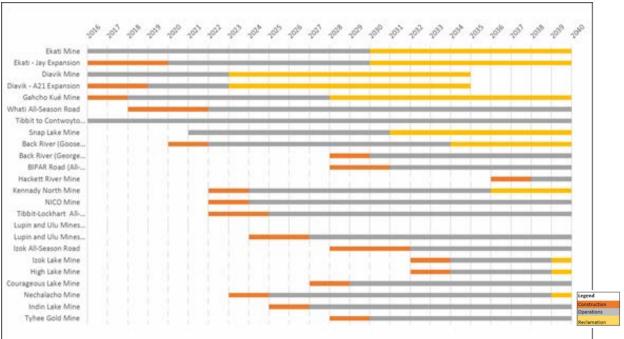


FIGURE 17: POTENTIAL FUTURE HUMAN MINERAL DEVELOPMENT IN THE BATHURST RANGE: CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT).

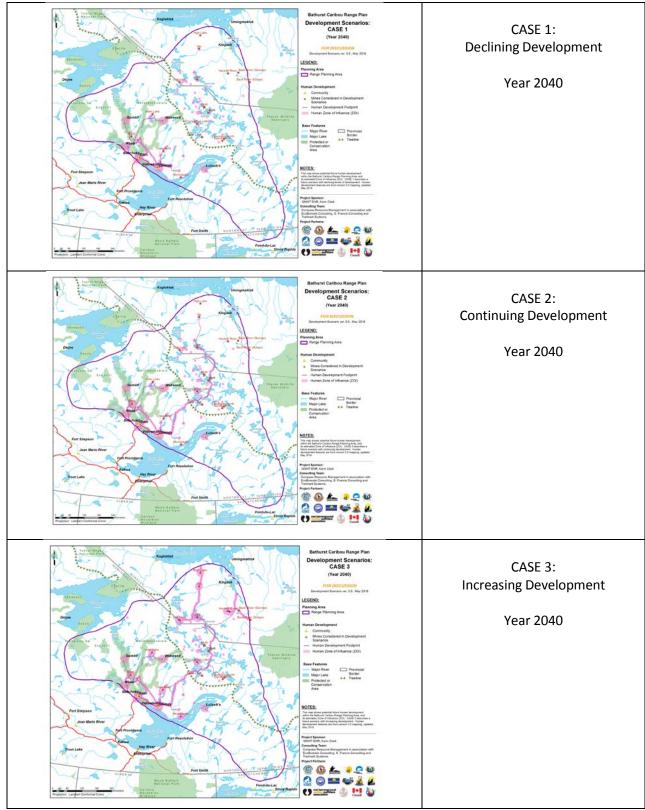


FIGURE 18: POTENTIAL FUTURE DISTURBANCE IN THE BATHURST RANGE AT YEAR 2040: CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT).

NOTE⁵

Projection of potential habitat disturbance in RAA1: Nunavut Tundra

Figure 6 (Section 5.1.2 above) displays the projected potential increase in the total disturbance footprint associated with human activities (which includes the ZOI) (km²) in RAA1:

- **Case 1**: There is no projected development, only minor increases in exploration activity. Total disturbance remains relatively constant below 1,700 km² 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 km².
- **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 km².
 - The Izok Lake and High Lake projects begin in 2033 using all-season road access. Total disturbance rises to over 9,400 km².
 - The Hackett River project begins in 2037 using all-season road access. Total disturbance rises to nearly 9,800 km².

Projection of potential habitat disturbance in RAA2: NWT Central Tundra

Figure 6 (Section 5.1.2 above) displays the projected potential increase in the total disturbance footprint associated with human activities (which includes the ZOI) (km²) in RAA2:

- **Case 1**: There is no projected new mineral developments. Total disturbance begins at nearly 6,600 km², increases to over 6,900 km² 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 km² by 2026, decreasing after 2030 when some mines enter the closure/reclamation phase.

⁵ IMPORTANT NOTE: All disturbance areas in this appendix are approximate and being reviewed.

Projection of potential habitat disturbance in RAA4: NWT Central Winter Range

Figure 7 (Section 5.1.3 above) displays the projected potential increase in the total disturbance footprint associated with human activities (which includes the ZOI) plus wildfire disturbance (km²) in RAA4:

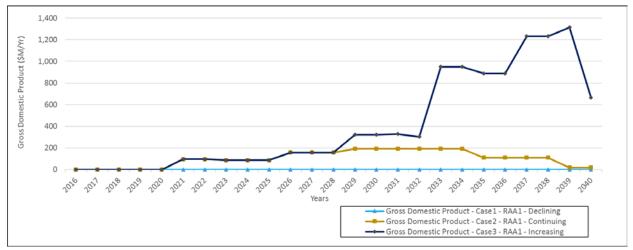
- **Case 1**: There is no projected development other than the proposed Whati all-season road in 2019, which has a relatively small disturbance footprint (110 km²). Total disturbance with wildfire (assuming constant at 2016 level) remains constant at 44,600 km² into the future, decreasing somewhat when the winter road is no longer required.
- **Case 2**: The NICO project begins in 2023 using an all-season road to Whati. Total disturbance with wildfire (assuming constant at 2016 level) then remains constant at 45,700 km² 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 allseason road is built in 2023, replacing that portion of the TCWR. Total disturbance then remains constant at 47,400 km² into the future.

Appendix B – Assessment of Potential CDF Implications for the Mineral Development Sector

Projection of potential implications in RAA1

Figure 19 and Figure 20 display the projected potential increase in gross domestic product (GDP) (\$M/Yr) and employment (PY/Yr) in 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 19: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1.

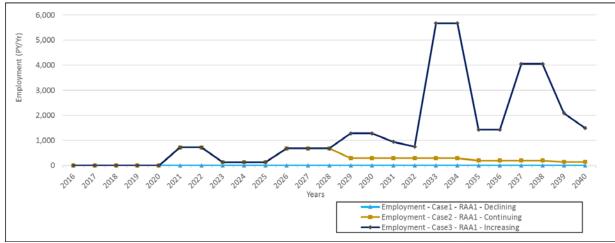


FIGURE 20: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1.

CDF Comparison for RAA1

The proposed CDF cumulative disturbance thresholds (see Figure 6 in Section 5.1.2 above) are:

- 3,500 km², which triggers the cautionary level with increased requirements for compensatory mitigation and enhanced cumulative environmental assessment.
- 7,000 km², which triggers the critical level with no new disturbance allowed until existing active footprint disturbances are minimized or removed in the future.

Under future development Case 1, the CDF would have no future implications on either habitat disturbance or economic development opportunity.

Under future development Case 2, the CDF would trigger the cautionary level by 2026 (see Figure 6 in Section 5.1.2 above), with increased requirements for compensatory mitigation and enhanced cumulative environmental assessment.

Under future development Case 3, the CDF would also trigger the critical level by 2028 (see Figure 6 in Section 5.1.2 above), meaning that all future development projects after that date would be deferred indefinitely into the future. Table 11 shows a comparison of potential implication on both potential habitat disturbance and economic development activity in the future year 2034.

TABLE 11: CDF IMPLICATIONS ON RANGE DISTURBANCE AND ECONOMIC DEVELOPMENT IN RAA1 FOR FUTURE YEAR 2034.

		With CDF	Without CDF
		(Case 2)	(Case 3)
Total Disturbance (ZOI)	km ²	~ 4,600	~ 9,500
Gross Domestic Product	\$M / Yr	~ 200	~ 950
Total Employment	PY / Yr	~ 300	~ 1,500
			(peak: ~ 5,700)

Projection of potential implications in RAA2

Figure 21 Figure 22 display the projected potential increase in gross domestic product (GDP) (\$M/Yr) and employment (PY/Yr) in 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.

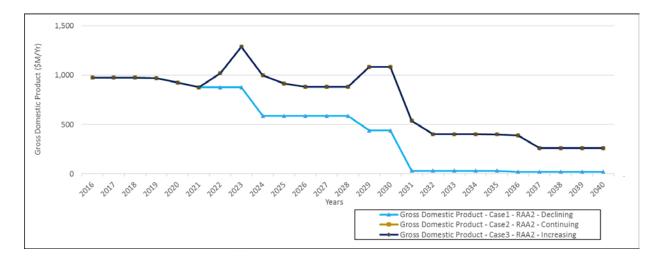


FIGURE 21: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA2.

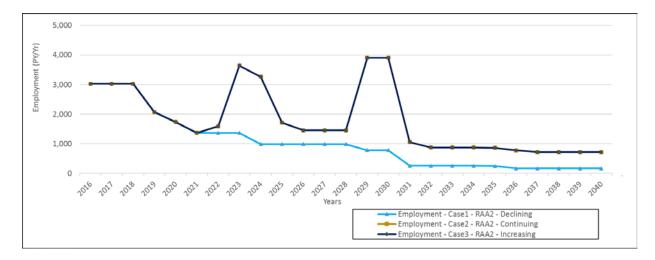


FIGURE 22: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA2.

CDF Comparison for RAA2

Under all three future development Cases 1, 2 and 3, the CDF would remain in the cautionary level (between 4,500 km² and 9,000 km²) (see Figure 6 in Section 5.1.2 above), with increased requirements for compensatory mitigation and enhanced cumulative environmental assessment.

Projection of potential implications in RAA4

Figure 23 and Figure 24 display the projected potential increase in gross domestic product (GDP) (\$M/Yr) and employment (PY/Yr) in 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 long-term GDP to around 470 \$M/Yr.

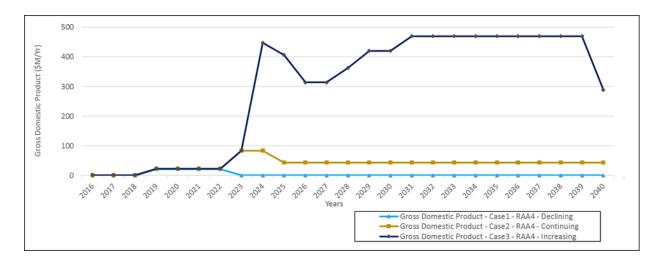


FIGURE 23: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA4.

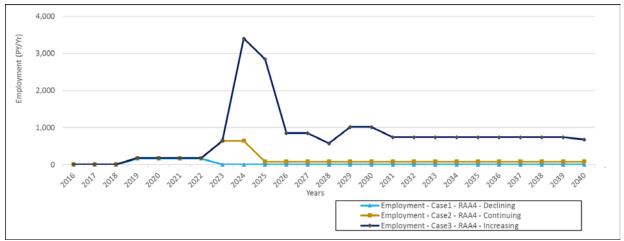


FIGURE 24: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA4.

CDF Comparison for RAA4

The proposed CDF cumulative disturbance thresholds (Disturbance ZOI plus wildfire) (see Figure 7 in Section 5.1.3 above) are:

- 30,000 km², which triggers the cautionary level with increased requirements for compensatory mitigation and enhanced cumulative environmental assessment.
- 45,000 km², which triggers the critical level with no new disturbance allowed until existing active footprint disturbances are minimized or removed in the future.

Under future development Case 1, the CDF would have no future implications on either habitat disturbance or economic development opportunity.

Under future development Case 2, the projected total disturbance (ZOI) plus current 2016 wildfire area would climb slightly above the CDF critical level threshold (see discussion in Section 5.1.4).

Under future development Case 3, the projected total disturbance (ZOI) plus current 2016 wildfire area would climb further above the CDF critical level threshold by 2026. If the critical level management response was implemented, then all future development projects after that date would be deferred indefinitely into the future.

Table 12 shows a comparison of potential implication on both potential habitat disturbance and economic development activity in the future year 2034 (assuming deferral of the Nechlacho, Indin Lake and Tyhee projects).

TABLE 12: CDMF IMPLICATIONS ON RANGE DISTURBANCE AND ECONOMIC DEVELOPMENT IN RAA4FOR FUTURE YEAR 2034.

		With CDF	Without CDF
		(Case 2)	(Case 3)
Total Disturbance (ZOI + Wildfire)	Km ²	~ 45,000	~ 47,000
Gross Domestic Product	\$M / Yr	~ 40	~ 470
Total Employment	PY / Yr	~ 80	~ 740

Bathurst Caribou Range Plan

Interim Discussion Document

Plain Language Summary



Plain Language Summary – Bathurst Caribou Range Plan - Discussion Document

BACKGROUND

Barren-ground caribou are a key northern species. They have shaped the cultural identity of First Nations, Inuit and Métis peoples over millennia through mutual relationships built on respect. Caribou use large expanses of land throughout their seasonal movements often travelling thousands of kilometres annually. As a result, they encounter many features such as roads, communities, mines, camps and burned forests, and can suffer by being disturbed by these features.

The Bathurst caribou range (or use of habitat) extends from southern and central Northwest Territories (NWT) to the Bathurst Inlet in Nunavut. In some years, they have wintered as far south as northern Saskatchewan. The Bathurst caribou herd has suffered a dramatic decline in numbers from a high of roughly 450,000 in the mid-1980s to a low of about 20,000 today.

PURPOSE

Due to concern over pressures on the Bathurst herd a process was started to develop a Bathurst Caribou Range Plan (BCRP) to manage human and natural disturbance, such as wildland fire, across its habitat. A Working Group (WG) consisting of Aboriginal governments and organizations, industry, non-governmental organizations, co-management boards and territorial and federal governments has, over the last two and a half years, brought together scientific and traditional knowledge information to help develop options for habitat management.

The WG is entering a phase of community and decision-maker engagement on these options prior to developing a Draft Range Plan. A Discussion Document has been produced to guide engagement.

GOALS

The overall proposed management goal is to maintain the Bathurst caribou herd annual range in a resilient landscape condition. This goal acknowledges northerners' role as caribou guardians and the responsibility to manage habitat disturbance to allow for a healthy Bathurst caribou herd to sustain itself over time.

Four specific management objectives are proposed to achieve this goal:

Objective 1 – Maintain the amount of human disturbance below threshold levels.

Objective 2 – Maintain connectivity between seasonal ranges.

Objective 3 – Maintain integrity of sensitive habitats.

Objective 4 – Manage human access.

MANAGEMENT APPROACHES

The habitat management approaches presented in the Discussion Document are meant to be in addition to the measures imposed on individual projects to reduce impacts to caribou. The approaches consider the whole range used by the Bathurst herd and ensure key areas, such as

migratory pathways, water crossings, important seasonal habitat areas, are managed appropriately and sustained into the future. The management approaches under consideration are:

- *Cumulative disturbance frameworks* propose thresholds for levels of disturbance in different parts of the range and are based on sensitivity of the caribou and habitat. Setting disturbance thresholds has been requested by the Mackenzie Valley Environmental Impact Review Board and the Wek'eezhii Renewable Resources Board and is viewed as an important management tool. Many community members have also called for setting disturbance limits to manage the number of mines operating at any given time into the future.
- **Protected areas/Conservation zones** can be applied to legally protect important migration corridors and sensitive habitats, such as calving grounds and key water crossings (migration routes). Conservation areas can be established through land use plan designations, *Wildlife Act* conservation areas or habitat designations and yet to be developed Conservation Areas legislation.
- *Land Use Activity Guidelines (Mobile Measures)* can be used to temporarily halt or reduce the intensity of activity when caribou enter an area of development. These measures offer flexibility to development projects, by only imposing restrictions when caribou are within a certain distance of a site.
- *Access Management Planning* could address issues like construction methods and route orientation to reduce barriers to caribou, and controlling the amount and timing of traffic to minimize the disturbance to caribou. It could also be used to manage harvest through community-based rules and protocols if and when it is reinstated for the Bathurst herd.

RANGE ASSESSMENT AREAS

To better understand the potential land use and management issues affecting caribou in different parts of the range, the BCRP WG divided the planning area into five different range assessment areas (RAAs). These are show in Figure 1 below:

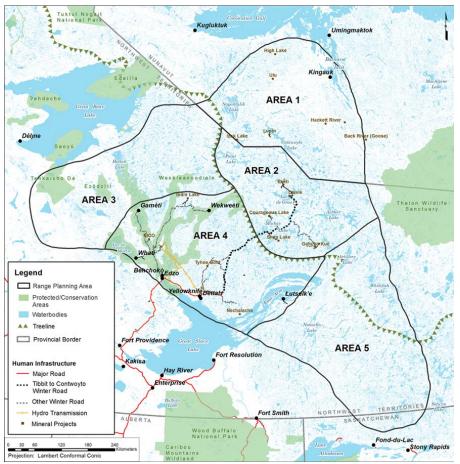


Figure 1: Range Assessment Areas in the Bathurst caribou range planning area

APPLYING MANAGEMENT APPROACHES

The management approaches for the Bathurst caribou range can be applied in various ways and are all necessary to achieve the stated goal and objectives for the BCRP. Possible options for applying the approaches are presented below. Important considerations and questions to guide discussions with communities and organizations involved in the development of the BCRP are also presented.

OBJECTIVE 1 – MAINTAIN THE AMOUNT OF HUMAN DISTURBANCE BELOW THRESHOLD LEVELS.

The key interest of WG members regarding <u>the amount</u> of human disturbance is to establish clear disturbance thresholds that guide management and set limits on habitat loss. While community members have observed many years when caribou numbers were low, it is reported that numbers today are lower than in living memory.

Disturbance includes both direct footprint (changed habitat as a result of a building or a road, for example) and the area around the footprint created by noise, dust, light and activity which might affect caribou behaviour (this is called the zone of influence or ZOI). The sensitivity of caribou through the seasons was considered in setting the thresholds in the tundra and forested regions. Each framework is comprised of three levels:

- 1. <u>desirable</u> within this level there would be an acceptable amount of land disturbance for that region. In this level best management practices are applied to manage impacts on caribou;
- 2. <u>cautionary</u> if the amount of disturbance was above the cautionary threshold more strict management of activity would occur; and,
- 3. <u>critical</u>- if amount of disturbance were anticipated to go above the critical threshold existing disturbances would need to be minimized or removed before any new disturbances took place.

The proposed levels of disturbance (direct disturbance footprint and ZOI) for each assessment area, according to size and sensitivity of the RAA, are provided in Table 1 (disturbance from fire is included in RAAs 3, 4 and 5):

Table1: Proposed Disturbance Thresholds for each Range Assessment Area (RAAs 3, 4 and 5 include disturbance from fire)

Range Assessment Area	Proposed Disturbance Thresholds
1	Desirable– less than 3,500 km ²
	Cautionary– 3,500 km ² - 7,000km ²
	Critical – above 7,000 km ²
2.	Desirable loss than 4 500 km ²
Ζ.	Desirable– less than 4,500 km ²
	Cautionary– 4,500 km ² - 9,000km ²
	Critical – above 9,000 km ²
3	Desirable– less than 27,000 km ²
	Cautionary– 27,000 km ² - 44,000km ²
	Critical – above 44,000 km ²
4	Desirable– less than 30,000 km ²
	Cautionary– 30,000 km ² - 45,000km ²

	Critical – above 45,000 km ²
5	Desirable– less than 22,000 km ² Cautionary– 22,000 km ² - 48,000km ² Critical – above 48,000 km ²

Based on these proposed cumulative disturbance frameworks, RAAs 2, 4 and 5 are at the Cautionary level and RAAs 1 and 3 are in the Desirable level. RAA 5 is in the cautionary level due to the large amount of fire in that region.

IMPORTANT CONSIDERATIONS:

- If Cumulative Disturbance Frameworks are established, there will be a clearer understanding for northerners and industry on the level of development allowable at any one time.
- The Cumulative Disturbance Frameworks could add costs to industry for more strict management of impacts to caribou and with respect to progressive reclamation and enhanced cumulative effects assessment.

NEXT STEPS:

- Develop a way to assess the entire range condition by using a range-wide threshold or range-wide status report.
- If wildfire is to be considered as part of the thresholds further work is needed in the technical aspects of measuring, tracking and aging fires.

DISCUSSION QUESTIONS:

- 1. Would these disturbance thresholds represent an appropriate balance between achieving a resilient landscape and supporting sustainable economic development activities?
- 2. Are the management responses suitable? Are there others to include and consider?
- 3. How would these thresholds respect caribou and the relationship between caribou and people?

OBJECTIVE 2 – MAINTAIN CONNECTIVITY BETWEEN SEASONAL RANGES.

Mobility is the ultimate adaptation of migratory barren-ground caribou. Migration allows barrenground caribou to access food, escape predators and to cope with environmental change. The Bathurst caribou use many water crossings and land bridges in the summer and fall. BCRP WG members have identified the Contwoyto Lake/Lac de Gras area as the main route between the calving grounds and fall and winter ranges. The Ekati and Diavik diamond mines are located on or around Lac de Gras.

IMPORTANT CONSIDERATIONS:

• The Draft Nunavut Land Use Plan (DNLUP) has proposed Protected Areas for an extensive area of water crossings in RAA1. At this time, the DNLUP planning process is at an important stage of development and many Bathurst Working Group members are actively engaged in the planning process independent of the BCRP.

NEXT STEPS:

• More work with community members could be done to identify and prioritize the most important migratory corridors including water crossings and land bridges.

DISCUSSION QUESTIONS:

- 1. Under what conditions are either of the management options (protected/conservation areas vs. mobile caribou protection measures) preferred? How can these options be used together?
- 2. What is an appropriate zone around migratory corridors, water crossings and land bridges where caribou should not be disturbed? Why?
- 3. How can transboundary coordination be improved?

OBJECTIVE 3 – MAINTAIN INTEGRITY OF SENSITIVE HABITATS.

Important habitats are areas that are used repeatedly by caribou or areas that are required for use if conditions are poor in other areas (e.g. unburned forested areas). Important habitats can also be used during time periods when caribou are very sensitive to disturbance, such as during calving. Minimizing the loss of important habitats and disturbance to Bathurst caribou in important habitats is a priority.

BCRP WG members have focused on two very sensitive time periods and the important habitats during those time periods for caribou:

- calving (and the area used just after calving) in Nunavut
- summer which includes parts of both Nunavut and NWT

These two habitats were ranked as being the most sensitive parts of the Bathurst range when caribou react strongly to noise, light and smells and when they need to feed a lot to gain the condition needed to get pregnant. The calving grounds are also considered sacred places in Aboriginal culture.

BCRP WG members have concerns regarding the amount of wildfire on the winter range and how this may be impacting caribou. Forests that have not been affected by wildfire for a period of more than 50 years are considered to be the most important parts of the winter range.

IMPORTANT CONSIDERATIONS:

- The Draft Nunavut Land Use Plan (2016) is currently under review. If the draft land use plan is approved without modification, protected areas will be established for much of the calving and post-calving range and parts of the summer range (including freshwater crossings).
- The proposed *Thaidene Nene* protected area is expected to cover a large area of winter range around the East Arm of Great Slave Lake.
- The amount of future wildfire cannot be predicted accurately but is expected to remain similar or at higher levels than experienced in the recent past.

NEXT STEPS:

- Monitor the status of existing planning processes such as the Draft Nunavut Land Use Plan (2016) and the *Thaidene Nene* proposal.
- Further develop wildfire management concepts and better understand the potential effects of wildfire on caribou habitat and population.

DISCUSSION QUESTIONS:

- 1. Should protected areas be established in the calving and post-calving and summer ranges to assist in maintaining these important habitats? Is it possible to identify locations for protected areas for the summer range?
- 2. Is it feasible to increase fire suppression effectiveness in the winter range? Is this desirable?
- 3. Is habitat restoration (e.g., planting trees in recently burned areas) a realistic option for winter range management?

OBJECTIVE 4 – MANAGE HUMAN ACCESS.

Roads are often built in the north to support industrial development and winter roads, in particular, are important for connecting communities and resupplying mines over a period of a few months. Roads and trails increase the ability of people to access remote areas for recreational and other purposes, such as harvesting. Caribou behaviour can change when they near roads and their migratory movements can be altered. Roads with high traffic volumes can restrict the ability of caribou to move from one area to another. Managing industrial activity and human use of roads to reduce noise, dust and other disturbances is an important way to achieve landscape-scale resiliency.

IMPORTANT CONSIDERATIONS:

- The Bathurst caribou herd range is the most accessible barren-ground caribou range in the north.
- Once a road is built, there are few effective means to regulate or prohibit people's use of the road or their activities on it.
- In the Bathurst winter range, caribou are on their winter range at the same time as winter roads are in use. Therefore, winter roads may have a similar impact on caribou as all-season roads in this part of the range.
- The Draft Nunavut Land Use Plan (2016) recognizes the value of winter road-only design to access mineral development in the tundra biome.
- In the future, due to a changing climate the use of winter roads as an access management tool may be reduced, at least in some parts of the range.

NEXT STEPS:

- Further explore opportunities for community guardianship to be used as an effective access management tool in some parts of the Bathurst range planning area.
- Consider winter-only access in the tundra and the effects this may have on mineral development in the calving and post-calving and summer ranges.

DISCUSSION QUESTIONS:

- 1. Could community guardianship be used as an effective access management tool in some parts of the Bathurst range planning area? How might this work?
- 2. Are winter roads an effective management tool in the Bathurst winter range?
- 3. Are other approaches to managing human access possible?

CONCLUSION

Community members today worry about such low numbers of caribou and have called for action to rebuild populations. Caribou are food security, a foundation of the traditional economy, the tether of cultural identity and more. Within the context of the BCRP, community members are weighing threats to these important cornerstones with the potential benefits that industrial development can provide during a time when many community members suggest a threshold has already been exceeded. This is the difficult discussion that must take place.

To support the recovery of barren-ground caribou, human activities and land use should be managed in an effective way. Strategies for managing cumulative effects from land use and habitat disturbance are especially important during low cycles of abundance when caribou may be more vulnerable to human disturbance.

Bathurst Caribou Range Plan - Interim Discussion Document

Understanding Approaches



Understanding Approaches - Bathurst Caribou Range Plan

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

BATHURST CARIBOU RANGE PLAN

WHAT IT IS

The Bathurst Caribou Range Plan is a plan to provide guidance on managing and reducing disturbance to caribou and caribou habitat resulting from human and natural change.



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• In response to concerns regarding the cumulative effects of mineral exploration and development on the Bathurst range

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Indigenous and Northern Affairs Canada -	Government of Nunavut – Environment
Nunavut	Kitikmeot Inuit Association
Athabasca Denesuline	Kitikmeot Regional Wildlife Board
Barren-ground Caribou Outfitters	Kugluktuk Hunters and Trappers Organization
Association	Łutsel K'e Dene First Nation

Canadian Parks and Wilderness Society Chamber of Mines - Exploration Chamber of Mines - Industry GNWT - Department of Environment and Natural Resources (ENR) GNWT - Department of Industry, Tourism and Investment (ITI) GNWT - Department of Lands

North Slave Métis Alliance Nunavut Tunngavik Incorporated NWT Métis Nation NWT Wildlife Federation Tłįcho Government Wek'èezhìı Renewable Resources Board Yellowknives Dene First Nation

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

GOALS

• Maintain the Bathurst caribou herd annual range in a resilient landscape condition.

OBJECTIVES

- Maintain the amount of human disturbance below threshold levels.
 - The Bathurst caribou's use of space across its extensive annual range is a key adaptive behaviour.
 - Community members have observed this cyclic use of space since time immemorial.
- Maintain connectivity between seasonal ranges.
 - Conserving caribou migrations requires that connectivity the ability to move freely between core seasonal ranges – is maintained
- Maintain the integrity of sensitive habitats.
 - Calving and post-calving areas are considered the most sensitive habitats to disturbance followed by summer range areas.
- Manage human access.
 - Construction and use of winter and/or all season roads on the Bathurst caribou range is fundamentally important for economic development of the region because road access facilitates construction and operation of mines. Minimizing disturbance to caribou from roads will be crucial as economic development progresses.

APPROACHES

- Conservation zones
- Cumulative disturbance thresholds
- Access management
- Activity guidelines

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

CONSERVATION ZONES

Protected or conservation areas can offer legal protection of important migration corridors and sensitive habitats. They can be either permanent—for example, a land use protected area zone—or flexible, such as mobile conservation areas to manage disturbance.

PURPOSE

- Protect important and sensitive habitat from disturbance
- Protect caribou at sensitive times of the year

BENEFITS

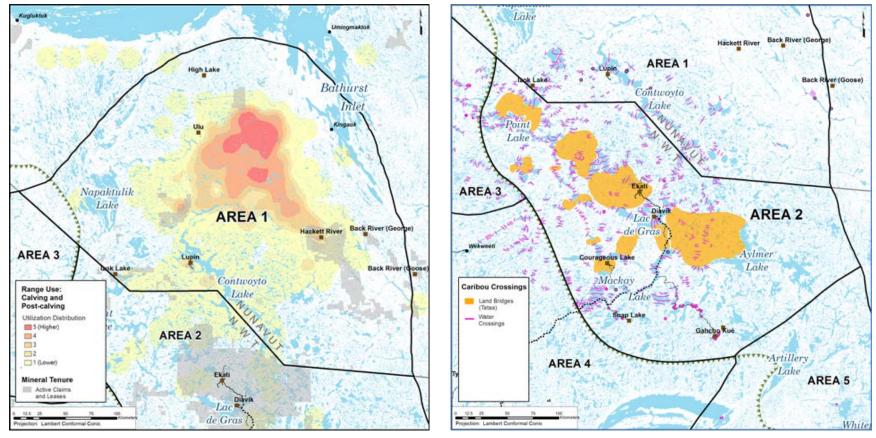
- Prohibit both development and disturbance
- Could protect key cultural sites located at important areas along caribou migration routes

CHALLENGES

- Caribou may change their use of the area and not use the protected area /conservation zone
- May preclude future economic development or transportation opportunities

WHERE THEY COULD BE USED

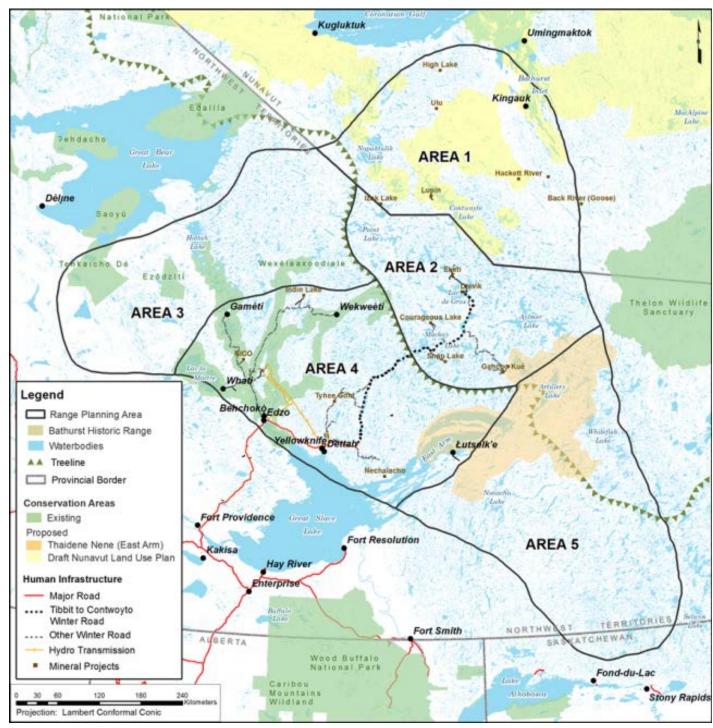
- Calving and post-calving areas are considered the most sensitive habitats to disturbance
- Water crossings and land bridges have been identified as important migratory paths.



Calving and post-calving grounds

Water crossings and land bridges (from: Tłįchǫ Government Traditional Knowledge Study)

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>



WHERE ARE THEY ALREADY BEING USED

Existing and proposed protected areas

KEY QUESTIONS

- Should protected areas be established in the calving and post-calving ranges?
- Is it possible to identify locations for protected areas for the summer range, when caribou are mobile?
- Are there areas of winter habitat that should be included in the ENR Fire Values at Risk database? Where are they?

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

CUMULATIVE DISTURBANCE THRESHOLDS

One way of helping to maintain sufficient space and habitat for caribou into the future is to manage the total amount of human disturbance across the Bathurst herd's annual range.

PURPOSE

- Manage the amount of total disturbance
- Adjust management actions to levels of disturbance
- Have more strict management of impacts to caribou, as total amount of disturbance increases (see figure below)



Amount of Disturbance	Action
High	Active disturbances are minimized or removed prior to further development
Moderate	 Enhanced mitigation: Offset or compensate for all anticipated impacts Accelerated reclamation Reduction of zone of influence Application of new mitigation techniques Focused research into impact pathways
Low	Best Practices: • Community based monitoring programs • Maintain key habitats • Minimize disturbance

Green indicates a low level of disturbance; yellow indicates a moderate level of disturbance and red a high level of disturbance. Each colour zone triggers certain mitigation requirements.

BENEFITS

- Improved certainty regarding the types of mitigations that will be required as development increases
- Clarity on the level of development supported at any one time

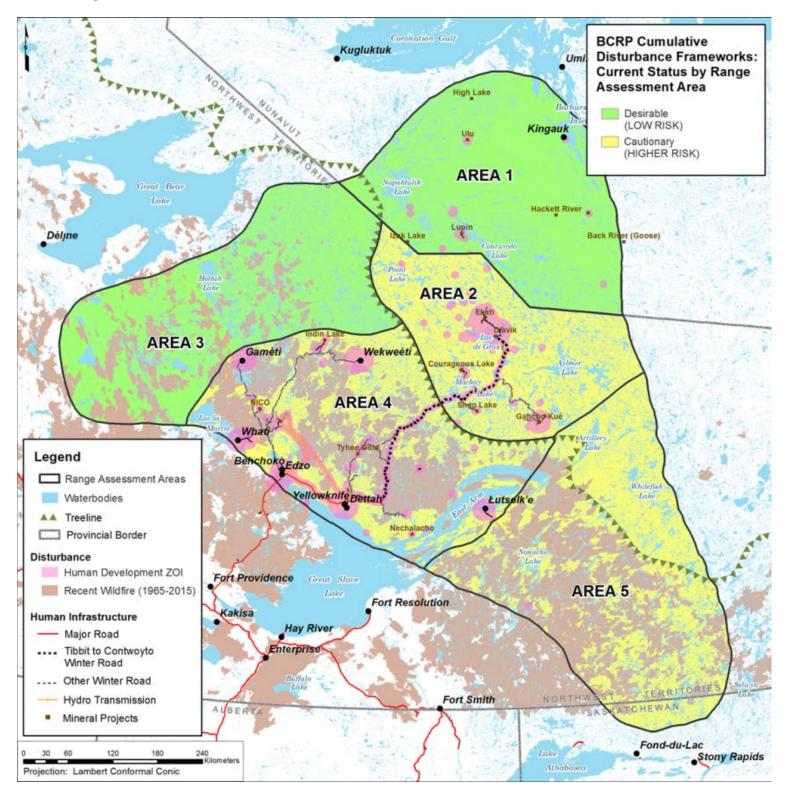
CHALLENGES

- May have an impact on the potential opportunity for economic development
- May impose increased costs in terms of the requirements for mitigation

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

WHERE THEY COULD BE USED

- Across the range
- If thresholds are applied as presented in the Discussion Document, the status of the range could look like the figure below:



KEY QUESTIONS

- Can disturbance thresholds provide balance between caribou and economic development?
- Are the management responses in each zone suitable?
- Is wildland fire an important part of disturbance in the forested regions?
- Should wildland fire be incorporated into disturbance thresholds in the forested regions?

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

ACCESS MANAGEMENT

New road access has many economic benefits, however it often has unintended consequences for caribou. These are:

- Disturbance from road traffic
- Increased harvest opportunities—that is, when harvest is reinstated for the Bathurst herd
- Restricting caribou movement from one area to another—habitat fragmentation

PURPOSE

- Access management and planning approaches could address issues such as:
 - o construction methods and route orientation to reduce barriers to movement
 - o consolidating routes among multiple users to reduce fragmentation
 - using seasonal roads vs. all-season roads to minimize/control the timeframe over which disturbance might occur

BENEFITS

- Winter roads greatly reduce direct habitat disturbance and are generally preferable to all-season roads
- In the tundra, activity on winter roads avoids the period when Bathurst caribou are on the calving and post-calving, and summer ranges

CHALLENGES

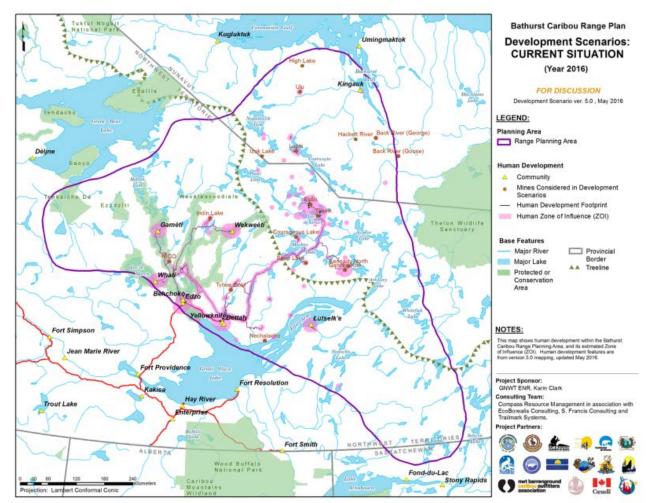
- Once a road is built, it is very difficult to manage people's use of and activities on the road.
- Some types of development may require all-season roads to be economically viable
- winter roads may have a similar impact on caribou on their winter range as all-season roads

WHERE THEY COULD BE USED

- Across the range for all road developments
- Scenarios show a few different versions of what road development could look like in the future

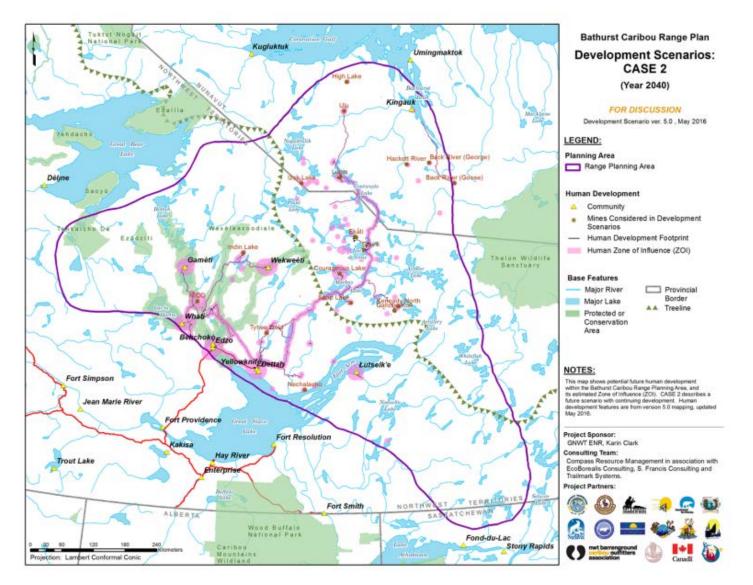
KEY QUESTIONS

- Could community guardianship be used as an effective access management tool?
- Are winter roads an effective management tool in the Bathurst winter range?
- In times of warmer winters is it realistic to expect winter road use to continue?
- Are other approaches to managing human access possible?

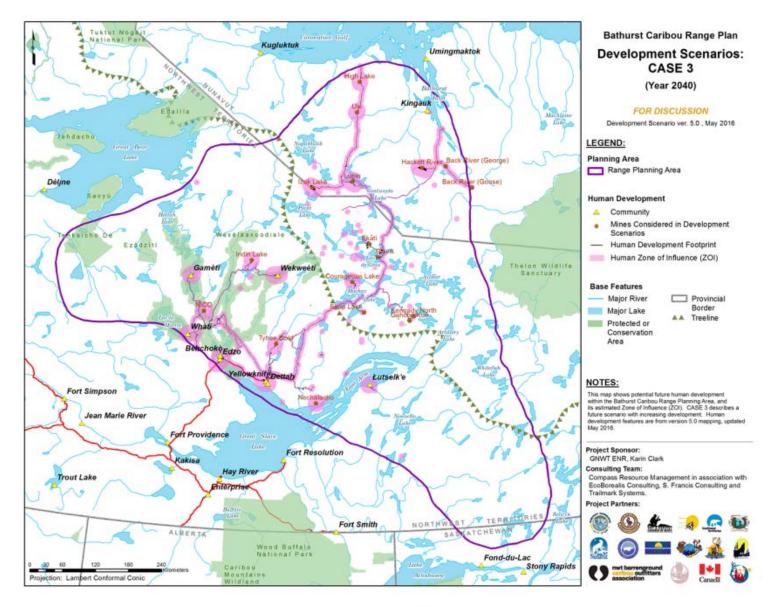


Current activity on the Bathurst range – roads, mines, camps, communities

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>



Potential future activity on the Bathurst range if development continues in similar manner as in past



Potential future activity on the Bathurst range if development increases as compared to the past

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

ACTIVITY GUIDELINES

Activity guidelines for industry would specify the conditions when activity needs to shut down or be reduced to protect caribou. These could include:

- Time of year
- Number of caribou nearby
- Distance of caribou to the site
- Sex and age of caribou in group—females, males, yearlings, calves

PURPOSE

• Stop on-site operations or reduce the intensity of activity when caribou enter a certain development area, to reduce impacts to caribou

BENEFITS

- Maintains flexibility for industry because operations are unaffected when caribou are not within the development area
- Directly addresses concern of sensory disturbance to caribou during sensitive time periods
- Supports opportunities for community-based monitoring

CHALLENGES

- Requires real-time monitoring of caribou, and therefore can be difficult and costly to implement
- Does not address direct habitat loss or disturbance—for example, construction of roads, mines, location of exploration camps
- Results in unpredictable—and therefore costly—restrictions to work scheduling for industry

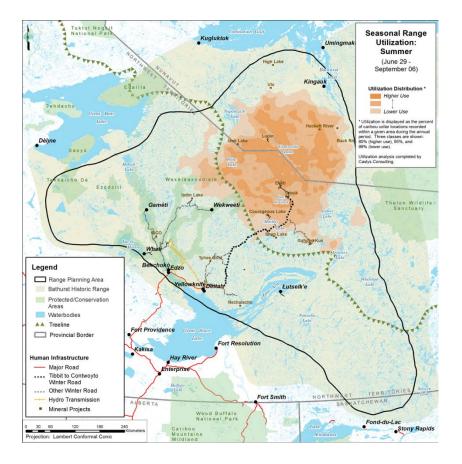
WHERE THEY COULD BE USED

- Calving and post-calving areas are considered the most sensitive habitats to disturbance followed by summer range areas
- Water crossings and land bridges have also been identified as important migratory paths

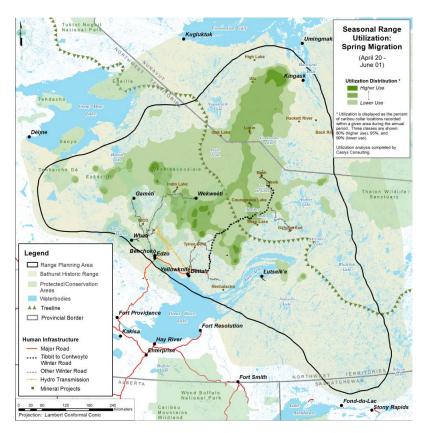
KEY QUESTIONS

- When is temporary protection of migratory pathways and seasonal ranges appropriate?
- When is one preferred over the other?
- What is an appropriate zone around migratory corridors, water crossings where caribou should not be disturbed?

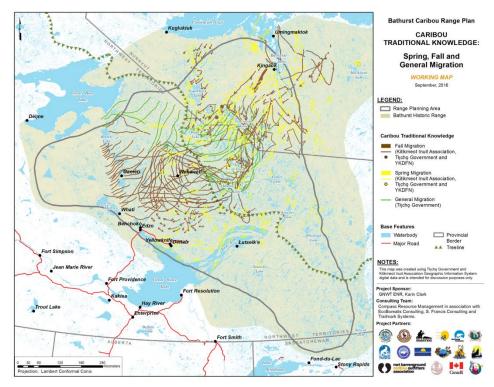
For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>



Summer range



Spring migration



Spring, fall and general migration

For more information: <u>http://www.enr.gov.nt.ca/programs/barren-ground-caribou/bathurst-caribou-range-plan</u>

Bathurst Caribou Range Plan:

Interim Range Assessment and Technical Methods Report

March, 2017

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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.

This document should be cited as follows:

Bathurst Caribou Range Plan: Interim Range Assessment and Technical Methods Report. March, 2017.

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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 km², 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, socioeconomic and socio-cultural perspectives, and is a shared resource between many different aboriginal groups, including the Tłįchǫ, 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 species².

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 nongovernment 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 km² 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.

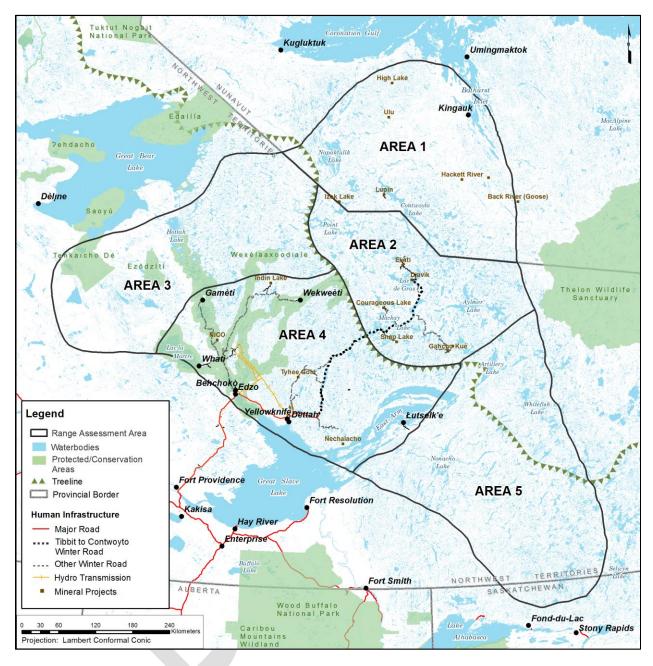


FIGURE 2: RANGE ASSESSMENT AREAS IN THE BATHURST CARIBOU RANGE PLANNING AREA.

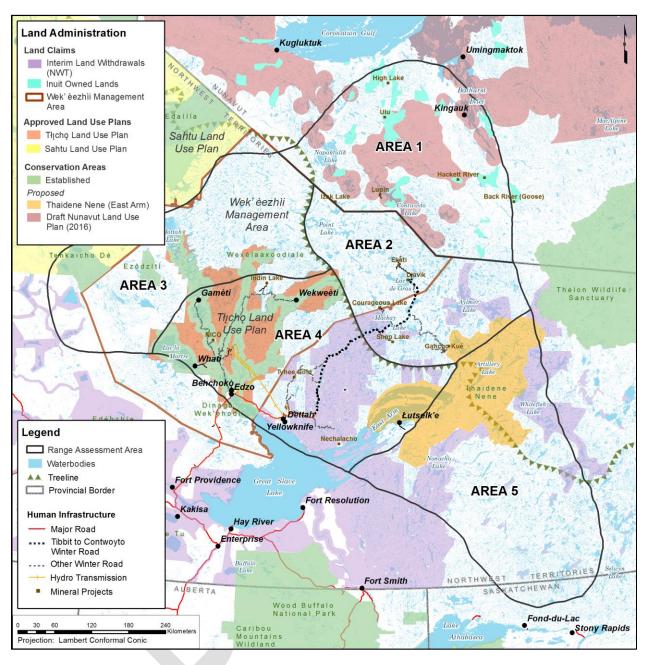


FIGURE 3. RANGE ASSESSMENT AREAS AND LAND MANAGEMENT CONSIDERATIONS IN THE BATHURST RANGE PLANNING AREA.

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 km² (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 km² (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	Area	Rationale for	Caribou Habitat	Land Use	Land Management
Assessment Area	(km ² and %)	Creating RAA disturbance than other parts of the winter range.	 and Range Use 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 Tłįchǫ Settlement Area, and the approved Tłįchǫ 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 Tłįchǫ Settlement Area, and the approved Tłįchǫ 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	Area	Rationale for	Caribou Habitat	Land Use	Land Management
Assessment Area	(km ² and %)	Creating RAA	and Range Use		
				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:	95,127 km ²	This part of the winter	• This part of the winter	RAA5 is remote and	RAA5 includes the
NWT Winter	(24 %)	range is remote and	range has received lower	currently receives low	proposed Thaidene Nene
Range - Southeast		currently has low land use pressures, but has experienced a large amount of wildfire disturbance.	 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 	 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. 	 (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).
			also occurred.		
Total	389,022 km ²				

1.5 References

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

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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'èezhii 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'èezhii 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'èezhìi 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 Tłįchǫ 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 Tłįchǫ 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: Tłįchǫ 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 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; Tłįchǫ 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 biogeographical 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'ìiæedaà '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.;
- 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 industryprovided 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 disturbance⁴ 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 inò dè >ògoèhshì (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: Tłįcho 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**.

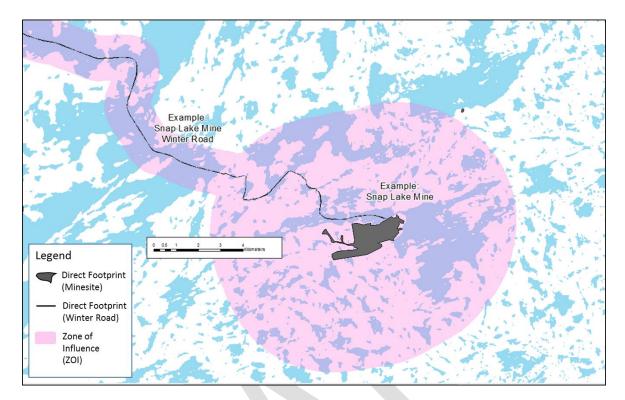


FIGURE 4: HUMAN DISTURBANCE CONCEPTS—DIRECT FOOTPRINT AND ITS SURROUNDING ZONE OF INFLUENCE (ZOI).

3.3 Current Situation

3.3.1 Major Land Uses in the Bathurst Range

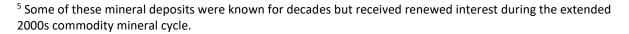
3.3.1.1 Mineral Exploration and Development

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 Territories⁵ (**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.



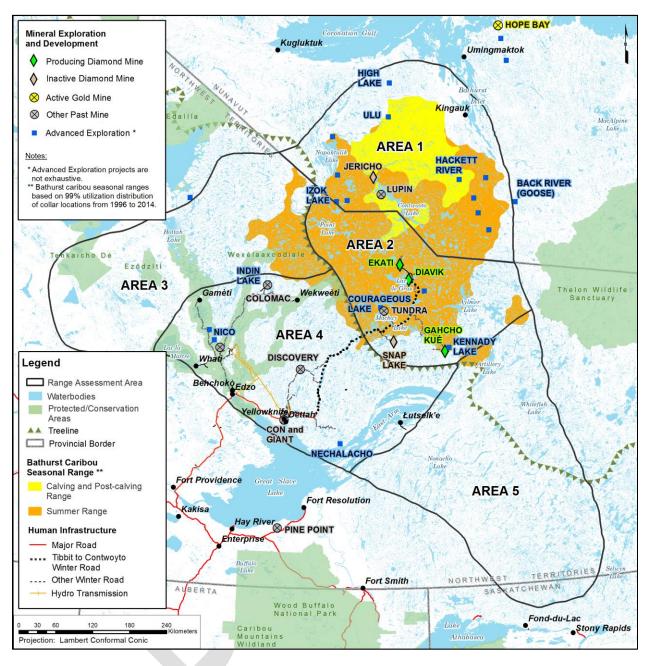


FIGURE 5: PAST MINES, NEW MINES CURRENTLY OPERATING OR UNDER CARE AND MAINTENANCE, AND OTHER ADVANCED EXPLORATION PROJECTS IN THE BATHURST RANGE.

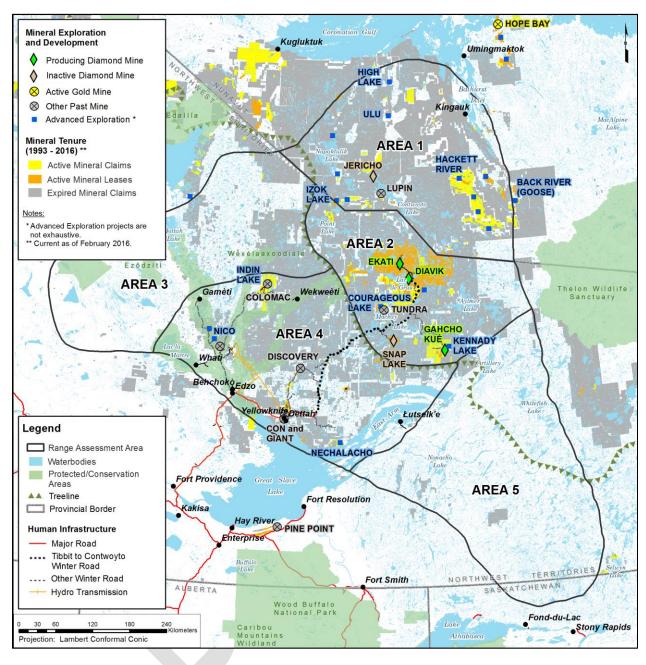


FIGURE 6: HISTORICAL AND CURRENT MINERAL TENURE ON THE BATHURST RANGE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF INVESTMENT, TRADE AND TOURISM, AND NATURAL RESOURES CANADA).

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.

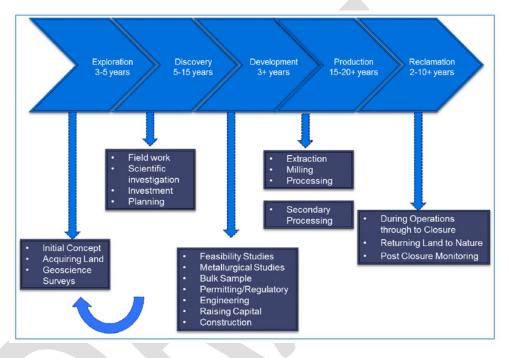


FIGURE 7: THE MINERAL EXPLORATION AND DEVELOPMENT LIFE-CYCLE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF INDUSTRY, TOURISM AND INVESTMENT).

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 barrenground 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 Tłįchǫ 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 Tłįchǫ 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 Behchokò, to Whatì is also being planned⁶. 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 Behchokò to Whatì all-season road was undergoing environmental assessment.

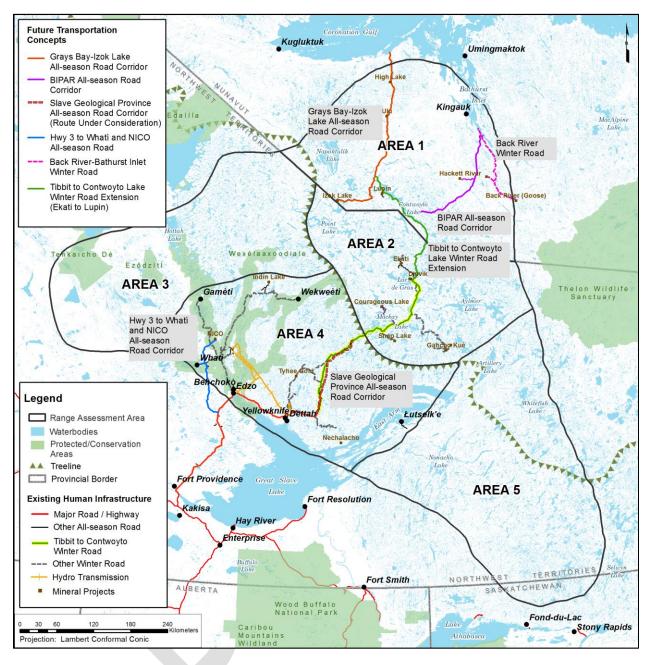


FIGURE 8: MAJOR TRANSPORTATION AND HYDRO FACLITIES AND TRANSMISSION LINES IN THE BATHURST RANGE.

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 km²) 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 km²) 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.

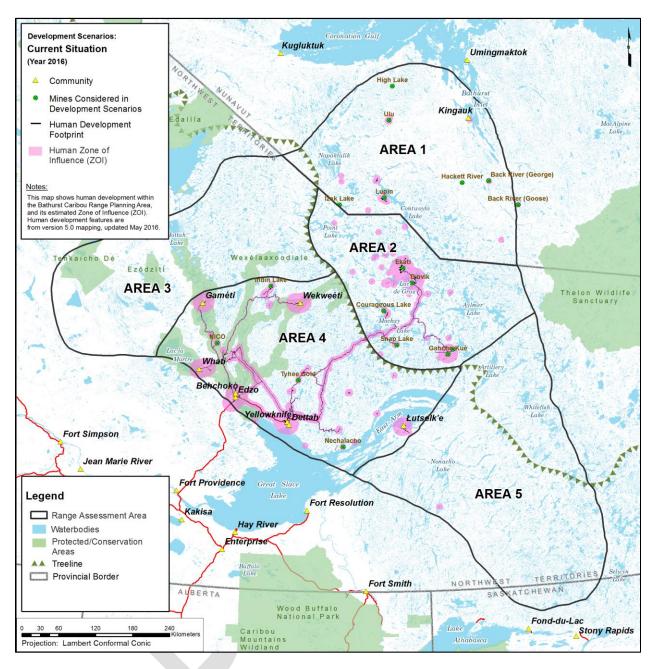


FIGURE 9: CURRENT DIRECT AND INDIRECT HUMAN DISTURBANCE IN THE BATHURST RANGE.

Range Assessment Area	Range Assessment Area Size	Direct Human Development Footprint		Total Human Disturbance (includes ZOI)	
	(km²)	(km²)	(% of RAA)	(km²)	(% 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 km²	70 km²	<1%	6,610 km²	11.8%
Area 3: NWT Winter Range - Northwest	77,001 km²	<1 km ²	<1%	<1 km ²	<1%
Area 4: NWT Winter Range – Central	84,858 km²	90 km²	<1%	14,120 km ²	16.6%
Area 5: NWT Winter Range – Southeast	95,127 km²	<1 km ²	<1%	88 km²	<1%
TOTALS	389,022 km ²	181 km²	<1%	21,898 km ²	5.6%

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

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.

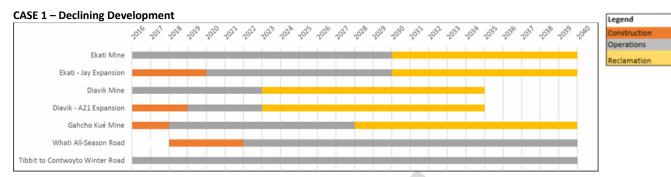
⁷ The BCRP Working Group worked closely with the Mineral Task Group to develop assumptions and project parameters for the three development scenarios.

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.

Scenario CASE 1: Declining		CASE 2: Continuing	CASE 3: Increasing
Assumptions	Development	Development	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 Current situation	No change; current situation is maintained.	No change; current situation is maintained.
Settlements		No change; current situation is maintained.	No change; current situation is maintained.

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

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



CASE 2 – Continuing Development



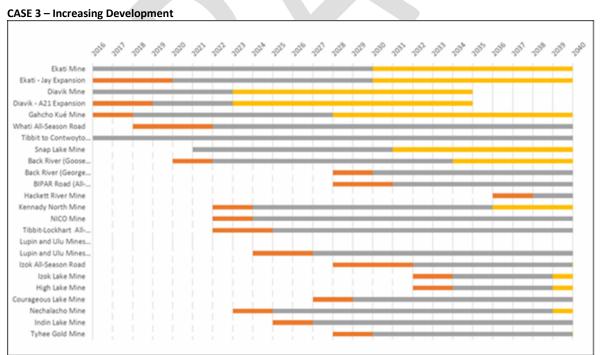


FIGURE 10: DETAILED TIMELINES FOR PROJECTS CONSIDERED IN BCRP FUTURE DEVELOPMENT SCENARIOS.

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 km² 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 km².
- **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 km².
 - The Izok Lake and High Lake projects begin in 2033 using all-season road access. Total disturbance rises to over 9,400 km².
 - The Hackett River project begins in 2037 using all-season road access. Total disturbance rises to nearly 9,800 km².

RAA2: NWT Central Tundra

- **Case 1**: There is no projected new mineral developments. Total disturbance begins at nearly 6,600 km², increases to over 6,900 km² 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 km² by 2026, decreasing after 2030 when some mines enter the closure/reclamation phase.

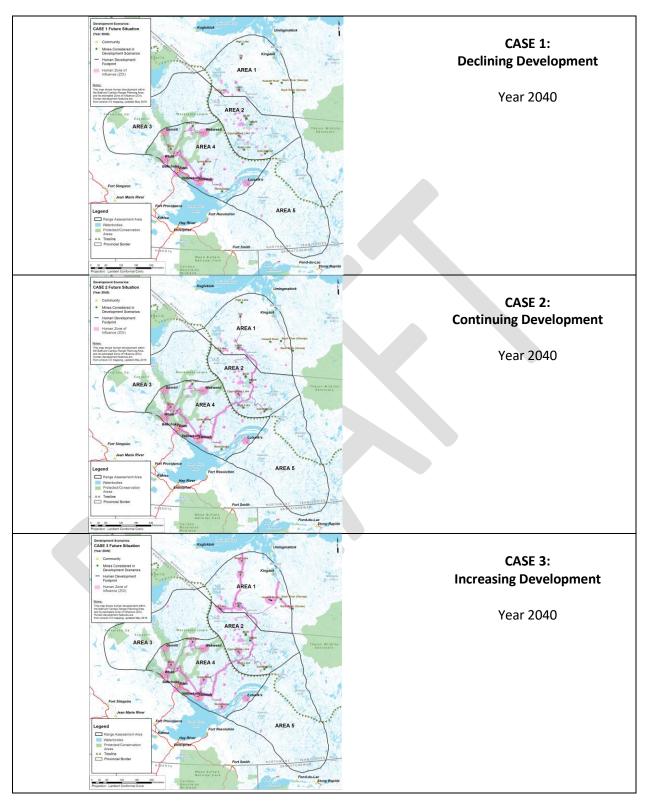


FIGURE 11: POTENTIAL FUTURE HUMAN DISTURBANCE IN THE BATHURST RANGE: CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT). ALL MAPS SHOW RESULTS AT YEAR 2040.

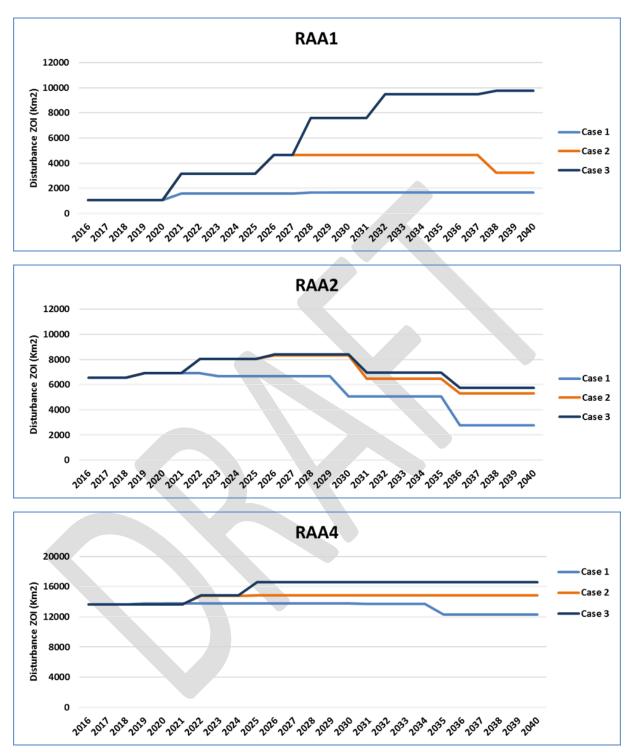


FIGURE 12: TOTAL HUMAN DISTURBANCE RESULTING FROM THREE FUTURE DEVELOPMENT SCENARIOS, CASE 1 (DECLINING DEVELOPMENT), CASE 2 (CONTINUING DEVELOPMENT), AND CASE 3 (INCREASING DEVELOPMENT), IN RAA1, RAA2 AND RAA4.

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 km²). Total disturbance remains constant at 13,700 km² 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 km² 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 allseason road is built in 2023, replacing that portion of the TCWR. Total disturbance then remains constant at 16,600 km² 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.

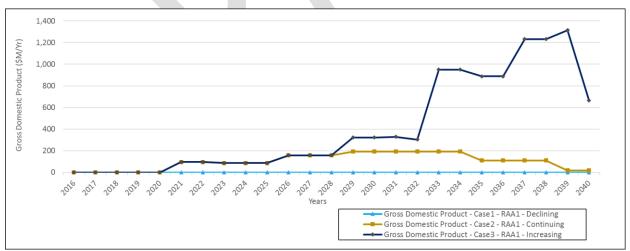
The potential economic implications of the three development scenarios, reported by range assessment area, are as follows:

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.

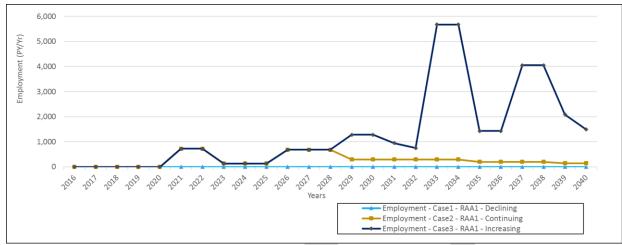


FIGURE 14: RAA1 (NUNAVUT) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

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.

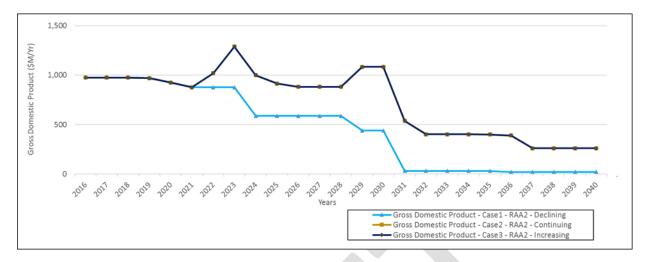


FIGURE 15: RAA2 (NWT CENTRAL TUNDRA) - PROJECTION OF POTENTIAL CHANGE IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

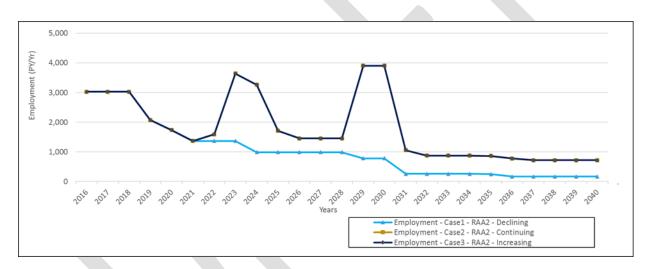


FIGURE 16: RAA2 (NWT CENTRAL TUNDRA) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

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.

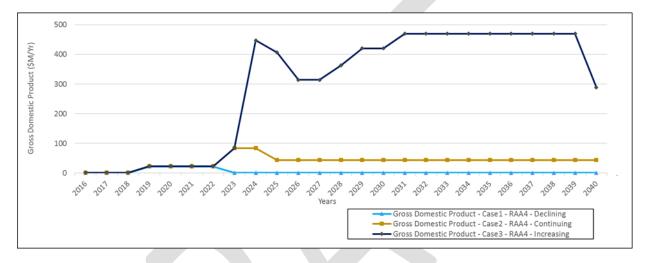


FIGURE 17: RAA4 (NWT CENTRAL WINTER RANGE) - PROJECTION OF POTENTIAL CHANGE IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

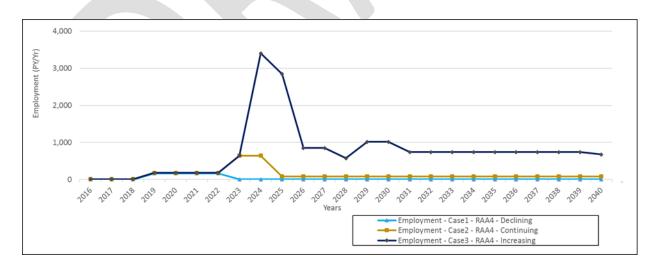


FIGURE 18: RAA4 (NWT CENTRAL WINTER RANGE) - PROJECTION OF POTENTIAL CHANGE IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3.

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 km²) 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: <u>http://www.statsnwt.ca/economy/multipliers/</u>.

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 Union⁹ (**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.

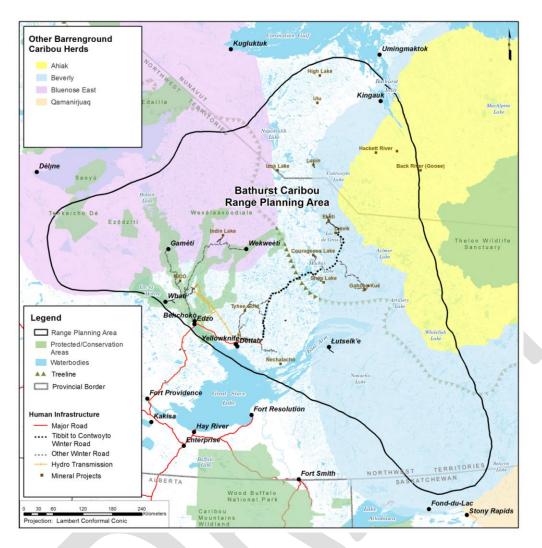


FIGURE 19. OTHER BARREN-GROUND CARIBOU HERDS OVERLAP WITH THE BATHURST HERD ANNUAL RANGE (SOURCE: GOVERNMENT OF NORTHWEST TERRITORIES, DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES).

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 \pm 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).

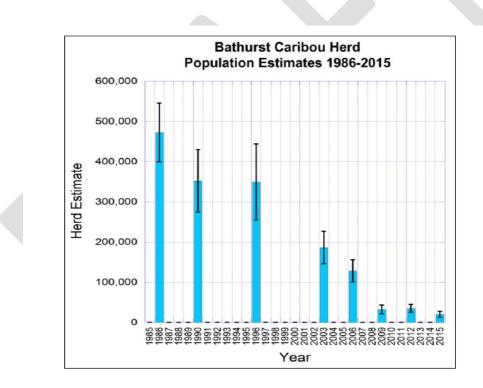


FIGURE 20: BATHURST CARIBOU HERD SIZE ESTIMATES FROM 1985 TO 2015 (SOURCE: BOULANGER ET AL. 2016).

Traditional knowledge and science tell us that barren-ground caribou go through periods of abundance and scarcity. Tłįchǫ 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.

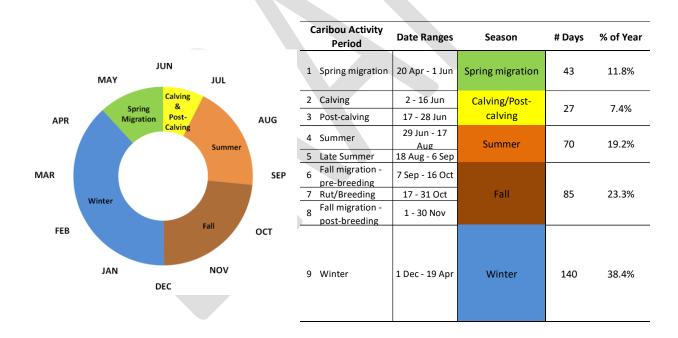


FIGURE 21: THE FIVE GENERAL SEASONS OF THE BATHURST HERD ANNUAL LIFE CYCLE, WITH ASSOCIATED DATE RANGES (ADAPTED FROM NAGY 2011).

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).

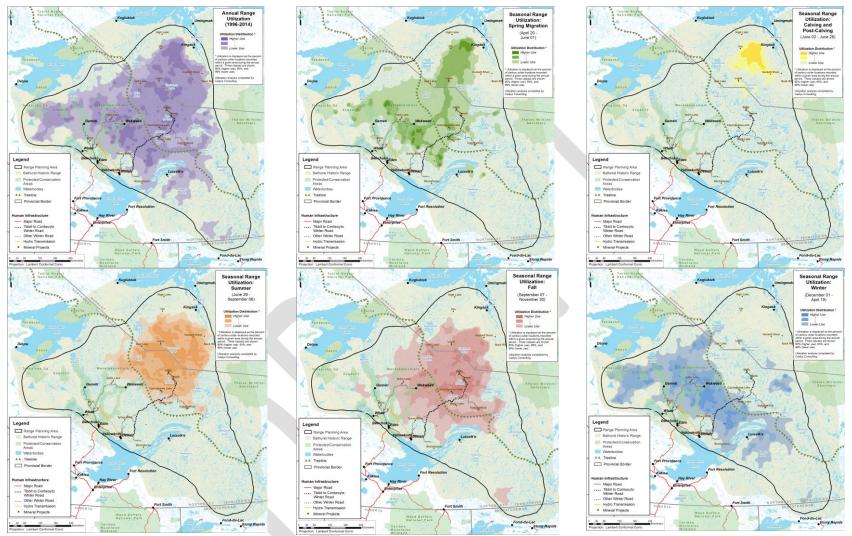


FIGURE 22: ANNUAL AND SEASONAL RANGES OF THE BATHURST CARIBOU HERD BASED ON SATELLITE TELEMETRY DATA FROM 1996 TO 2014. DARKER COLOURS INDICATE HIGHER USE BY CARIBOU.

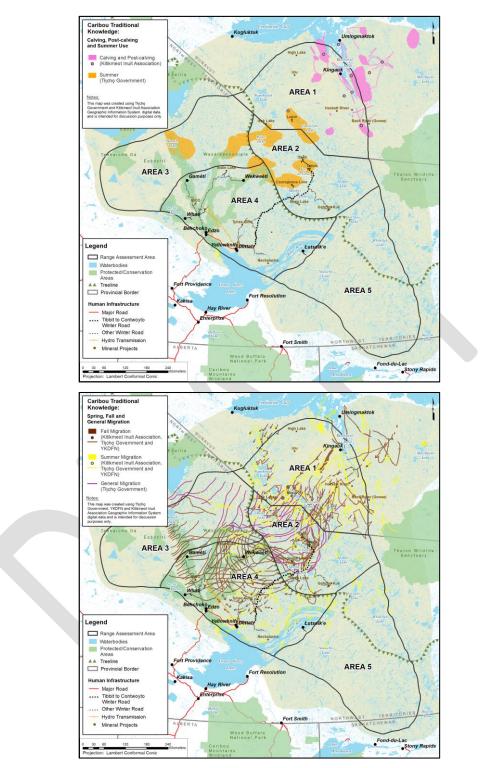


FIGURE 23: SEASONAL RANGES (CALVING AND POST-CALVING, AND SUMMER) AND SPRING, FALL AND GENERAL MIGRATION PATHS AS IDENTIFIED THROUGH TRADITIONAL KNOWLEDGE.

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**).

CARIBOU LIFE CYCLE PERIOD	CARIBOU SENSITIVITY RATING ²	RANGE SENSITIVITY RATING ³	CARIBOU - RANGE SENSITIVITY RATING		
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)		

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

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 barrenground 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).

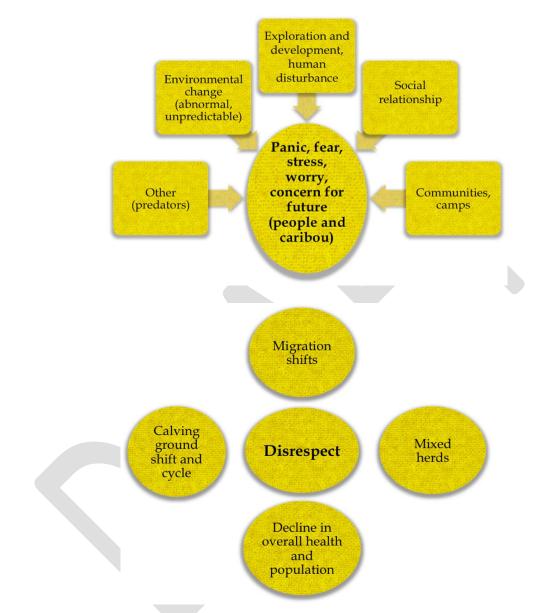
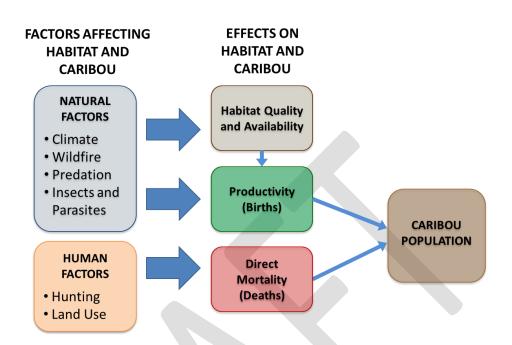


FIGURE 24: TRADITIONAL PERSPECTIVES ON FACTORS AFFECTING BARREN-GROUND CARIBOU AND CARIBOU HABITAT, AND THE HUMAN-CARIBOU RELATIONSHIP.



Factors Affecting Barren-ground Caribou and their Habitat

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 precipitations. 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: Tłįchǫ 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 forests¹⁰ (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 km² area burned per year) for the entire Taiga Shield west of Hudson Bay.

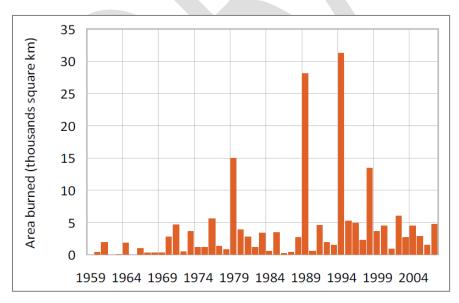


FIGURE 26. ANNUAL AREA BURNED BY LARGE FIRES IN THE TAIGA SHIELD ECOZONE, 1959-2007. (SOURCE: FIGURE 16 FROM KREZEK-HANES ET AL. 2011).

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 km² has been affected by wildfire since 1965¹¹ (**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 range¹². 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 km² represents the total extent of area affected by wildfire; the total area burned calculated from individual fire years is 86,400 km², as some recent fire extents overlap with older re-generating burns.
 ¹² Approximately 30% (28,538 km²) 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.

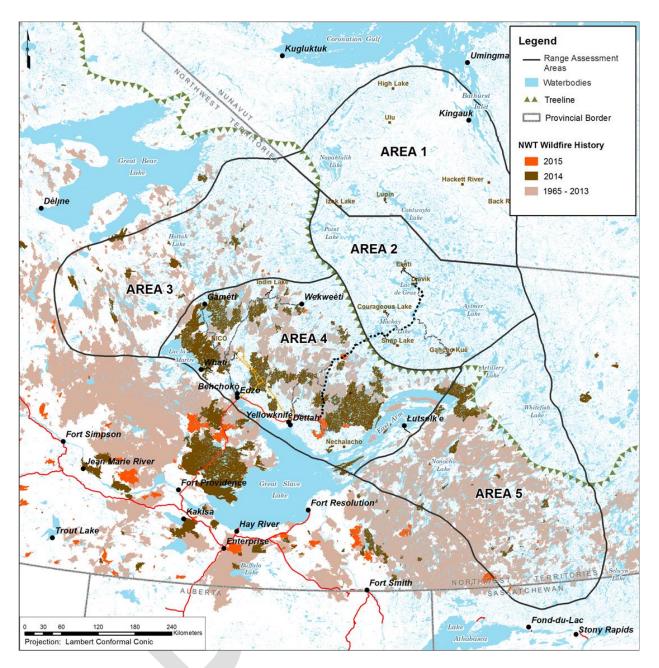


FIGURE 27. AREA AFFECTED BY WILDFIRE BETWEEN 1965 AND 2015. (SOURCE: NWT WILDIFRE HISTORY DATABASE).

Range Assessment Area	Range Assessment Area Size	Recent Wildfire Disturbance (1965-2015)		
	(km²)	(km²)	(% of RAA)	
Area 1 : Nunavut	75,902 km²	20 km ²	<1%	
Area 2: NWT Central Tundra	56,134 km²	5 km ²	<1%	
Area 3: NWT Winter Range – Northwest	77,001 km ²	15,178 km²	19.7%	
Area 4: NWT Winter Range – Central	84,858 km²	30,839 km²	36.3%	
Area 5: NWT Winter Range – Southeast *	95,127 km²	35,459 km²	* 37.3%	
TOTALS	389,022 km²	81,501 km²	21.0%	

TABLE 6: SUMMARY OF RECENT WILDFIRE DISTURBANCE (1965-2015) BY RANGE ASSESSMENT AREA.
TABLE 0. SOMMART OF RECENT WIEDTINE DISTORDANCE	1303 2013	

*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 km²) 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).

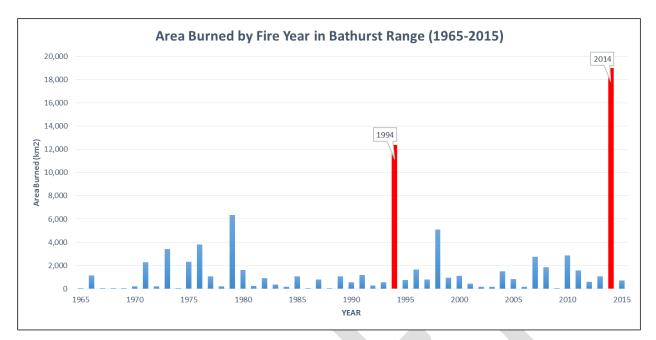


FIGURE 28: AREA BURNED BY FIRE YEAR IN THE BATHURST RANGE PLANNING AREA (1965-2015). SOURCE: GNWT ENR, WILDFIRE HISTORY DATABASE.

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'èezhìu Renewable Resources Board (WRRB 2016a) recommended that GNWT and Tłįchǫ Government conduct a collaborative feasibility assessment of options for wolf management. Tłichǫ 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 [Ndilodilo [Ndrlo, Ndilo [Ndrlo, 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 ?ekwò you must understand them first. You must understand the names of ?ekwò 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 ekwò . Every Aboriginal child has to understand the laws pertaining to ?ekwò (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.

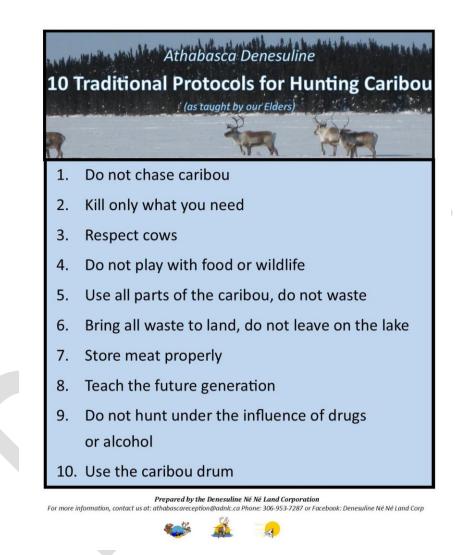


FIGURE 29: TEN TRADITIONAL PROTOCOLS FOR HUNTING CARIBOU, PROVIDED BY ATHABASCA DENESULINE (2016: A-1).

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.

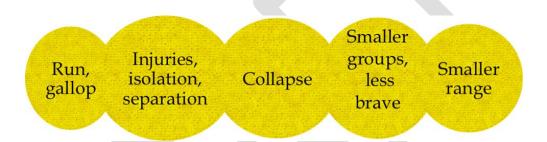


FIGURE 30: TRADITIONAL PERSPECTIVES ON HOW LAND USE AND HUMAN DISTURBANCE AFFECT BARREN-GROUND CARIBOU.

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 Tłicho 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 Tłic ho 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 inò dè >ògoèhshì 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: Tł₂cho 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; Tłįchǫ 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 'ekwö in association with the ice road, the 'ekwö 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 'ekwò 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)

Effects of Aircraft and Vehicles

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 ?ekwò [caribou] are thinning out, we have to take action. We must protect those calving grounds, the home of ekwò. 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 ?ekwò 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 ekwò. If you disturb the calving ground, they'll go elsewhere. They may decide to disappear (Sangris 2012: 78).

The elders suspect that ?ekwǫ̀ 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 Thchǫ 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 >Q 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. EKWQ YEKA AT'Į-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 barrenground 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 ZOI¹³ (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.

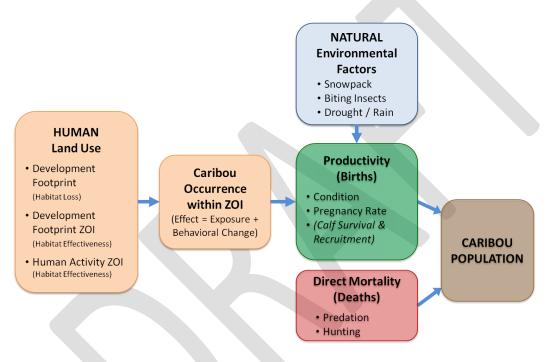


FIGURE 31: A CONCEPTUAL IMPACT PATHWAY OF HOW DISTURBANCE RESULTING FROM HUMAN LAND USE AND OTHER NATURAL AND HUMAN FACTORS INFLUENCE BARREN-GROUND CARIBOU VITAL RATES AND POPULATION HEALTH.

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. <u>However</u>, <u>development levels had a synergist effect with mortality levels and reduced population trend further</u>, 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.

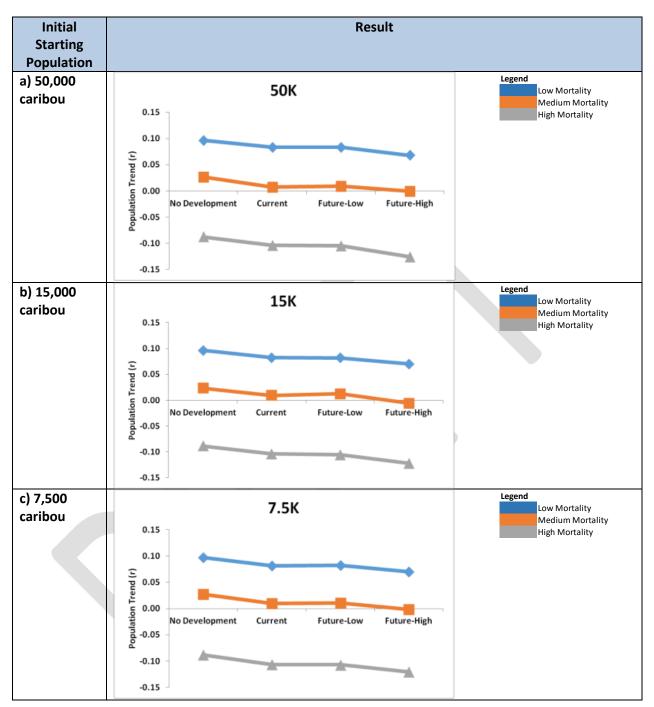


FIGURE 32: INFLUENCE OF INDUSTRIAL DEVELOPMENT LEVELS AND RATES OF NATURAL MORTALITY ON SIMULATED CARIBOU POPULATION GROWTH RATES, WITH SCENARIOS STARTED AT DIFFERENT POPULATION SIZES.

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 \sim 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 \sim -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.

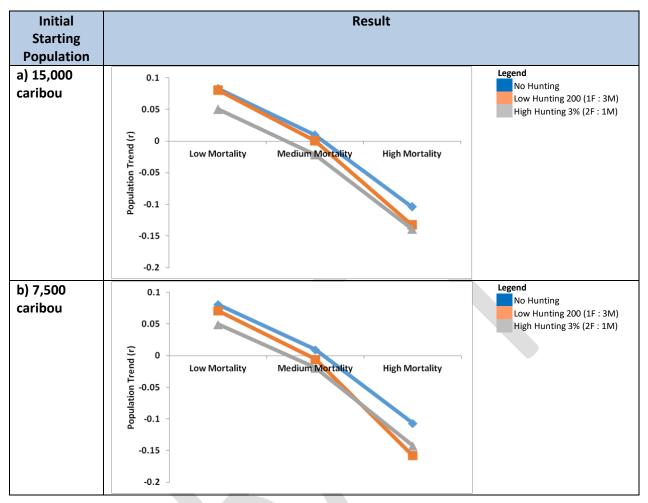


FIGURE 33: COMPARING THE INFLUENCE OF MORTALITY AND HUNTING LEVELS ON POPULATION RATE OF GROWTH WITH INITIAL POPULATION SIZE AT A) 15,000 CARIBOU AND B) 7,500 CARIBOU.

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.

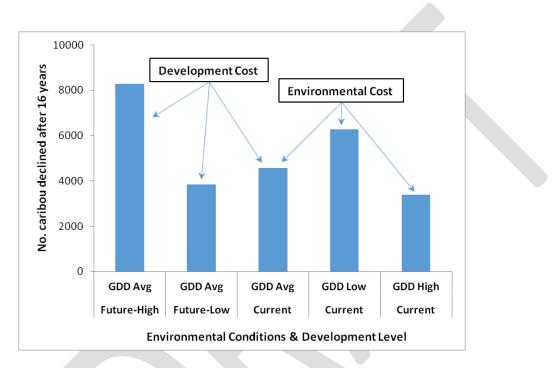


FIGURE 34: RELATIVE DECLINE IN CARIBOU ABUNDANCE AFTER 16-YEAR SIMULATION PERIOD COMPARED TO A REFERENCE CASE SCENARIO WITH AVERAGE MORTALITY ASSUMPTIONS, AVERAGE GROWING DEGREE DAYS (GDD) ENVIRONMENTAL CONDITIONS, AND NO DEVELOPMENT FOOTPRINT.

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).
- 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).
- 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).

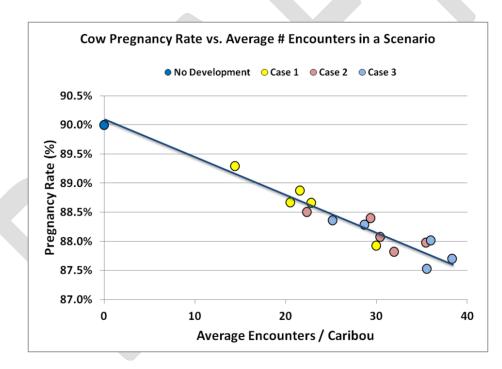


FIGURE 35: RELATIONSHIP BETWEEN EXPECTED PREGNANCY RATE AND AVERAGE ANNUAL ENCOUNTER RATE OF A BATHURST CARIBOU COW WITH ANTHROPOGENIC FOOTPRINTS ON THE ANNUAL RANGE.

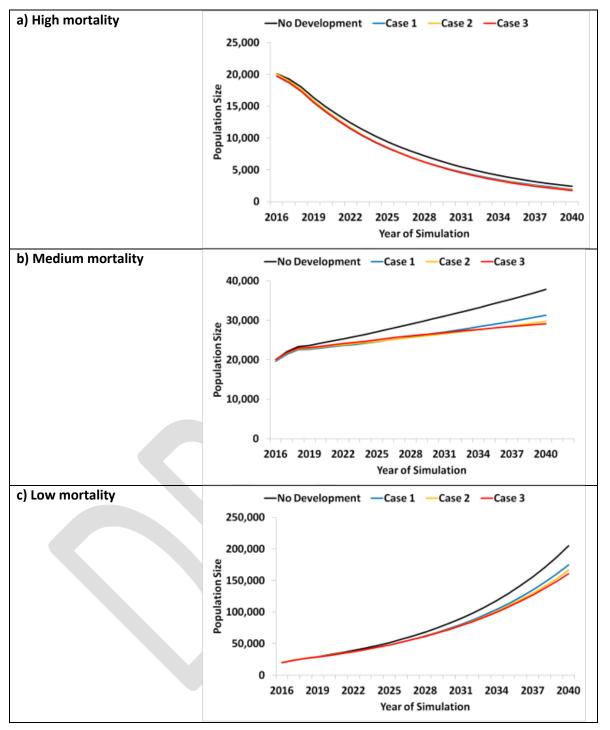


FIGURE 36: COMPARATIVE POPULATION TRENDS OF BATHURST CARIBOU STARTING FROM AN INITIAL SIZE OF 20,000 ANIMALS AND SIMULATED 24-YEARS IN TO THE FUTURE BASED ON THREE DIFFERENT INDUSTRIAL DEVELOPMENT CASE SCENARIOS (CASE 1-3), AND ORGANIZED BY (A) HIGH, (B) MEDIUM, AND (C) LOW RATES OF NATURAL MORTALITY.

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**).

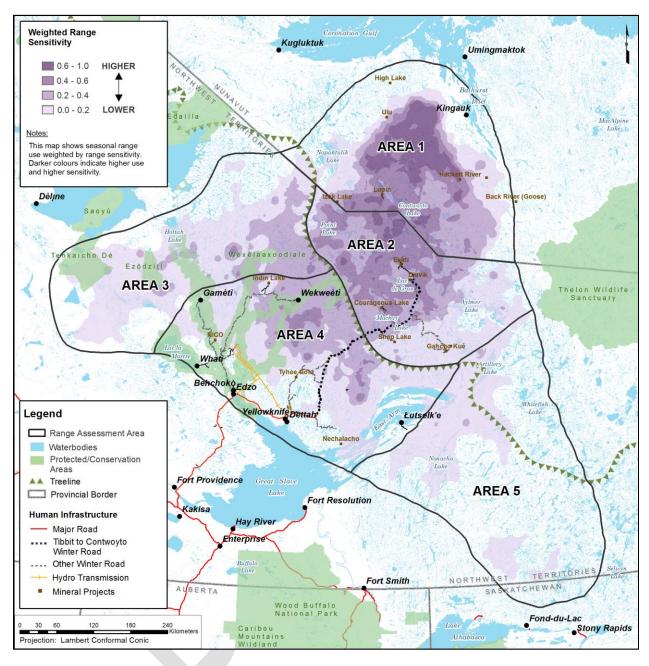


FIGURE 37: BATHURST CARIBOU RANGE USE WEIGHTED BY RANGE SENSITIVITY. DARKER COLOURS SHOW AREAS WITH HIGHEST USE WITHIN THE MOST SENSITIVE SEASONAL RANGES.

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. Tłįchǫ 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.

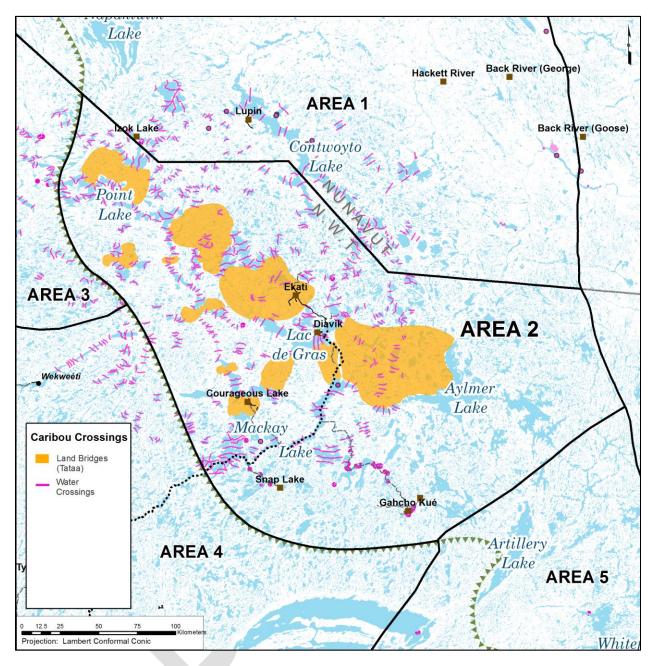


FIGURE 38: WATER CROSSINGS AND LAND BRIDGES IDENTIFIED BY TŁĮCHQ AND KITIKMEOT INUIT ASSOCIATION TRADITIONAL KNOWLEDGE IN THE CENTRAL BATHURST RANGE. MANY CROSSING LOCATIONS OUTSIDE OF THIS AREA ARE ALSO KNOWN BUT ARE NOT CURRENTLY AVAILABLE FOR DISPLAY.

4.4.2.2 Land Bridges

Land bridges refer to areas where caribou pass between major lakes. The Tłįchǫ 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 Tłįchǫ traditional knowledge in the central Bathurst range (Tłįchǫ 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) *
	(km²)	(% 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 km²)	1.4% (1,080 km²)	<1% (20 km²)	1.4% (1,063 km²)
Area 2: NWT Central Tundra	56,134 km²	<1% (70 km²)	11.8% (6,610 km²)	<1% (5 km²)	11.7% (6,568 km²)
Area 3: NWT Winter Range - Northwest	77,001 km²	<1% (<1 km²)	<1% (<1 km²)	19.7% (15,178 km²)	19.7% (15,169 km²)
Area 4: NWT Winter Range – Central	84,858 km ²	<1% (90 km²)	16.6% (14,120 km²)	36.3% (30,839 km²)	47.4% (40,223 km²)
Area 5: NWT Winter Range – Southeast **	95,127 km²	<1% (<1 km²)	<1% (88 km²)	37.3% ** (35,459 km²)	37.3% (35,482 km²)
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 eachrange assessment area in the BCRP planning 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

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
		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	• 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. 	 A large part (18%) of RAA4 was burned in 2014, with approximately 36% of the area 	 RAA4 has the highest level of human (17%) and combined human and wildfire disturbance (47%) in 	 Given the large amount of permanent infrastructure and communities, in the future RAA4 is
84,858 km²		 The City of Yellowknife, all of 	being affected by wildfire since 1965.	the Bathurst annual range.	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 process¹⁴.

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: Tłįchǫ 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.

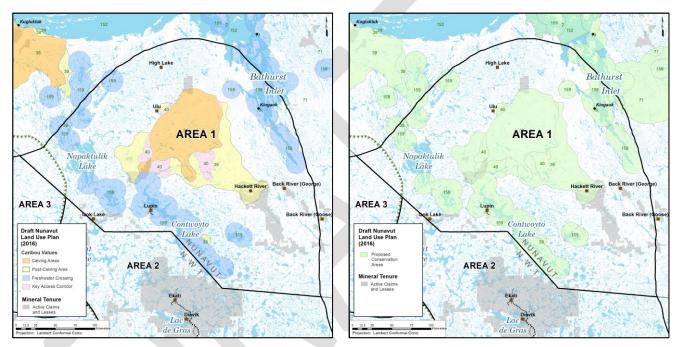


FIGURE 39: DRAFT NUNAVUT LAND USE PLAN (2016) IDENTIFIED CARIBOU VALUES (LEFT MAP) AND PROPOSED PROTECTED AREAS FOR CARIBOU VALUES (CALVING, POST-CALVING AND WATER CROSSINGS) (RIGHT MAP) IN THE NUNAVUT PORTION OF THE BATHURST RANGE (RAA1).

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.

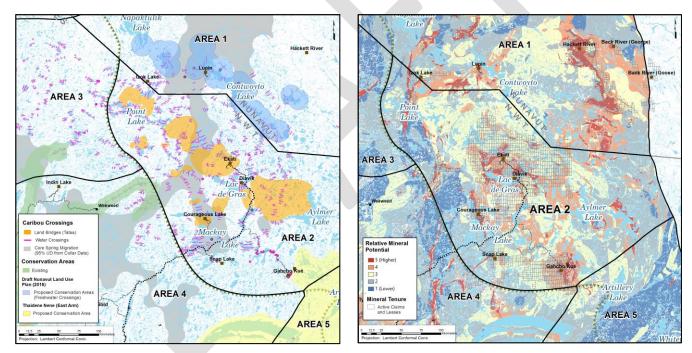


FIGURE 40: (LEFT MAP) IDENTIFIED WATER CROSSINGS AND LAND BRIDGES IN THE CENTRAL BATHURST RANGE, AND THE CORE SPRING MIGRATION CORRIDOR (SHOWN IN GREY). EXISTING AND PROPOSED PROTECTED OR CONSERVATION AREAS ARE ALSO SHOWN. (RIGHT MAP) RELATIVE MINERAL POTENTIAL AND ACTIVE MINERAL CLAIMS AND LEASES IN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

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Bathurst Caribou Range Plan: Draft Range Assessment and Technical Methods Report (March 2017)

APPENDIX A:

Traditional Knowledge References and Information Sources Reviewed in Support of Bathurst Caribou Range Plan

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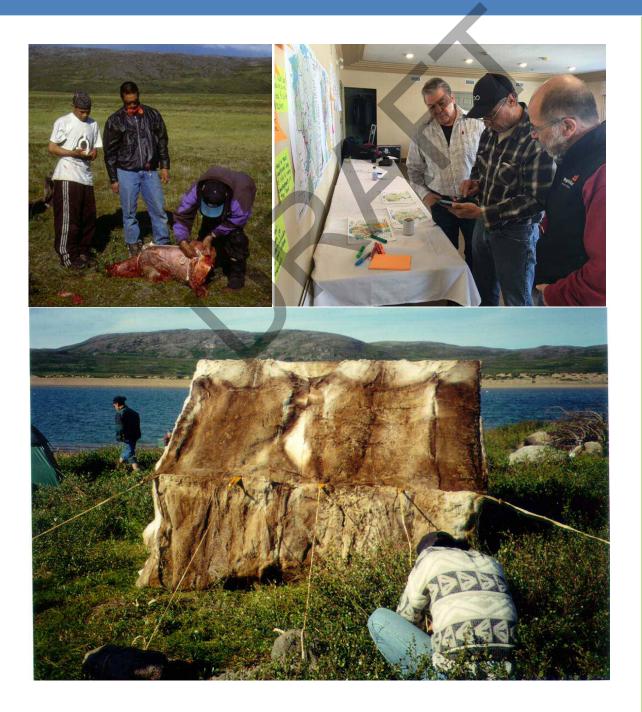
APPENDIX B:

Report on the Bathurst Caribou Range Plan Traditional Knowledge Workshop

Draft Workshop Report is attached.

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Report on the Bathurst Caribou Range Plan Traditional Knowledge Workshop



Yellowknife, NT March 30–31, 2016

Acknowledgements

The BCRP is grateful to community members who participated in the TK Workshop for their generous contributions of knowledge, insight, guidance, and encouragement.

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Finally, many thanks are sent to 4A and 7A for providing the opening and closing prayers for the TK Workshop, and to the Honourable ENR Minister Wally Shuman for giving the opening address to the TK Workshop and for providing words of encouragement and gravity to the workshop and its participants. Thank you! Masi! Quana/koana!

Disclaimer

This is a living document released by permission of participants of the Traditional Knowledge Workshop convened by the Bathurst Caribou Range Plan on March 30-31, 2016 in Yellowknife, NWT. The document does not represent the results of community consultation.

Traditional 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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TrailMark Systems Inc. Primary Office - TLU / TEK Consulting Suite 412 - 645 Fort St. Victoria BC, Canada, V8W 1G2 P: 250.383.7979 E: info@trailmarksys.com The caribou is a long story. Some say its climate change. The government blames the hunters. The biologists blame the hunters. We have meetings like this and we have to think about the predators too such as wolves and thinking about the feeding grounds like whether moose is going to come. -3A

Traditional knowledge is very different from scientific knowledge because you can use some of this stuff on the caribou but traditional knowledge is living, it's today, it's not something that you can pull out of a drawer like scientific knowledge where there is data written down. Traditional knowledge is alive, it's at the moment and every single species is different. — 6A

If there is no more caribou we are really going to suffer. We are going to have to do our utmost to prevent [the population] from declining. -4A

Report Summary

Developing the Bathurst Caribou Range Plan (BCRP) requires a high-level of community input through traditional knowledge, sound science, and the development of innovative ways of bringing both ways of knowing together. A workshop focusing on traditional knowledge (TK) of the Bathurst caribou was convened as one way in which communities could engage in the BCRP. Results from the TK Workshop are the focus of this report.

The workshop took place in Yellowknife, NWT on March 30-31, and included representatives from the Aboriginal organizations: Athabascan Denesuline, Bay Chimo/Bathurst Inlet Hunters and Trappers Organization, Kitikmeot Regional Wildlife Board, Łutsel K'e Dene First Nation (LKDFN), North Slave Métis Association (NSMA), NWT Métis Alliance (NWTMA) and Tłįchǫ Government (TG). During the second day of the workshop, representatives from the following agencies observed: Barrenground Outfitters Association, Beverly and Qaminirjuaq Caribou Management Board, Dominion Diamonds, Government of Nunavut (GN), Government of the Northwest Territories (GNWT), Kitikmeot Inuit Association (KIA), NWT Wildlife Federation, Wek'èezhì Renewable Resources Board (WRRB).

Discussions throughout the TK Workshop centred around the following guiding 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?

The following important underlying themes guided discussions throughout the TK Workshop:

- 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. Youth must be taught how to respect caribou and given opportunities on-the-land to learn the caribou way of life.
- 8. People predicted caribou populations would decline.
- 9. People feel strongly that TK should have been accepted as fact earlier.
- 10. Everybody must all work together: all people of NU and NWT as well as community members, biologists and other resource people.

Building on discussions that emerged around these themes, participants presented the following recommendations:

- 1. Renew spiritual relationship with caribou
- 2. Carry out an on-the-land healing ceremony
- 3. Teach the Youth
- 4. Curtail mineral exploration and development: how much is enough?
- 5. Protect key areas (e.g., calving grounds, caribou crossings, land bridges)
- 6. Increase on-the-land monitoring (i.e., community-based monitoring)
- 7. Support incentives to encourage people to reduce hunting caribou (e.g., alternate harvest, subsidized meat programs)
- 8. Integrate more TK to understand the Historic Range of the Bathurst Caribou
- 9. Review Fire Fighting / Burn Policies
- 10. Repair / Reclaim Damaged Habitat
- 11. Look to Other Successful Examples
- 12. Trust / Honour TK

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1. Background

The Bathurst Caribou Range Plan (BCRP) is being prepared by a working group composed of government and non-government agencies and organizations from the Northwest Territories, Nunavut and Saskatchewan. The Plan will recommend approaches for managing and reducing the impact of cumulative disturbance on Bathurst caribou and their habitat. The Plan is considering other values supported by land use, including traditional practices and economic development, and is focusing on range and population-scale effects and solutions. The Plan will provide tools and approaches to reduce impacts on caribou and improve land use decision-making across the Bathurst caribou herd's range based on both western science and traditional knowledge (TK).

The BCRP started in 2014 with a large group and we talked about what we wanted to do in terms of a range plan and what did we mean when we said range plan. We meant a plan to manage caribou habitat. When we say caribou habitat we mean the activities that are taking place on the land and these could be communities, they could be roads, they could be things like forestry, mining, and other kinds of industrial development. But how can we manage, how can we think about, how can we undertake some of these activities in a way that is not going to harm caribou, or in a way that will allow caribou to come back to be more plentiful in the future. — Karin Clark

TK must be interwoven into the BCRP in a meaningful, consistent, and respectful way, not only through the process of developing the BCRP, but also throughout the outcomes. Although challenging in that it is a new approach, the *strategic decision-making process* that guides the BCRP is grounded in TK. The BCRP Working Group recognizes and honours TK and so convened a workshop of TK holders from across the range of the Bathurst herd to guide the BCRP. This report presents results from this workshop.

2. Workshop Overview

Herds are getting smaller and smaller and smaller and it's time for us to step away from that approach from planning with our minds, need to work from the heart, need to go and meet with the caribou and deal with them from our heart if we are going to understand what the caribou need now. . . . If you are feeling that what we are doing is unusual, it is. — Joanne Barnaby

The purpose of the TK Workshop was to bring together TK experts from across the range of the Bathurst herd to discuss key issues, themes, concerns, and understandings related to the Bathurst caribou and their habitat. Outcomes from the TK Workshop are just one step towards informing the BCRP and process.

The TK Workshop was held at the Days Inn in Yellowknife, NT, from March 30-31, 2016 followed by a one-day session of the BCRP Working Group on April 1, 2016. The session was co-facilitated by Joanne Barnaby (Barnaby Consulting) and Natasha Thorpe (Trailmark Systems) from 8:30 to 4:30 daily. Pido Productions provided audio support and translating equipment. Bertha Catholique and Celine Marlowe

of the LKDFN provided interpreting services. Janet Murray provided *in situ* and post production transcription of recordings.

Participants in the TK Workshop included:

- Athabascan Denesuline: 1A, 1B, 1C
- Bay Chimo/Bathurst Inlet HTO: 2A, 2B
- Kitikmeot Regional Wildlife Board 3A
- Łutsel K'e Dene First Nation (LKDFN): 4A
- North Slave Métis Association (NSMA): 5A, 5B
- NWT Métis Alliance (NWTMA): 6A, 6B
- Tłįchǫ Government (TG): 7A, 7B, 7C

Note that Nunavut delegates were not present during the first day of the workshop due to cancelled flights. Delegates from the YKDFN were absent for unknown reasons.

The following observers were present on the second day of the TK Workshop:

- Kitikmeot Inuit Association (KIA): 8A
- GNWT: 9A, 9B
- NWT Wildlife Federation: 10A
- Government of Nunavut (GN): 11A
- Dominion Diamonds: 12A
- Wek'èezhìı Renewable Resources Board (WRRB): 13A
- Barrenground Outfitters Association: 14A
- Beverly and Qaminirjuaq Caribou Management Board: 15A
- 16A (PhD Student)

The BCRP Project Team prepared a proposed draft agenda (Appendix A) based on feedback from previous BCRP community sessions; identified "gaps" in the BCRP process where TK might provide particular insight; and a strong understanding of current issues with the Bathurst caribou, in particular, the damaged relationship between caribou and people and the sharp decline in population over the last few years. The proposed agenda and guiding questions were reviewed and approved by participants at the outset of the workshop.

Discussions throughout the TK Workshop centred around the following guiding 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?

Before the BCRP Working Group can consider how to meaningfully integrate TK, a broader discussion one at the forefront of the hearts and minds of northerners—needs to take place around how to heal the relationship between people and caribou. Indeed, this is the "elephant in the room" and provided the starting point for discussion for the TK Workshop. Accordingly, facilitators provided a quick overview of the conditions and events leading up to the TK Workshop based on their collective experience working with Bathurst caribou herd communities and hearing the following common sentiments:

- People have been talking about the problems related to the disappearance of the caribou for a long time.
- Elders have been talking about the relationship between human beings and caribou and our responsibilities.
- Back when the world was new, there were agreements made between people and animals; there is concern that we have broken those agreements.
- The traditional laws that have been in place for hundreds of years have been broken and this is why the caribou have left us.
- Some elders have been saying that we need to go back and talk to the caribou and see what they need from us as human beings to allow them to come back.
- Need to go and make amends, apologize to the caribou so we can clear the way so caribou can speak to us again and tell us what they need.
- Elders have been trying to help by sharing their TK.
- TK shared by the different aboriginal groups is really valuable.
- Some Elders say what we are doing is not enough; that what we are doing and what government is doing to prevent herds from disappearing is not enough and not working.
- Elders have been frustrated for a long time about not having a place for the spiritual connection with caribou to be understood and relevant to decisions related to caribou management and caribou habitat.

I've been at these meetings a long time and we are going to tell you again what we told you before but I think we are going to have a really hard time because we know the problem but people are listening but they can't do anything about it because of industry so I don't know, we might be wasting our time unless we are going to do something very serious to make it work. — 6A

Participants opted to work as one large group rather than smaller break-out groups and remained in a talking circle formation to encourage open conversation between all participants. A key element of facilitation was to record key points, themes and quotes on large 'sticky-notes' that were posted on the wall (Figure 1). As the workshop progressed, key themes emerged under which each post-it sticky-note was then organized. These themes became the 'bones' of the TK Workshop (see Section 3) that ultimately informed the recommendations (see Section 4).



Figure 1 Key points, observations, themes and recommendations were showcased on the walls during the workshop to form an evolving record

The workshop was audio-recorded and transcribed nightly. Verbatim transcripts were critical to "getting the words right," which is important given a legacy of Aboriginal peoples feeling that their words have been misconstrued or appropriated. With quality simultaneous notes, it was possible to present a list of preliminary recommendations, observations, and other key findings for participant comment on the final day of the workshop (Appendix B).

In an effort to continuously improve the BCRP, an evaluation form was circulated at the close of the workshop. Results from completed forms combined with comments shared during the closing circle suggested that this initiative was a success according to participants (Appendix C).

The document includes a mixture of summaries of key messages along with quotes from session participants that give examples or bring alive the messages with a story. We hope that this will make the messages more meaningful and useful for both Aboriginal communities and the BCRP.

3. Proceedings: Key Themes

The following important underlying themes guided discussions throughout the TK Workshop:

- 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. Youth must be taught how to respect caribou and given opportunities on-the-land to learn the caribou way of life.
- 8. People predicted caribou populations would decline.
- 9. People feel strongly that TK should have been accepted as fact earlier.
- 10. Everybody must all work together: all people of NU and NWT as well as community members, biologists and other resource people.

Each of these ten themes is elaborated in the following sections.

3.1. Renewing the Relationship between Caribou and People: Respecting Caribou Determines their Well-being

The first theme of the workshop was that 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.

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

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

Talking to the elders to respect the caribou is never to leave antlers where the routes are. I don't know about the Dene land but in Nunavut we have markers and we are told not to destroy them because those are the caribou paths. A lot of times the elders are right but no one listens to them. -3A

Part of the spiritual work is to work on the traditional trail system that goes all over the land. That's how you meet the animals, and go to the grave sites, and that's what we are trying to do revive the trails. We traveled from Gamètì to the barrenland and we revived that trail system, the trail hadn't been used in 60 years so it took a long time to find the trail. So it's important to open that up so people can go and build that relationship and learn from the land. — 7C

The Dene drum: we need to bring that tradition back, that's what will bring the caribou back. They hear that and they come back. I think we can't tiptoe around things that are happening in the core areas with industry and it's something we need to tackle head on. It's something we always seem to shy away from that because industries voice is strong and I feel like even since we started things have been going backwards. When you hear that Nunavut just opened calving grounds to development, that is something we should be talking about here, those are big problems and we should be able to talk about that and not shy away from it. -1A

Disrespect threatens caribou well-being and causes fractures in the relationship between people and caribou. Workshop participants spoke 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

When caribou are respected, they will give themselves to people:

I have heard that I am a good hunter. In reality I am not that good but I leave my community, I usually take a few people with me. I do a prayer, I talk to the caribou, talk to the animals ahead. What I want to do with it, that I have to feed people at home. I speak to the Creator in my language. People are looking for caribou all over the country but the caribou find me because they know what I am going to do. I am really lucky. I know the animal and I know where to go but the animals gives itself to me. I appreciate it. When I use my own language I break down, it is too powerful. — 6A

A lot of things happening related to caribou because we love it and we live with it. The caribou come back from the north for people to use them. -7A

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. When I was thinking about this I don't blame younger woman but younger men too. — 7A

Workshop participants recognized that the relationship between caribou and people is suffering and, through this awareness, are taking the first steps in healing. They acknowledged the need to help people learn and understand the historic relationship between people and caribou and how traditional laws maintained the integrity of that relationship.

3.2. People Depend on Caribou

The second theme of the workshop was that people across the range of the Bathurst herd have long respected and depended on caribou for subsistence and sustenance, extending back to the time when caribou and people could speak to one another and people could become caribou. The years when caribou migration routes came close to camps or communities meant health and wealth in terms of clothing, tools and more.

Because this food, if you were to replace all the caribou meat that is used in Nunavut, it would cost 20 million dollars to replace the caribou meat they eat every year, so when those caribou are gone who's going to pay for that? Not to mention the way of life, and the cultural way of life. They live on caribou, they depend on caribou, they think caribou, and everything is centered around caribou. -6B

These people [Europeans] are coming to our house. Europeans have a fence around their yard and keep it clean. The range of the caribou is our yard, our life. We have to look after this. - 6A

People have always expressed deep gratitude and reverence for caribou for offering themselves to people. Although people are not as dependent on country foods as they were in the past, people continue to depend on caribou for their cultural identity. Elders have been known to slip into depression and lose their health without caribou, not only from the absence of caribou meat in their diet but also because they "miss being with them" spiritually.

Just like to say that times have changed a lot from when we were much more dependent on caribou. Time has come for us to carry out our part of the deal. Caribou took care of us, when we had nothing else, we were totally dependent and that's why most of us are here today. It's an interesting relationship we have with caribou: at the same time as being our loved ones, they are our beautiful food. Now that we know the trouble that the caribou are in is largely our own doing we have to do something to help them back for getting us here today. — 5A While people have always understood that the relationship between caribou and people is grounded in respect, they have also depended on caribou so intensely that there were times when people flowed between the caribou and human worlds and were able to speak the same language.

3.3. Traditional "Management": People Understand Caribou and are their Guardians

The third theme of the workshop was that, for generations, people have considered caribou populations, migrations, behaviour and well-being through people speaking the same language as caribou and transitioning between being a person and caribou. The incredible closeness between or melding of people and caribou, has meant that respecting and taking care of caribou are part of traditional laws. For example, workshop participants explained that respecting caribou was to act as their guardians:

And the caribou do understand human people. Even though I go by myself on the land. I understand because I have been there. All the animals do understand you. All the animals that are migrating are all suffering. It is not only the humans because they are not getting meat. There are animals that are skin and bones...starving. -4A

We are related to caribou. - 1B

They say leave caribou alone. Caribou is not going to talk for themselves. Help our generation to go slow. Today because they have high-powered machines they can go far in one day and come back. In dog team day everything is slow and being take care of well. — 7A

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

Discussions during the workshop provided clarity on how people moved back and forth between being caribou and living in relationship with caribou:

Way in the past, animals have been human beings. - 6A

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 be taking of, this 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. Before my time. They call the K'awoo [hunting leader], the boss, people follow him because he is a 'lucky' person with fish or moose. — 7A One participant gave a particularly strong example of the interconnectedness between people and caribou:

I'm not speaking 100% [my Aboriginal language] anymore. That is something to look at, the disruption from my culture. I cannot speak 100% [my Aboriginal language] all day because I am not with my elders anymore. I look at the migration routes in the same way. We are leaving something out in between, [there is] a void in between the migration route. There is a void in me. . . . That is the way I think. The way I speak is just like a migration route. My life has been disrupted because I am not speaking 100% Inuinnagtun anymore. — 2A

One workshop participant explained that a caribou spirit can come back two or three times, but only if it is respected.

Workshop participants explained that, given people are caribou and caribou are people and people must be guardians of caribou, it is necessary for people to speak on behalf of the caribou:

Everybody lives on caribou and eats caribou. Everyone is after the caribou, so of course they have problems. Like elder 7A says, caribou don't talk, that is why we are here for them. I learn and listen, they all have the same message. We have to get the leaders to help us and take direction from our people. -6A

The caribou is really important. The caribou doesn't talk for itself and we have to talk for him. How can we help in any way? We put something there for our future generation. If you have seen this, you follow the way. Then you can live with the caribou a long time. That's the way I was looking at it. By listening to others, leave them alone but not forever. — 7A

Since northern Aboriginal peoples have always "studied" and "monitored" caribou numbers, migrations, behaviour, and well-being, they feel a sense of urgency associated with recent and profound changes in caribou. Never before have people felt it is more important to take care of caribou and to act as their guardians.

We all have different things to do so there is no time to do things with others unless they see something written this is the only time they look at it. -7A

I think the harvest information is a very critical piece of the puzzle as to what is going on with the herds. -6B

Workshop participants explained that some groups have voluntarily stopped harvesting in order to help bring numbers back, even though this is very difficult:

It doesn't benefit them to stop eating the caribou, it's not something they want to do, but it is something they will do to preserve the caribou for future generations. -7B

The elders they have been raised on caribou meat, they crave it, they will do anything to get it but it is just so difficult and the herds are so low that we don't want to impose any more hardships on the herds that are being depleted. So we start hunting more moose and more buffalo. -6B

We aren't waiting for government: we are the first to stop hunting the Bathurst. I hunted all my life. This is the first year that we are not going to hunt caribou, any caribou, we are buying meat from the south but we are already doing this. I went to the elders and they weren't happy about it, but I said let's try it for one year to help the caribou, if they like the beef and the buffalo from the south maybe we will do it again next year. — 6A

We are encouraging people to try and save the caribou for the future and are exploring different things [meat sources] for our community. -2B

We passed a motion that the Métis in the south Slave weren't going to access and hunt the caribou until the numbers come up and we did this voluntarily. -6B

In summary, being caribou guardians requires that people listen to caribou, manage themselves, accept sacrifices, and breathe life into traditional laws: the true challenge is to "manage" people and the way they use the land and treat animals.

We are always trying to manage animals, I never seen one human management board that is managing the humans that are hurting the environment through industrial activity. - 6A

3.4. Caribou Face Many Threats

A fourth theme was that human activities threaten caribou around the circumpolar north, with the Bathurst herd being one of many to decline in recent years. Workshop participants spoke of threats from various perspectives ranging from a high-level or global scale through a regional or range scale through a low-level or localized scale. Global change, atmospheric fallout, industrial development, overhunting, forest fires were mentioned. Predators were also cited as a key natural threat. Cumulative impacts were recognized as a driving force behind caribou decline and degradation of their habitat.

In the late 30s, Giant Mine was developed and caribou moved away. After that the caribou started moving away from people. In 1925 Łutsel K'e became settled and caribou again moved away. After this the caribou hardly come this way. In 1979, I fought fire and this whole country is all burnt [south slave]. 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. Then after that they have the mines kick in so the haul roads interfere with the caribou crossing. — 7A

We did a TK study combined with science looking at the food around the mine around Diavik and as Joseph was saying at 30 km away from the mine, it was almost normal,

but the closer you got to the mine the more dust there was and the less sign of caribou. Harry Apples said the [East] Island [Diavik mine site] is dead to caribou, caribou don't go there anymore. -7C

Workshop participants explained that human expansion and development across the range of the Bathurst herd (itself an act of disrespect) has changed the relationship between people and caribou such that caribou fear and are no longer happy to see people anymore. Caribou were said to have started to move away when communities, roads and development came to the North. Workshop participants cited the fact that the Beverly and Ahiak caribou stayed on the coast this year as evidence that caribou are "staying away." Other factors such as climate change and increases in predators have also changed caribou.

3.4.1. Mining Exploration and Development

Mineral exploration and development across the range of the Bathurst herd, particularly since the 1990s, largely explains caribou decline according to participants. Workshop participants spoke to the cultural dilemma they face, knowing that the strong relationship between caribou and people depends on the ability of people to respectfully harvest caribou and for caribou to offer themselves to people and yet recognizing that mining provides some opportunities. Some elders have indicated the need to apologize to the caribou for allowing industrial development to take place even while they expressed their fears that such activity could hurt the caribou.

In [my area] we have [several] mines near us. The Bathurst caribou, the last time we saw them was 1995. Our tradition suffers when we don't see them and we can't stop hunting caribou and if we stop that we are going to be suffering. The government would be happy and give you money right now. Look what they did to us the pollution, the mine industry, look at the environment around us. The reason I, I'm not saying not stopping or reducing but it's our right so I will continue, it doesn't matter right now: we don't have any caribou. We went to Manitoba to get caribou this year. I have been growing up in the wilderness and I still today harvest other animals like moose, muskox. Moose that's only a season, just temporary but caribou is our full time. — 1B

A suggestion was to carry out assessments on how many jobs versus caribou are "needed" by communities and to plan mining operations accordingly:

I think we need a needs assessment done in every community, how many people are there? How many jobs are needed? How many people want training and need training? That can do the jobs and from there you can kind of gauge as to what amount of industrial activity that will take place within that region. Also a needs assessment for caribou, how many caribou are needed for these people to live the way they used to be. — 6B

There are all those mines out there do we really need that many mines?... In my community there are only a few people that work in the mines but we get a big impact

from no caribou. We don't benefit from the mines but we sure feel the impact and they are impacting the caribou. How many mines do they need? - 6A

In our country there is no place for the caribou to hide, a few eskers its flat and pretty easy for a human to travel so we have to get a message to the government that too much activity is not good for the animals. - 6A

In recent years, the clustering of developments around the Lac de Gras area has created a barrier to caribou migration. As such, workshop participants explained that caribou migration routes have deflected away from the traditional crossings such as "the Narrows" (known as at "Nàk'ooaa to the YKDFN) between Lac de Gras and Lac du Sauvage.

These people that always had caribou, this year they had none. . . . It goes to show the hardships these people have to go through. The only place to get caribou is in Nunavut and even some of those places it's hard to get, the caribou are staying away from development. There is probably good food and no disturbance. Maybe after a few years those caribou know to stay away. There is nothing. I think Nunavut is seeing the same thing. — 6B

If you look at it right from the Bathurst Inlet there's a fence. The caribou come down here, this whole country is burnt here, the whole lot of it. It is just like a fence lined up so the caribou follow it but don't cross it, they come here then they change direction, they move on. You change or destroy their food on them and they move away. There is too much activity [so] they move... So you really have to watch caribou you can't disturb them too much. The mines are lined up like a fence and the caribou follow the fence, they get deterred and now they are gone way down to N Saskatchewan. The food was burned and changed, then you add the fence which is the barriers created by mining. - 6A

Research carried out by the Tłįchǫ (Dedats'eetsaa: 2016) affirms this perspective:

One of the assumptions we made was caribou come from the north and they migrate through the area but the elders say they are blocked by the mines so instead they moved to the east and the west. So that's the assumption: if you destroy food in one area, what happens to the migration of caribou further away from them? . . . Caribou start to associate this noise with people and so they try to stay away. Where before caribou would see people and be happy, now they see people and run away. Now you have miners on the land so you create a different relationship. Habitat destruction but also they don't want to go towards people because of fear. — 7C

Industry itself is on the migration route. It is splitting the migration route in half. Industry and whatever is happening out on the land. That is destroying the migration routes, the mines and projects on the land. You break that migration route. Once that caribou are migrating, their migration route is split if there is something in front of them that they don't like. Once they see it, they will always look at it [that way] for the rest of their lives. -2A

Roads and power lines were mentioned as threats to caribou:

The only place to get caribou is Nunavut and even some of those places it's hard to get, the caribou are staying away from development. There is probably good food and no disturbance. Maybe after a few years those caribou know to stay away. There is nothing I think Nunavut is seeing the same thing. Baker Lake has a long 112 km road and caribou are starting to stay away from there now as well. - 6B

When they put the power line in we haven't seen caribou past it since it went in. Lots of noise from the power lines. Lots of caribou south of Cree Lake in Saskatchewan. South of Fond du Lac. Before they build the road to the mine, caribou were there. -1B

Finally, dust from roads and mining activities such as blasting has affected caribou and important habitat according to workshop participants. Caribou are like people and don't like their food covered.

Dust on caribou food is like pepper on mashed potatoes for me. I don't like pepper on my mashed potatoes, I won't eat it. Caribou do not like dust on their food and even though it may not have chemicals in it, they don't like it and will go somewhere else to find clean food. - 6A

I think the last 3 or 4 years ago, we did research about 15-20-30 km south of the first mine and we took samples all of those caribou foods and brought it to the camp and then every few km closer to the mine, as we got closer to the mines it got dusty and dustier the closer to the mine. -7A

The caribou couldn't go near the mine because they couldn't eat anything. -7A

Animals need the plants to be as clean as possible from dust. -2A

One of the Tłįchǫ elders did study around mine sites. 30 km outside in to the mine. Caribou migration they cannot use that land no more. Caribou threw [what used to be] the better land away because of what is on that land now. — 7A

Some workshop participants suggested ways in which mining operations could be improved to manage impacts:

They need to put bigger filters in their plants, they should use better fuel, the cheap fuel they are using sets off a lot of emissions in the air, also all their haul roads should be

watered down not with calcium because calcium brings all the animals in they all want that salt, when they blast they should water it down to keep the dust down. — 6A

Throughout the workshop and in other caribou-related events, many Elders have shared their beliefs and fears that too much exploration and mining within the caribou range would result in caribou population and decline and loss, long before the mines were established. Their fears have come to pass and they believe that the cumulative effects have proven to be too much for caribou. They feel that they have sacrificed too much: in exchange for mining jobs, which have not met expectations, they have lost a major food source that had sustained them for thousands of years.

3.4.2. Environmental Change

Participants shared their observations of how global 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 these times of intense fire activity. In addition, caribou were said to be scared away from other animals encroaching on their range.

Another thing, talking about buffalo. This range that is moving slowly to the north. At the same time moose and caribou are moving out to the barrenland. Four years ago we saw moose, beaver and muskrat at Courageous Lake. Never seen that before. All these buffalo are moving after them. Not only buffalo, but there are porcupines in my community. They are scary animals. Porcupine quills got into dogs last summer. These animals in the south are coming way north because of warming. What will happen with animals we live with? Abandoned mines and exploration camps on the barrenlands, there are a whole bunch of them. Caribou coming down they start to see the things that were not there before. -7A

I think the biggest problem is predators and other animals taking the feeding ground. -3A

Burned areas were also cited as causing shifts in migration routes, particularly in the last few years, as climate change is causing more fires:

All these camps that they are blocking the caribou migration and we need that cleared up, its their road. . . . If something is blocking them, they can't go through it, they go around it. So this is why we want to clear all the barrels and tent frames everything that is laying around in that area should be taken out. -7A

The natural global warming has gotten stronger over the years because of industry. We have to look at cumulative effects on everything and the way the communities are experiencing what they haven't seen before. We have grasshoppers and they are migrating in certain ways, industry is giving a lot of cumulative effects by what they are bringing to the north. -2A

In the Tł_ichǫ 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. -7A

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

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

Workshop participants spoke at length about how changes to the government burn policy and current forest-fighting practices have led to loss of key caribou habitat.

They fought fires in the past to protect the caribou range. Nowadays they don't fight fires, the only place they fight fires is around the communities so all the lichen and caribou moss is burned [in the south slave]. - 6A

Back 20-30 years it was all burned down (South Slave). When you fly from Fond du Lac to k'e it's all burned, all gone. No food for caribou, nothing to eat. — 1B

3.4.3. Predators

Workshop participants explained that predators are driving caribou populations down.

Predators are the most that are killing off the caribou. Too many wolves and grizzly bears back home. Muskox populations are really south now from our areas. In the past I always tell people that we control wolverines, wolves and grizzly bears through use of furs. -2B

They pointed out that traditionally people actively harvested caribou predators. It was common for a trapper to harvest several hundred wolves and to also hunt grizzly. Now there are so few full time trappers and these populations have grown significantly and have added significant pressure on the caribou. Several participants expressed the need to reduce the wolf and grizzly populations as they have experience with this being effective in maintaining a balance.

3.4.4. Cumulative Effects

Workshop participants expressed their frustration around the cumulative effects of human activities across the range of the Bathurst caribou. Everything from global warming to mineral exploration and development to forest fires were said to be causing shifts in the locations of migration routes; areas for over-wintering, calving, and post-calving; and overall caribou well-being.

Global warming is blamed for everything but that global warming is caused by people and the country is drying up. Of course it's drying up. If you look on the Slave River, six dams on the Peace River. Fort McMurray is taking half of the water. The fish in the river can't even be eaten. I flew over Uranium City and looking at the tailings pond, there was a yellow fluid that flows into Lake Athabasca. There is a dam on Snare River. And then they say the water is naturally dropping! — 6A

Warmer temperatures are also having an impact on caribou health:

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 hooves can't dry out... Also we are getting moose way up on the tundra, and these moose have different diseases and we don't know how the caribou will deal with these. -6B

This is one of the problems [mining corridor] there are mosquitoes, water, air, hunters, food is burning everything is against the caribou $\ldots - 6A$

Finally, disrespect and wastage of meat were said to be another reason why caribou populations have declined:

One of the biggest contributors to caribou decline is wastage. The amount out there is terrible. I have to bring it up it is part of the responsibility of everyone in the room. We all have to bring this up to the young people and show them that it's not right, that if you kill a caribou you have to respect it. Just because there are lots, don't just take the legs and leave the rest. Every caribou matters. It matters to every person living on the land. When the caribou don't come back people used to starve. — 6B

Protecting key habitat from these multiple threats was at the forefront of discussions ranging from key caribou crossings to land bridges to calving grounds.

The tataa [land crossings] is one of those concepts and one of the areas that should be protected. . . . Caribou go east or west after these blockages, what happens when you put a mine there? The elder Harry Apples says the island is dead to caribou maybe we should put something there to protect certain areas. -7C

The tataa that he is talking about is in between the Lac de Gras and Mackay Lake they used to use when coming back from the north... They are still doing the same thing but not many animals anymore crossing it should be really protected. — 7A

Also in Nunavut we strongly feel about protecting the calving area. The hunters and trappers organization, the Inuit Regional office in the Kitikmeot region, tourism, exploration camps, supporting us and Nunavut [Wildlife] Management Board is supporting us. We have to work together and it takes hard work to get to that goal but we cannot give up it is our main food. -3A

3.5. Caribou are Smart and can Adapt

A fifth theme underlying the workshop was that caribou have long been recognized as smart, sensitive and alert animals and are known to adapt to human disturbances of various types and scales. As elaborated in the previous section, workshop participants spoke of how caribou have adjusted their migration routes to avoid mineral developments or burned habitats; they know where to find good food; and they know not to overlap ranges with other animals who may be eating the same food. Aboriginal peoples also know that herds will break up and join other herds. The question outstanding is whether these "adaptations" will enable caribou well-being and survival.

They are smart animals. On calving grounds, there should not be mining and exploration. Calving grounds should be kept the way it is. Nothing should be built, no mining or roads. — 7A

Dogs were the only means of travel in those days. The dogs understand. The caribou will never wait for you when you travel with a dog team. When you hunt a caribou you have to sneak up on them. -4A

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

3.6. Youth are the Future

Another key theme expressed by participants in the TK Workshop was that youth face profound challenges today as they try to balance two worlds: the old and new as well as the traditional and modern-day. At the same time, there is worry that youth do not know enough of the traditional laws and so will not be safe out on the land or able to show the necessary respect to caribou. These are challenges facing all communities represented at the TK Workshop.

A lot of these kids, get them out of the house from the TV. I've seen guys out hunting caribou. Their dad is out in a snowstorm cutting up a caribou and both boys are sitting in the truck. They have to know how to survive and they have to get out there. The elders aren't going to be around forever. Other kids in the communities don't have the luxury of growing up in the bush; somebody has to teach them. -6B

Nobody thinks of pulling the sinew for the moccasins, nobody pulls the kidney fat out for the elders that want it. It's not total use of the whole animal. It's going to take a long time to get a new generation to have half the respect that the elders really had. — 14A

Today the environment, younger generations with drugs and alcohol, how do we get them to go back to the land? We need this kind of recommendation to get the young people to go back to the land. -1B

I see all the young people in our community of Kugluktuk, some have never been out on the land. I see them chasing hikhik [ground squirrel] and chasing ptarmigan. They are made this way. We are made to provide for ourselves and we chase ptarmigan, birds and hikhik. That is Inuk culture in him or her instilled in him because of his culture. He wants the hikhik and that bird and that animal. We depend on these little hunters and gatherers. The way I look at it, other cultures trying to change our way of living and cultural way of doing things. That is a lot of money available to change someone's culture. -2A

We hunters respect what we catch. The harvesters have to educate our younger generations. The younger generation has really fast machines and really fast rifles. The younger generation are not like us they are stuck between native and non-native. We have to teach them how to harvest and not only caribou. Need to teach generation to generation. Pass on knowledge to them or all animals will keep declining. — 3A

People recognize the importance of ensuring that traditional knowledge is passed from one generation to the next:

In the old days, they hunt with snowshoes and walk after caribou. If they want to kill them they have to follow them until they get it. They look at the weather too and sometimes it changes. That is how they follow the animals, the way they hunt. So this is the culture that we have left on the side. We are not white but we follow these people. We don't know where we are going but we follow them. We need to come back and figure out where we left off from our traditional laws. It will take a long time to do that. -7A

What I am telling you now is how I lived through the land. I have been everywhere out in the barrenland. There are trails all over that I have been on. The way the men work is how I worked all my life and lived on the barrenland. I don't say it is so hard to work.... The young generation is going to be suffering and it will be hard [without caribou]. We are leaving our rewards [teachings] for the young people for the ones that are listening. — 4A

We need to keep them out there and teach all four seasons. There is lots to be learned. Some of our children have been doing that. No one wants to be out on the land without money anymore. In communities they are breaking cultural rules. . . . I think if we as natives across the north and have teachers living out on the land for the full seasons. So we can have a school, send them to these people on the land. . . . A one week project is wasting money. That child in one week will look at it but in another week he will forget it again. Needs the full experience of the four seasons. — 2A I think it's a really key point to try to find a way that's grounded in the traditional knowledge of respect for caribou that can help the next generation who are going to have all these new tools [technologies, models, collar data, etc.] coming up, we have to find a way to use the respect and knowledge have to guide ourselves before it becomes a problem. — John Nishi

Participants discussed some of the hard choices needing to be made around balancing industrial development opportunities with their costs. Advice was given on how development could be more accommodating to northern cultural ways:

If we don't open the mine our younger people won't have a job but if we let them open the mine then our children will have jobs. — 7A

We want more people working and the mines have to take into consideration that. These people, they were traditional users of the land they are not used to a job 6-6 or 9-5 or whatever, a trappers routine is a little bit different, you get up when you feel like it and go when you feel like it so when they have a schedule for two weeks then they go home for two weeks so they have a schedule they are not use to so you have look at the and try to be flexible with these people, be patient with them, not the minute they don't show up fire them you have to look at the way they use to live and blend it in with your style. So look at that aspect maybe get a month off here and be more flexible and try to accommodate their life style too. And I think you will find a lot more people working at the mine. — 6B

Workshop participants expressed concern about youth and spoke to the importance of making sure that youth are taught well in both worlds. People recognized that youth are the future and how they respect caribou and balance human activities in a world of opportunity and cumulative effects will influence the future of the Bathurst caribou. People commented that the work they were doing will benefit future generations.

3.7. Caribou Populations / Numbers Change

The seventh theme was that people across the range of the Bathurst caribou herd know that caribou come and go and that their numbers increase and decrease in cycles; however, most workshop participants explained that never in living memory have numbers of the Bathurst caribou been so low.

My ekwò, where did it go? — 6A

Today we thought we were lucky, except the last 15 years. I keep thinking why they are declining? Always going down, worse and worse. I live with the animals and love them. -7A

At the same time, a few participants shared that they didn't think that caribou numbers were decreasing but rather going elsewhere to forage and join other herds:

The caribou are not declining. They will come back and migrate again. They are not disappearing they are going to other areas to have food to eat and join other caribou. This is what caribou people know. That is how the caribou are travelling, they migrate all over and return again. -4A

Participants have lived through many cycles in wildlife populations in the past and remember hearing stories, if not their personal experiences, of years when the caribou migrations did not come close to their camps or communities.

As an example, we had lots of Peary caribou, we had lots of them, and they are small little white caribou. They have disappeared and 30 years later we are starting to spot them again. 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. Resource people are helping us by inviting us and our elders to workshops. — 3A

Whether caribou numbers will increase again or whether they will come back to people was said by some workshop participants to be in the hands of the Creator:

None of us know when they will come back to us. Only the Creator knows. We have to rely on the Creator maybe then we will get the caribou back. That is how my grandparents would talk to me. All these young students they do not understand me, some do but most have lost their language and it is very difficult to teach them. This is a little story that I wanted to share. We are talking about caribou. They are declining and having problems. Sometimes in life we go through hardships and this is one of those times. Those who remember what I said maybe in the future it will get better for us. The elders used to look ahead to the future and that is what is happening today. — 4A

Disrespecting caribou, for example, through specific actions was also blamed for lower numbers:

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 Wekweeti 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

3.8. TK Should Have Been Accepted as Fact Earlier

A common sentiment—the eighth theme—that continued to seep into discussions was that, owing to TK, people "knew better" or "predicted" that caribou would decline with increased development across the range of the Bathurst herd. Participants recounted their experiences voicing their forecasts at environmental assessment hearings, workshops and meetings, particularly since the mid-1990s. People expressed their frustration around feeling like their Elders (or they, themselves) were not heard:

When I was less than 20 I heard a prophet say that someday there won't be any caribou. That is what they were saying which is what is happening now. -7A

It's kind of interesting what the elders were predicting in the 1990s and 2000s 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. -7C

To me as a harvester, as chair of Kitikmeot Regional Wildlife Board, my elders are the power. That's what should have happened in the first place. Biologists and mining camps should have listened to our elders in the first place. -3A

The way I look at it is we know the problem. Traditional knowledge tells us the problem. Our people knew what it was like before industry came in or before Europeans came, how the animals used the country prior to the invasion of people. It seems like we moved out towards the west and the caribou have moved away from us. The only thing is when we do tell them the problem, what can or is going to be done about it? — 6A

We have been talking about this issue a long time. How come we haven't resolved it? Only way is to work together. We harvesters point fingers at mining companies. Government points fingers at us. -3A

Frustration about apparent inaction by governments was also cited as leading to caribou declines:

I commented on that and I was talking about for caribou populations. Is what we were talking about the reason being is they waited too long for collecting information on other herds and those herds are just about gone now? — 6B

When will government, when will action actually happen at an early stage, when Aboriginal people are seeing these problems? Why is it taking so long for actions to occur? Why does it have to be at risk before they do anything? And I have lost my voice, I'm tired of saying it. It's time to listen and act early, rather than late! — 8A

Our experience . . . surrounded by . . . mines, they have seen a whole lot of changes to the environment, changes to caribou behavior, and the whole migration doesn't go south like it used to. You hear time and again industry coming into communities telling you all this and industry saying well our monitoring doesn't show any impact to the caribou or the environment. It's kind of a slap in the face of all this knowledge. I think in a situation like this, our recommendation to industry would be to take it, listen to our knowledge. — 6A

Often people are consulted and nothing comes of it. I have been sitting in these meetings for 30 years would be nice to hear back what has become of these meetings. - 10A

The current status of the Bathurst caribou herd combined with threats facing their habitat calls for new ways of listening to and hearing one another; honouring frustration through meaningful action. With commitment, people can map a new way of working together.

3.9. Working Together for Caribou

The ninth theme was that participants expressed their interest in continuing to work together across the range of the Bathurst herd, regardless of their feelings of frustration around not being heard or having their predictions recognized. They emphasized that collaboration across territorial boundaries was important—imperative even—to "taking care" of caribou.

I strongly feel our wildlife is important to us. Doesn't matter if you are from NWT or Nunavut, we have to work together. A lot of biologists and miners make good money. They buy their food. The Dene and Inuit people live on caribou. That's the way the resource people and biologists need to think about it. -3A

Something that we need to do, healing the caribou and trying to work with these animals, we have to do it all together: that's the only thing that we can do. — 7A

The elders have a strong power on wildlife, whether its caribou, wolf, sea mammals, they know it but no one listens to them. Before it's too late, we have to work together whether from NWT or Nunavut. We have to protect our wildlife. — 3A

Workshop participants expressed support for working together, but at the same time, criticized western science/biology for not being holistic, appropriate or "right" in some situations related to the Bathurst caribou herd:

We know everything about our country because this is where we are from. Not only in legend. But passed from our grandparents and their grandparents. I live by two laws. Traditional law the law of the land. . . . We have this whole range and we share it. We not only share the minerals, food but they have to share our knowledge too. That's the only thing they don't share because they won't listen, they don't understand. Scientific knowledge is grade 1. Scientists need to start listening to traditional knowledge. — 6A Science they tend to know a lot of things when they take an animal apart, anatomy of any animal, they know the science part of all the insides. But they have not lived out on the land like we have for thousands of years. We know the whole picture not just the inner parts of any animal. Scientists they learn that by looking at the scientific way of doing it, taking things apart, that's their way of doing it. We need to meld science and traditional knowledge at all times doing projects out on the land, especially mining companies who might be working out on the land. We need to work more closely together. -2A

It's good that we do more workshops like this, trying to make a really good decision and do something about this, just a few groups will go home. We all have different things to do so there is no time to do things with others unless they see something written this is the only time they look at it. -7A

The next 20-40 years—even the next 10 years—is going to be crucial to maintain a relationship with the caribou and the caribou need to be there to have a relationship. I think there is experience around the table. The classic argument the concerns from peoples saying they are wrong and I guess the one thing we want to try and do is work together and I see on the one hand we are very good at knowing where the caribou are and when they are available we can harvest them. Collectively its very difficult to reduce the harvest before there are really strong signals, before there are real problems. — John Nishi

Mahsi we did a lot of work in the last few days, we did hear each other and we talked about wanting to work together and goals we want to reach, because if we stay together things might happen because our previous elders have been pushing that. We need to help one another and do it together. -7A

Healing the relationship between people and caribou and ultimately supporting the Bathurst caribou herd will begin when people work together, for example, as per the recommendations put forth by participants in the TK Workshop.

4. Outcomes: Recommendations

You have to have the concrete items on the table in order for an industry plan to take place so I think industry development has to be engaged at a pace that is compatible to the people and the land—what it can sustain so that land does not take a back seat. -6B

By looking at these other places, you learn from people. Friends of ours, you know, we try to help one another to make clear recommendations for the future. This is what we try. -7A

We need to figure out something that everyone will agree on. Otherwise we will come out of this with nothing if we don't think of something that all the ministers will sign. -12A

Building on the themes shared throughout the workshop, participants put forth ten key recommendations outlined in the following section. These included:

- 1. Renew spiritual relationship with caribou
- 2. Carry out an on-the-land healing ceremony
- 3. Teach the youth
- 4. Curtail mineral exploration and development: how much is enough?
- 5. Protect key areas (e.g., calving grounds, caribou crossings, land bridges)
- 6. Increase on-the-land monitoring (i.e., community-based monitoring)
- 7. Support incentives to encourage people to reduce hunting caribou (e.g., alternate harvest, subsized meat)
- 8. Improve the historic range of the Bathurst Caribou
- 9. Review firefighting / burn policies
- 10. Repair / reclaim damaged habitat
- 11. Look to other successful examples
- 12. Trust / honour TK

1. Renew spiritual relationship with caribou

Workshop participants explained that their spiritual beliefs and laws governing their relationships with caribou are critical to the health of caribou and that the relationship must be healed if the caribou are to return. As part of this, people must also heal their relationship with the land before the caribou will return. Most importantly, people shared that healing required work through the heart and not just the head. Reinstating spiritual practices such as paying the land and water when traveling or working will help make people mindful of the spirits of the land and conscientious of their behavior.

In the olden days, the feeding the fire is always what our elders did. I know that not many of us know that and we need to teach the youth so they can keep it going in order for relations between caribou and ourselves to heal. -6B

2. Carry out a healing ceremony

A key part of healing the relationship with caribou will be to hold healing ceremonies on the land. Workshop participants fleshed out what the healing ceremonies would involve, recommending the following:

- Such events should be open to all Aboriginal nations who reside within the range of the Bathurst caribou.
- The intent is to facilitate spiritual ceremonies based on the traditions of each group in a manner that not only respects difference but also allows each nation to carry out ceremonies and traditions that are sacred to them.
- Ceremonies such as fire feeding, fasting, dreaming, drumming and other traditions effective in establishing a renewed relationship with caribou would be supported.
- Such activities must include men and women, youth and elders and active harvesters. One objective is to inspire youth to commit to sharing this experience with other youth and a renewed spiritual relationship with caribou.
- These events would take place over a minimum of 4-6 days providing sufficient time for preparation and ceremony.
- Charter float plane transportation would facilitate the participation of elders who might not be physically able to travel by land or water.

There was debate about whether the healing ceremonies should be held together or separately by each Aboriginal group and whether they had to take place on the barrenlands or they could occur on the territory of each Aboriginal group:

It's a good idea but for my community, we don't have to go right to the range to speak to the caribou. We could likely do something on our own. We could go by boat and not by air-elders prefer travel by boat than plane. We might propose to do our own thing on the south side of the lake. - 6A

3. Teach the youth

Participants recognized youth as the future and the necessity of teaching them in the traditional ways. Meaningful time must be taken to teach them our history and worldview. They must learn through ceremony and by being on the land, practicing hands-on learning throughout all seasons. The recommendation to teach youth was presented with the following context:

- Our elders are passing so we need to be teachers.
- We must work together to teach our youth.
- Youth must learn by doing.
- There is concern for youth who don't know the traditional ways, set nets, etc.
- Teach youth how to take care of caribou.
- Work we do today is for generations tomorrow.

4. Curtail mineral exploration and development

Workshop participants recommended the mineral exploration and development be curtailed through limiting activity and/or staggering development and improving mining operations and/or practices. In addition, the question "how much is enough?" must be considered in light of cumulative effects. A limit to the number of mines operating at any given time must be set and this should be based on protecting caribou habitat as well as aiming to employ only northern residents. Exploration must also be curtailed.

They could have smaller mines for a longer time. Why take all the resources at once? There is a certain amount of wage economy that is needed but also to continue they're way of life, at one time and its slowly going to take over every community if we are not careful. 50 years from now there won't be anything left for anyone. — 6B

Enough is enough: How much development is enough to have a good life and live traditionally? I know they need diamonds, but do they need this many mines? It's too much. How much do you need? The people that are benefiting from the mines, I'd say at least 80% of those benefiting are not from here. I wouldn't trade my grannies dry meat for diamonds. - 6A

Workshop participants provided specific recommendations on how to improve mining operations to reduce their impact on the ecosystem:

The dust is the main cause and also the winter haul roads, they have to spread the trucks out a little more, right now they are what 5 minutes apart. — 6B

If there is a real recommendation coming out I would like to see something on the dust control, about the food and the dust. But what we can't do through traditional knowledge, we can't document the biochemical or what are the health effects. I would like to invite the industry or universities to meet with the Tłįchǫ government so we can set up a research program and then we can study that and the correlation. — 7C

5. Protect calving grounds, caribou crossings, land bridges and other key areas

One of the most discussed recommendations was the necessity of protecting key areas, especially the calving grounds of the Bathurst caribou. Protecting caribou crossings and land bridges was also seen as important. Specific action must be taken now to ensure that the Government of Nunavut does not open the calving grounds to exploration and development.

We have to fight for our animals and protect their habitat. We need to approach our leaders, it might take 10 years but we need to find a way of getting support for protecting habitat in the Nunavut area. -3A

In addition to protecting key habitat from human activity, workshop participants recommended that important areas for caribou be protected from fire:

We identified migration corridors for ENR. 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. We identified them over the last 5-10 years. They have been putting effort into initial attack on some of the priority zones. We used to have remote camps to fight fires in caribou habitat. Looking at reviving the remote camps to protect the green areas out there now. — 6B

6. Increase on-the-land monitoring (i.e., community-based monitoring)

Workshop participants recommended that Aboriginal peoples increase on-the-land monitoring in order to better understand caribou well-being. There were two types of monitoring discussed. One was that monitoring be undertaken in each community of harvesting as well as on the winter road system in order to add to a sense of responsibility to follow the traditional self-management system when caribou are at risk. The second was to reinstate traditional monitoring systems where anyone traveling on the land reports their observations of the state of the environment to their community, this is especially critical to identifying cumulative effects.

We want to start a monitoring program, we have been working with hunters because they go out on the land and they come back and report their knowledge but the hunters in Wekweeti are not hunting anymore [because there are no caribou to hunt] so we still need to be on the land and get the information so we want to have a team of eight hunters and do monitoring based on traditional knowledge observing the caribou, the food, see how they are impacted by the planes and mines so its continuous research and it is continuous research from a traditional knowledge point of view. I feel very strongly the traditional knowledge is what's going to bring the real answers to the questions. -7C

While monitoring was recommended, it must be done in combination with other actions:

We should have our own check point in Gamètì to see if they bring anything back but that's not the way it's set up right now. Care for the animals but it's not enough. Like me, if I go through this check point for lumber, these people that are working for us and the monitoring let's say for Bathurst how are we going to be watching it instead of teaching different ways? Some think different ways, we stop and tell them they shouldn't be killing these without a tag but "that's my right" that's the first thing we hear all the time. -7A

7. Support incentives to encourage people to reduce hunting caribou (e.g., alternate harvest, subsidized meat)

Workshop participants recommended that incentives such as subsidizing alternate meat food sources be explored. Recognizing the extreme costs of buying meat for people who are dependent on caribou and subsidizing replacement meat from the land will help alleviate the pressure people feel to continue hunting caribou. Further, where possible, help people share meat between regions (help one another).

Caribou is a main food source for a lot of the outlining communities and it would be more accepted by the community if there were some form of subsidizing the cost of food that comes in on the plane, then it will give them more of a reason not to hunt caribou. -7B

8. Integrate more TK in understanding the historic range of the Bathurst Caribou

Workshop participants recognized that the defined range of the Bathurst caribou herd is very difficult to draw on a map, and recommended that the TK be considered in future initiatives to delineate the range. Another option is to consider a "fuzzy boundary" based on TK. Specifically, the TK of elders should contribute to updating the historic range of caribou and include the period that this occurred.

9. Review firefighting / burn policies

More in-depth work needs to be done to understand the traditional fire management practices to inform firefighting policies of the GNWT, according to workshop participants. Loss of caribou feeding areas through fire contributes to the survival pressures the caribou are now facing. The cost of losing a critical and staple food source must be taken into account when setting priorities.

10. Repair / reclaim damaged habitat

Participants recommended that damaged areas across the range of the Bathurst caribou herd be repaired and reclaimed, particularly areas that are key habitat where exploration or development has left behind materials.

There are a lot of abandoned exploration camps a lot of abandoned camps all over the land and we see that when we travel, a lot of old tent frames and oil drums and we flew over South side of Ekati and there is a small land bridge and there is big old abandoned exploration camps there preventing the caribou from going there and elders are always talking about those and that we need to map them out and we should be cleaning those spots up so that caribou can use them again. -7C

11. Look to other successful examples

The workshop participants recommended that the BCRP Working Group look to other examples to guide the BCRP and how TK has been integrated.

Sometimes it's easier to look at things that have already worked so you don't have to reinvent the wheel. . . . If there are successful examples, the Porcupine, Caribou management plan which the GNWT is a signatory of, is a model to some other

jurisdictions but we seem to ignore it because it has specific ways of dealing with the population rise and drops. -10A

12. Trust / honour TK

Finally, workshop participants recommended that TK be recognized, honoured, and trusted as fact to improve the well-being of the Bathurst caribou herd. The reliance on science alone has proven ineffective.

From what Tłįchǫ are saying, caribou are not migrating where they used to. Same with our situation. . . . Industry has to look at that as fact and act on it, instead of trying to justify or defend and I think that would create a lot more trust and respect between the two groups if there was action done on the words of community on traditional knowledge. - 6A

5. Immediate Next Steps

In addition to the twelve recommendations above, the closing circle of the TK Workshop, several recommendations were presented as immediate next steps. These included the following directives:

- Lobby your organizations to protect the calving grounds
- Continue with TK programs in the NWT and NU
- Find funding to help caribou

Right now what I think is that we have to do more talking and more training and tell our younger people to protect this animal. -7A

We have to come up with funding to recover the caribou. It will take a long time. -3A

6. References

Dedats'eetsaa: Tłíchǫ Research & Training Institute. 2016. Ekwò zò gha dzô nats'êdè: "We Live Here For Caribou" Cumulative Impacts Study on the Bathurst Caribou. Tłíchǫ Traditional Knowledge and Land Use Study. Tłįchǫ Government.



Appendix A: Draft Workshop Agenda



BATHURST CARIBOU RANGE PLAN Traditional Knowledge Workshop

Date:	Place:
March 30, 2016	Commissioner's Room, Days Inn & Suites 4401 50th Avenue. Yellowknife
March 31, 2016	Commissioner's Room, Days Inn & Suites 4401 50th Avenue. Yellowknife

Purpose:

The TK Workshop will allow for a gathering of TK experts and members of the Bathurst Caribou Range Plan Working Group to consider the current relationship between people and caribou.

DAY 1 – March 30

Agenda Item	Start Time	End Time
Arrival and Coffee	08:00	08:30
Welcome and opening remarks	08:30	09:00
Background to the Bathurst Caribou Range Plan	09:00	12:00
 Considering the Relationship between People and Caribou – An Aboriginal Focus Questions to Consider: How can the relationship between people and caribou be healed? Who needs to be involved? When? Where? When we listen to caribou, what can we learn from them to better care for caribou today and in future generations? What do the youth and younger generations need to understand to continue a healthy relationship with caribou? What do we need in order to feel assured that our concerns and recommendations are understood? 		
Lunch Break – Catered	12:00	13:00

Considering the Relationship between People and Caribou – An Aboriginal Focus (cont.)	13:00	16:00

DAY 2 – March 31, 2016

Agenda Item	Start Time	End Time
Arrival and Coffee	08:00	08:30
Opening and Introductions Recap of Day 1	08:30	09:00
Sharing Thoughts on People and Caribou within the Bathurst Caribou Range Plan Review of Recommendations	09:00	12:00
Lunch Break – Catered	12:00	13:00
 Sharing Thoughts on People and Caribou within the Bathurst Caribou Range Plan (cont.) Reporting out from each Aboriginal Government and/or Organization on TK work to date: Athabasca Denesuline Kitikmeot Inuit Association Łutsel K'e Dene First Nation North Slave Métis Alliance NWT Métis Nation Thicho Government Yellowknives Dene First Nation 	13:00	15:30
Next Steps and Closing	15:30	16:00

Appendix B: Workshop Presentation



Bathurst Caribou Range Plan TK Workshop Thoughts and Recommendations

March 31, 2016 Yellowknife, NT

Caribou . .

It's a long story, never-ending story

Thoughts and Themes

Threats to Caribou

- Caribou have learned to fear people through their experiences with development; shift in the relationship (not happy to see people anymore)
- Roads are like veins, spreading out on the landscape;
- Climate change impacts are causing animals like moose, porcupine to move northwards; increases in disease such as hoof rot
- Caribou started moving away when communities, roads and development came

Threats to Caribou (cont'd)

- Predators are a piece of the puzzle too
- Calving grounds must be protected (e.g. from development, consider predator control)
- Forest fire and burning policy changes caribou habitat
- Beverley and Ahiak caribou stayed on the coast this year – away from people, industry and roads

Understanding Caribou

- Caribou are going to better places to eat
- Caribou are smart; they learn where good food is
- Caribou are like people: they don't like their food covered
- The caribou used to migrate everywhere
- Caribou are smart: they migrate south and see new animals so keep on going
- A caribou spirit can come back 2-3 times but only if it is respected

Understanding People

- Our bodies are for pure water and animals
- I speak better in my language
- When I sleep on the ground, it's like I can hear it breathing
- Out on the land, you are happy all of the time
- I can't count on caribou to be there to hunt anymore
- Habitat (range) and harvesting recommendations are linked

People and Caribou

- All animals can understand people; caribou can understand people
- Our way of life changes when caribou are gone (e.g. Fort Smith)
- We live on caribou: it's our food
- We are the guardians of caribou
- We need to hear the caribou again
- We know how the caribou used the land before people came

People and Caribou (cont'd)

- There are agreements between people and caribou
- Rebuilding caribou trails could help rebuild relationship with caribou
- We need to talk for the caribou
- Leave the caribou alone, some people say
- Caribou took such good care of us during hard times

Cultural Rules

- Caribou seek out hunters who speak from their heart
- Animals give themselves when they know they are being respected
- This is our yard, our country, our store; we live by two laws: respect and traditional laws
- Antlers left on the caribou path should never be disturbed

Youth

- Our elders are passing so we need to be teachers
- We must work together to teach our youth
- Youth must learn by doing
- Concern for youth who don't know the traditional ways, set nets, etc.
- Teach youth how to take care of caribou
- Work we do today is for generations tomorrow

Working Together

- Elders are more like sociologists and not caribou biologists as they see caribou as people; not objects
- We have a lot of resource people, elders, biologists so we have to work together, Now.
- Inuit and other Aboriginal hunters feel strongly about protecting calving areas (in NU)
- As Aboriginal people, we have no real say in our homeland
- We have to work together NWT and Nunavut to keep herds healthy

Recommendations

Renewing our spiritual relationship with Caribou

- Our spiritual beliefs and laws governing our relationship with Caribou are critical to the health of caribou
- We must heal our relationship with Caribou if we expect them to return to us. To do this we understand that we must also heal our relationship with the land before the caribou will return

- In doing this healing, we must work from our heart and not our heads
- We recommend that a trip be planned to the barren lands to provide elders, youth and spiritual leaders with an opportunity to begin this healing

- Such an event should be open to all Aboriginal nations who reside within the range of the Bathurst caribou
- The intent is to facilitate spiritual ceremonies based on the traditions of each group in a manner that not only respects difference but also allows each nation to carry out ceremonies and traditions that are sacred to them.
- Ceremonies such as fire feeding, fasting, dreaming, drumming and other traditions effective in establishing a renewed relationship with caribou would be supported.

- Such a trip must include men and women, youth and elders and active harvesters. One objective is to inspire youth to commit to sharing this experience with other youth and a renewed spiritual relationship with caribou
- The event would take place over a period of 4-6 days providing sufficient time for preparation and ceremony
- Charter float plane transportation would facilitate the participation of elders who might not be physically able to travel by land or water.

Historic Range of the Bathurst Caribou

 The traditional knowledge of elders should contribute to updating the historic range of Caribou and include the period (what years) that this occurred

Fire Fighting Policies

- More in-depth work needs to be done to understand the traditional fire management practices to inform fire fighting policies of the GNWT
- loss of caribou feeding areas through fire contributes to the survival pressures the caribou are now facing

Curtailing industrial development

- Many elders shared their beliefs and fears that too much exploration and mining within the caribou range would result in caribou population decline and loss long before mines were established. Their fears have come to pass and they believe that the cumulative effects have proven to be too much for the caribou. They feel that they have sacrificed too much: in exchange for 25 years of mining jobs that have not met expectations, they have lost their major food source that has sustained them for thousands of years.
- How much is enough to have a good life and live traditionally? How much is too much?

On the land monitoring a good model

- Monitoring in each community of harvesting as well as on the winter road system (check points?) should be increased. This will add to a sense of responsibility to follow the traditional self management system when our caribou are at risk.
- Collect harvest info/data from everybody, everywhere.

Support incentives to encourage people to stop hunting caribou

- Incentives such as subsidizing alternate meat food sources should be explored. Recognizing the extreme costs of buying meat for people who are dependent on caribou and subsidizing replacement meat will help alleviate the pressure people feel to continue hunting caribou.
- Where possible, help people share meat between regions (help one another)

Appendix C: Workshop Evaluation Data



Bathurst Caribou Range Plan TK Workshop, March 30-31, 2016 in Yellowknife, NT

			Neither Good			Total	
Question	Very Good	Good	nor Poor	Poor	Very Poor	Responses	Comments
How would you rate the meeting for working together?	5	5				10	
How would you rate the workshop for							
considering the relationship between people and caribou?	3	3	3			9	
How would you rate the workshop for respect among participants?	4	6				10	
How would you rate the workshop for coming up with observations and recommendations?	2	6	1			9	
How would you rate the camp for documentation of Traditional Knowledge?	3	2	2	1		8	Recording is good, but how TK was presented Day 2 did not reflect wholly the discussion on Day 1.
How would you rate the venue and food for the workshop?	2	4	3			9	
How would you rate the facilitation of the workshop?	5	4				9	
		Тоо		Тоо	Total		
Question		much	Enough	little	Responses	Comments	
How would you rate the length of the workshop?		2	7	1	10		

How would you rate the workshop for communications among participants?

Response Summary to Open Questions

What were the strengths of the workshop? What did you enjoy about the workshop? Aboriginal groups working together to protect the caribou and habitat. Working together. Food. Lots of issues, etc. Translation provided. Next time would bring Dene speaking Elder to participate. 1 like it so much! People give their concerns on caribou.

8

8

How could the workshop be improved?

Bring industry people to the workshops with the Aboriginal people of their homelands. More input from other organizations and other departments (government). Put strong actions to improve the issue. No clear direction on how info will be used in Bathurst Caribou Range Plan. Yes! Two days was enough time for now, but we need to meet again to verifiy, add and follow up. Perhaps other participants could join after we finish recommendations. Smaller goup more comfortable for TK holders. Need better translating for elders. Appendix D: Workshop Evaluation Forms



Thank you for participating in the Traditional Knowledge Workshop for the Bathurst Caribou Range Plan on March 30-31, 2016 in Yellowknife, NT. We hope you enjoyed this gathering. We appreciate your honest and constructive feedback on your experience. Your responses will help us improve future workshops. Quanal Mahsil Masil

- 1. How would you rate the meeting for working together?
- O Very good
- Good
- Neither good nor poor
- O Poor
- O Very Poor
- 2. How would you rate the workshop for considering the relationship between people and caribou?
- O Very good
- Good
- O Neither good nor poor
- O Poor
- O Very Poor

3. How would you rate the opportunities for you to communications among participants?

- O Too many opportunities
- Enough opportunities
- Too few opportunities
- 4. How would you rate the respect among participants?
- O Very good
- Cood
- O Neither good nor poor
- O Poor
- O Very Poor

5. How would you rate the coming up with observations and recommendations?

1

- O Very good
- Good
- O Neither good nor poor
- O Poor
- O Very Poor

- 6. How would you rate the documentation of Traditional Knowledge?
- O Very good
- Good
- O Neither good nor poor
- O Poor
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- 7. How would you rate the length of the workshop?
- O Too much time
- Enough time
- O Too little time

8. How would you rate the <u>venue and food</u> for the workshop?

- O Very good
- Good
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- O Poor
- O Very Poor
- 9. How would you rate the facilitation of the workshop?
- Very good
- O Good
- O Neither good nor poor
- O Poor

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10. What were the strengths of the workshop? What did you enjoy about the workshop?

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Working together

other organization. Also other More input from othe departments. Government

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5. How would you rate the <u>coming up with observations and recommendations</u>?

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- Neither good nor poor
- O Poor
- Very Poor

2. How would you rate the workshop for <u>considering the relationship between people and caribou</u>?

- O∕ Very good
- O Good
- Neither good nor poor
- O/Poor
- 🍠 Very Poor

3. How would you rate the opportunities for you to communications among participants?

- O /Too many opportunities
- G Enough opportunities
- Too few opportunities
- 4. How would you rate the respect among participants?
- Very good
- Good
- O Neither good nor poor
- O Poor
- O Very Poor

5. How would you rate the <u>coming up with observations and recommendations</u>?

- /Very good
- Good
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- O Poor
- O Very Poor

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2

O Very Poor

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11. How could the workshop be improved?

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- Enough opportunities
- Too few opportunities

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- O Good
- Neither good nor poor
- O Poor
- O Very Poor

5. How would you rate the coming up with observations and recommendations?

1

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- O Good
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- O Poor
- O Very Poor

6. How would you rate the documentation of Traditional Knowledge?

- 🍼 Very good
- O Good
- O Neither good nor poor
- O Poor
- O Very Poor

7. How would you rate the length of the workshop?

- stop much time
- O Enough time
- 💢 Too little time

8. How would you rate the venue and food for the workshop?

- 😥 Very good
- O Good
- Neither good nor poor
- O Poor
- O Very Poor
- 9. How would you rate the facilitation of the workshop?
- 💢 Very good
- O Good
- O Neither good nor poor
- O Poor
- O Very Poor

10. What were the strengths of the workshop? What did you enjoy about the workshop?

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Thank you for participating in the Traditional Knowledge Workshop for the Bathurst Caribou Range Plan on March 30-31, 2016 in Yellowknife, NT. We hope you enjoyed this gathering. We appreciate your honest and constructive feedback on your experience. Your responses will help us improve future workshops. Quana! Mahsi! Masi!

- 1. How would you rate the meeting for working together?
- Very good
- O Good
- Neither good nor poor
- O Poor
- O Very Poor
- 2. How would you rate the workshop for considering the relationship between people and caribou?
- Very good
- O Good
- Neither good nor poor
- O Poor
- O Very Poor
- 3. How would you rate the opportunities for you to communications among participants?
- O Too many opportunities
- C Enough opportunities
- O Too few opportunities
- 4. How would you rate the respect among participants?
- Very good
- O Good
- Neither good nor poor
- O Poor
- O Very Poor

5. How would you rate the coming up with observations and recommendations?

- Very good
- O Good
- O Neither good nor poor
- O Poor
- O Very Poor

- 6. How would you rate the documentation of Traditional Knowledge?
- D Very good
- O Good
- O Neither good nor poor
- O Poor
- O Very Poor
- 7. How would you rate the length of the workshop?
- O Too much time
- Ø Enough time
- O Too little time

8. How would you rate the venue and food for the workshop?

- O Very good
- O , Oood
- W Neither good nor poor
- O Poor
- Very Poor
- 9. How would you rate the facilitation of the workshop?
- Very good
- O Good
- O Neither good nor poor
- O Poor
- O Very Poor

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10. What were the strengths of the workshop? What did you enjoy about the workshop?

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Bathurst Caribou Range Plan: Draft Range Assessment and Technical Methods Report (March 2017)

APPENDIX C:

Human Feature (Development Footprint) Mapping

1 Overview

An integrated GIS data set of human land use features/surface disturbances has been developed for the Bathurst Caribou Range Plan (BCRP) Planning Area (**Figure 1**). The human land use feature mapping was created by compiling and merging available GIS information including the GNWT CIMP database, the National Road Network, and mineral industry-provided information used to support project assessment and permitting activities. The information represents the current situation, and also contains two potential future mineral and transportation development scenarios that may occur in the coming 24-years. The purpose of the future scenarios is to support scenario-based planning as part of the BCRP exercise—they should not be interpreted as predictions of the future.



Figure 1. BCRP planning area.

1.1 User Notes

- Human feature mapping within the Bathurst range planning area has been developed iteratively since spring, 2015. The mapping has been guided by input from BCRP Working Group members, the NWT and Nunavut Chamber of Mines, and GNWT Department of Industry, Tourism and Investment. The current version of mapping is 5.0 and was last updated in May, 2016.
- While all attempts have been made to accurately represent and classify existing and future potential human land use features and surface disturbances, at this time individual features have not been checked for accuracy by GNWT staff or other users.
- The human feature mapping developed to support ranging planning within the Bathurst herd range contains not only existing human features, but also potential future developments in the coming 24-years (2016 to 2040). Three potential future Development Scenarios have been created to represent three potential situations: declining development (Case 1), continuing development (Case 2), and increasing development (Case 3). These Development Scenarios should be considered as hypothetical but 'plausible'—they are not intended to 'predict' which mineral or transportation projects may or may not occur within the 24-year future scenario period. The potential future development scenarios generally follow those used by the Jay Project Developer's Assessment Report (Dominion Diamond 2014) to examine the potential cumulative effects of human development on barren-ground caribou. The BCRP future Development Scenarios are fully described in a separate document.

2 Revised Human Feature Mapping

2.1 Methods

2.1.1 Linear Features

Linear features are roads, trails, utility corridors, and similar. Linear features in the BCRP planning area were compiled using available linear feature GIS data sets, including the NWT Cumulative Impact Monitoring Program (CIMP) February 2015 linear feature mapping

(*HumanDisturbances_BA_NS_SS_v2.gdb\Permit_Data_Lines*), spatial data used for the Jay Project Developer's Assessment Report (developed by Golder Associates,

DevLyr_REF_BASE.gdb\DEVELOPMENT_FOOTPRINT), the National Road Network, GNWT Department of Transportation, and other information provided by mineral exploration and development projects. No single information source was adequate to provide a reasonable representation of human linear features in the Bathurst range planning area.

Linear feature mapping was initially compiled as a 'master' file of polylines. The polylines were then converted to polygon features by buffering each linear feature by an average width (see

Table 2) to represent the direct areal footprint of the linear feature. The buffered linear features were then merged with polygonal features to create a single human feature database for each of the three BCRP future Development Scenarios (Case 1-3).

2.1.2 Polygonal Features

Polygonal features are considered to be settlements, mine sites, camps, gravel pits, and similar. Polygonal features in the BCRP planning area were compiled using available polygon feature GIS data sets, with the CIMP February 2015 polygon feature mapping

(*HumanDisturbances_BA_NS_SS_v2.gdb**Permit_Data_Polygons, Unvalidated_Data_Polygons*) being the most important. The CIMP 2015 mapping was used as the basis for the polygonal feature dataset.

The Bathurst range plan human polygonal feature updates were completed as follows:

- 1. The February, 2015 CIMP database was used as the starting point for most polygonal features.
- 2. All CIMP polygons were maintained, but additional polygons were added or where better information existed, were replaced with other data sets.
- 3. The Jay Project Developers Assessment Report (Dominion Diamonds 2014) footprint mapping was used to represent future mine site footprints, where available.
- 4. Where detailed project information was not available, generalized footprints were manually digitized to represent potential future minesite footprints.
- 5. Seven hypothetical advanced exploration projects were located in areas of high mineral potential (in specific Archean greenstone belts, as suggested by NWT and Nunavut Chamber of Mines).
- 6. A generalized feature classification was developed based on the detailed CIMP feature classes, and an attribute table was developed that would allow different queries to be performed for current or future direct footprints and their corresponding seasonal ZOI.

Completing the polygon human feature mapping updates was challenging for the following reasons:

- 1. The CIMP polygon feature mapping was generally derived from land use permit records (i.e., projects that received land use permits were included in the CIMP mapping, regardless of whether they represented an existing visible surface disturbance on the landscape).
- 2. It was difficult to discern whether many of the existing mineral exploration-related footprints are actively being used, or are historical.

In order to complete the polygon feature updates, a number of decisions regarding the status of each polygon were therefore required.

Existing Surface Disturbances

The following decision rules were used to determine if polygons included in the CIMP database represented existing surface disturbances:

• Much of the diamond exploration activity in the late-1990s and early-2000s occurred during the winter period, and was focused on or around frozen waterbodies. If the exploration drill holes

recorded in the CIMP database occurred on waterbodies (as represented by 1:50,000 CanVec hydrology features), they were not included as existing surface disturbance.

- If comments in the CIMP database indicated that no visible disturbance was observed during the data capture process, the CIMP polygon features were not included as existing surface disturbance.
- 'Large polygons' of non-specific exploration areas were maintained in the feature mapping but were not included as existing surface disturbance.
- In some situations, professional judgement was required to determine if CIMP polygons represented existing surface disturbances. However, the area affected by polygons subject to these determinations is very small.

Human Activities Associated with Surface Disturbances

The following decision rules were used to determine if polygons represented in the CIMP database are currently active or are active as part of the potential future development scenarios—human ZOI is only applied to active polygons:

- Existing surface disturbance polygons occurring on active mineral claims or leases (July, 2014 update) were generally considered to be active, unless specified in the CIMP database that drill programs were completed, etc.
- Known advanced exploration projects and or projects undergoing or recently completed environmental assessments were considered to be active both current, and as part of the potential future development scenarios.
- Past minesites under care and maintenance, or being actively reclaimed, were considered as active features in both the current and potential future development scenarios. In some situations, where mine remediation of old minesites is planned to be completed prior to 24 years future (e.g., Rayrock mine site), these were not included as active features in the potential future situation.

Seasonality of Human Activities

While recognizing there can be a large amount of variability, assumptions regarding the seasonal nature of activities associated with each active polygon feature were required:

- Most mineral exploration activities were assumed to occur during the summer period (May-October).
- Settlements, active minesites, and past minesites undergoing care and maintenance, or that are being remediated, were assumed to be active during all seasons.
- Camps and other features associated with the Tibbit-Contwoyto Lake Winter Road were assumed to be active during the winter period only.

2.1.3 Attribute Tables and Feature Codes

Table 1 and **Error! Reference source not found.** describe the attribute table structure and feature codes included in the BCRP human feature mapping GIS dataset, respectively. The attribute table contains information for both the current situation and features considered in the potential future development scenarios, the general season when they are present, and their potential zone of influence (ZOI) on

barren-ground caribou. The scenario period is 24 years into the future. The attribute table contains five reporting years (T1 to T5) as follows:

- T1 = year 2016 (current)
- T2 = year 2022
- T3 = year 2028
- T4 = year 2034
- T5 = year 2040

Table 1. File attribute table.

FIELD	Field Properties	Description
ID	Long Integer, 6	Feature segment ID
SOURCE	String, 50	Source for feature representation (named GIS file or other).
FEATURE_ID	String, 10	Unique feature identifier, created through combination of
		SOURCE and ID:
		• L1234 = Linear Feature + ID
		• P1234 = Polygonal Feature + ID
		Purpose of field is to create relational link to earlier versions of
		CIMP-based feature mapping.
FEATURE	String, 10	Field identifying feature type:
		 LINEAR (roads, trails and utility corridors)
		POLYGON (mine sites, settlements, camps and similar)
PROJECT	String, 50	General description of feature, either a specific project name
		(e.g., Ekati Diamond Mine, Back River Project) or
		geographic/populated place name (e.g., Gamètì Winter Road).
		Some features are unnamed.
Т1	String, 5	Field identifying if the feature exists at reporting year T1:
		• N = No
		• Y = Yes
T1_FCODE	String, 10	2 to 10 letter feature code. <i>See</i>
		Table 2 below for feature codes and descriptions.
T1_SEASON	String, 5	General season of year the feature is present:
		• A = All-season (used for all features other than winter
		roads).
		• W = Winter (January – April, used only for winter
		roads).
T1_ZOI	Long Integer, 6	Estimated zone of influence (ZOI), in metres, associated with
		each land use feature at T1. See
		Table 2 below for estimated ZOI extents. If the feature is
		inactive (a footprint does not receive human use) then ZOI =
		0m
Kepeat T1, T1_FC(DDE, T1_SEASON and T1_Z	DI for T2 to T5 reporting years.

Feature Type	FCODE	Description	ZOI (m)	
LINEAR	AR	All-season Access Road	5,000	
FEATURES	(average 10m width)			
(roads, trails				
and utility	Any all-season road, including roads in Settlements.			
corridors)	EC	Major Electrical Transmission Corridor	4,000	
		(average 30m width)		
		Any major electrical utility corridor (e.g., Snare River).		
	нw	Public All-season Paved Highway	5,000	
		(average 60m width)	,	
		Any all-season paved highway (e.g., NWT Highway #3 and #4).		
	MAR	Mainline All-season Access (Haul) Road	5,000	
		(average 20m width)		
		Any major all-season access or haul road (e.g., current Ekati Misery		
		Road or future Izok Corridor road).		
	WR	Winter Road	1,000	
		(average 12m width)	_,	
		All winter roads (excluding main Tibbit-Contwoyto Winter Road).		
	WR_TC	Main Tibbitt to Contwoyto Winter Road	4,000	
		(average 40m width)		
		Mainline Tibbit to Contwoyto Winter Road.		
POLYGONAL	AIRSTRIP	Airstrip	5,000	
FEATURES **		Active airstrip with paved or unpaved surfaces.	-,	
(mine sites,				
settlements,		CIMP Feature Class: Runway		
camps and		Note: Many runways associated with CAMP may be missing. The		
similar)		Runway feature class in the CIMP database may be under-reported.		
		Where known, additional AIRSTRIP features were added to the CIMP database.		
	САМР	Camp	5,000	
	<i>c.</i>	Mineral exploration camps, lodges and similar.	3,000	
		CIMP Feature Class: Camp		
		Note: This feature class includes a variety of different camp types –		
		lodges, outfitting, highway, research, etc. The most common type		
		of CAMP appears to be mineral exploration camp (the same ZOI has		
	СОММ	therefore been applied as MIN_EXPL). Communication Tower	1,000	
			1,000	
		CIMP Feature Class: Communications		
		Note: Only a few communications towers are contained in the		
		CIMP database; these features may be under-reported.		
	GEN_IND	General Industrial	1,000	
		A variety of general industrial disturbances.		

 Table 2. Bathurst human feature codes, descriptions and estimated zones of influence (ZOI) on barren-ground caribou.

Feature Type	FCODE	Description	ZOI (m)
		<u>CIMP Feature Class</u> : General Industrial is a "catch-all" category of	
		several CIMP features: Industrial, Culvert Replacement, Fuel	
		Storage, Geotechnical, Oil and Gas, Road Private, Road Public,	
		Staging Area, Woods / Forestry Operations	
		Note: Most Road Private and Road Public appear to be gravel pits	
		or clearings associated with the major highways (Highway # 3 and	
		#4).	
	MIN_EXPL	Mineral Exploration	5,000
		Mineral exploration-related infrastructure and disturbances.	
		<u>CIMP Feature Class</u> : Mineral Exploration is comprised of several	
		CIMP features, including selected Mining Exploration, Mining and	
		Milling – Water, Mining Exploration – Mine Shaft.	
		<u>Note</u> : There was no single CIMP feature available to represent	
		Mineral Exploration. Many Camp features are also associated with	
		Mineral Exploration activities.	
	MINE_ACTIV	Minesite (Active)	14,000
		Minesites under construction or in production.	1,000
		CINAD Facture Classe Colocted Mining Fundamentics and Mining and	
		CIMP Feature Class: Selected Mining Exploration and Mining and	
		Milling – Water features to represent active mines (i.e., Ekati,	
		Diavik, and Gahcho Kué).	
		Note: Several other data sources were used to supplement the	
		CIMP features, as required.	
	MINE_PAST	Minesite (Past or Closed)	5,000
		Past or closed minesites, either abandoned or under active	
		reclamation.	
		<u>CIMP Feature Class</u> : Closed or past mines are represented by	
		selected Mining Exploration or Miscellaneous features from the	
		CIMP database (e.g., Lupin, Jericho, Tundra, Rayrock, etc.).	
		<u>Note</u> : In CIMP database, many past mine footprints were classified	
		as Miscellaneous features; where known, they have been re-	
		classified as MINE PAST.	
	MISC	Miscellaneous	1,000
		A variety of industrial and non-industrial surface disturbances or	
		infrastructure.	
		<u>CIMP Feature Class</u> : Miscellaneous features are represented by	
		several CIMP feature classes, including Miscellaneous, Research	
		Projects, and Unknown.	
		Note: Some Miscellaneous features in CIMP database are old mine	
		sites, quarries, mineral exploration, communications, etc. Where	
		possible, obvious features were classified as a more accurate	
		feature category. Most CIMP database Miscellaneous features are	
		located along Hwy #3 and #4.	
	PORT	Marine Port	5,000
		Future proposed or conceptual marine port facilities in Nunavut on	5,000
		the Arctic coastline (e.g., Grays Bay, Bathurst Inlet).	
		The Aretic Coastille (e.g., Grays Day, Dathurst Illiet).	
		<u>CIMP Feature Class</u> : No equivalent in CIMP database.	
	1		I

Feature Type	FCODE	Description	ZOI (m)
		Note: This feature class was added to represent proposed future	
		port facilities to support mineral development in Nunavut (e.g.,	
		Grays Bay as part of Izok Road Corridor, Bathurst Inlet as part of	
		BIPAR concept).	
	POWR_GEN	Power Generation Facility	5,000
		Hydro power generation facilities (dams, spillways, powerhouses,	
		and associated)	
		CIMP Feature Class: Power Generation Facility (i.e., Snare River,	
		Bluefish, Taltson).	
		Note: associated transmission line clearings and infrastructure is	
		classified as EC (electrical transmission corridor).	
	QUARRY	Quarry	5,000
		Any excavation site used for purpose of developing aggregate,	
		sand, crushed rock, etc.	
		CIMP Feature Class: Quarrying	
		Note: Quarry features are likely under-reported in CIMP database.	
		Most occur along existing all-season roads and highways.	
	SETTLEMENT	Settlement	15,000
		Any permanent settlement with a recognized municipal boundary	
		(e.g., City of Yellowknife, Whatì, Gametì, etc.)	
		CIMP Feature Class: Community, Municipal	
		Note: Some settlement areas were manually digitized to better	
		represent direct footprints and built up areas.	

3 GIS Files

Three .shp files, named by BCRP Development Scenario, contain the updated version 5.0 BCRP human feature mapping (**Table 3**). Each has been intersected with the Range Assessment Areas.

FILE	DESCRIPTION
LINEAR FEATURES	
Bathurst_CASE1_human_features_v5_RAA_may2016.shp	Direct footprint of human land use features
	associated with BCRP Development Scenario CASE 1.
	Feature Type: Polygon
Bathurst_CASE2_human_features_v5_RAA_may2016.shp	Direct footprint of human land use features
	associated with BCRP Development Scenario CASE 2.
	Feature Type: Polygon
Bathurst_CASE3_human_features_v5_RAA_may2016.shp	Direct footprint of human land use features
	associated with BCRP Development Scenario CASE 3.
	Feature Type: Polygon

Table 3. Bathurst range plan revised human feature file names.

3.1 Projection Parameters

Projected Coordinate System:	Canada_Lambert_Conformal_Conic
Projection:	Lambert_Conformal_Conic
False_Easting:	0.00000000
False_Northing:	0.00000000
Central_Meridian:	-96.00000000
Standard_Parallel_1:	50.00000000
Standard_Parallel_2:	70.00000000
Latitude Of Origin:	40.00000000
Linear Unit:	Meter
Geographic Coordinate System:	GCS_North_American_1983
Datum:	D_North_American_1983
Prime Meridian:	Greenwich
Angular Unit:	Degree

4 Suggested Use

Each of the development scenario cases (CASE 1, 2 and 3) can be queried or symbolized to represent changes in human development features (i.e., direct footprint) or zone of influence at each reporting year over the duration of the 24 year scenario. For example:

- Selecting [T1] = 'Y' identifies which human features are on the landscape in reporting year 1 (2016).
- [T1_ZOI] identifies the estimated zone of influence associated with a specific feature.
- Selecting [T1] = 'Y' AND [RAA] = 'Area 4' will identify which features are within Bathurst Range Plan Range Assessment Area 4.

5 References

- Cumulative Impact Monitoring Program (CIMP). 2015. Human disturbance mapping (Bathurst caribou range). Prepared for GNWT CIMP by Caslys Consulting Ltd. Report and ArcGIS geodatabase. February 2015.
- Dominion Diamond. 2014. Jay Project Developer's Assessment Report: Section 12, Barren-ground Caribou, and Section 17, Cumulative Effects Summary. Prepared for Dominion Diamond by Golder Associates. October 2014.

End

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Appendix D:

Human Development Features and Zone of Influence Assumptions and References

Updated October 2016, Version 3.0

1. Background

In the Bathurst Caribou Range Plan (BCRP), **human disturbance** is defined as the area directly affected by human land use features (i.e., the development footprint) and its surrounding zone of influence (ZOI). Land use features such as roads, settlements and mine sites represent development footprints that directly result in habitat loss or alteration because of the space they occupy on the land. The ZOI is an associated area around the direct footprint that corresponds with an avoidance response (Johnson et al. 2005, Boulanger et al. 2012, Johnson and Russell 2014), where animals shift their distribution away from a development, alter behaviour in the vicinity of a facility, or change the types or quality of habitats used (Johnson and St. Laurent 2011). For barren-ground caribou a ZOI has been observed based on lower caribou abundance within a certain distance of established diamond mines than would be expected given available habitat (Boulanger et al. 2015, Caribou Zone of Influence Technical Task Group 2015). Some of the factors that are thought to influence caribou behavior or habitat use within the ZOI are sensory disturbances such as noise, dust, odors, and the visual stimuli from lights and viewscape – buildings, people, vehicles, and equipment. Thus, some implications of the indirect effect of a ZOI on caribou include the following:

- areas adjacent to development footprints are avoided or used less frequently resulting in reduced habitat availability;
- time spent feeding and intensity of feeding may be reduced concomittant with increased levels of activity (running and walking), which result in higher energetic costs to caribou leading to indirect population effects); or
- mortality risk may increase (direct population effect) in the case of roads and hunting access.

The area directly affected by human land use features is calculated directly from GIS mapping. Human land use features can be considered as either linear or areal (polygonal) features. Polygonal features include settlements, mine sites, gravel pits, and similar. Linear features include all-season roads, winter roads, trails, and electrical transmission corridors.

The ZOI around development footprints is the area indirectly affected by human activities, and is more difficult to define. The distance a ZOI may extend around a feature, and its effect on wildlife, varies depending on the nature of the development feature and the level of activity associated with the feature. Nonetheless, accounting for the ZOI around different development features is an important aspect of considering the total disturbance and cumulative effect of development footprints on wildlife. In GIS mapping, ZOI is estimated as a buffer of a defined distance around the development features.

2. Human Development Features and ZOI Extents

The ZOI extents used to represent indirect effects around the different linear and polygonal features contained in the Bathurst Caribou Range Plan GIS database are listed in **Table 1** and **Table 2**, respectively. The ZOI around different features types was estimated based on a literature review and values used in recent environmental assessments (e.g., Kiggavik Project Effects; Gahcho Kué Developer's Assessment Report; Golder Associates 2014b). References and a discussion of each human development feature and its assigned ZOI are provided. ZOI discussions are adapted from Russell (2014) and Golder Associates Ltd. (2014b) and attached for reference.

The NWT Cumulative Impact Monitoring Program (CIMP) database (CIMP 2015) was the main input for the Bathurst Caribou Range Plan GIS database. Given this, a large number of human development features have been identified, and each required estimates of their potential ZOI on barren-ground caribou. Average ZOI extents for different feature types have therefore been used, based on reported values and supportable rationale.

Feature Code	Feature Name	Feature Width (m)	Feature Description	ZOI (km)	ZOI Discussion
AR	All-Season Access Road	10	Any all-season road, including industrial access roads and roads in and around Settlements.	5	4 km ZOI around all-season roads identified by Vistnes and Nelleman (2001), Nelleman et al. (2003) and Weir et al. (2007). Abundance of calving barren-ground caribou less than expected within 4 km of roads (Cameron et al. 2005). 1.5 km ZOI used in Back River Project (Rescan 2013). Johnson and Russell (2014) found that Porcupine caribou demonstrated a definitive avoidance response to Main Roads and estimated a zone of influence of 30 km during 1985–1998 followed by a reduced distance of 18.5 km during 1999–2012. Data suggested that disturbance decreased over time or caribou became habituated to the footprint or associated disturbance activities. <u>AR includes roads around Settlements; therefore 5 km average</u> <u>ZOI selected</u> .
EC	Major Electrical Transmission Corridor	30	Major electrical transmission corridors (e.g., Snare Lake, Bluefish and Taltson transmission lines).	4	Major transmission lines found to have 4 km ZOI for barren- ground caribou (Vistnes and Nelleman 2001; Nelleman et al. 2003). Meliadine Project (Golder Associates Ltd. 2014) and Gachu Kué Project (Golder Associates Ltd. 2010) ZOIs ranged from 0 to 5 km . <u>Average 4 km ZOI selected</u> .
HW	Public All-Season Paved Highway	60	NWT Highways #3 and #4.	5	Same references as AR, All-season Access Road.
MAR	All-Season Mainline Access (Haul) Road	20	Major all-season industrial haul roads (e.g., currently Ekati Misery Road and proposed future haul roads such is IZOK and BIPAR corridors in Nunavut).	5	Same references as AR, All-season Access Road. Observed lower probability of occurrence of caribou within 6-14 km of combined mines and roads (Boulanger et al. 2012). <u>5 km average ZOI selected</u> .
WR	Winter Road	12	All winter roads <u>except</u> the Tibbit- Contwoyto Lake Winter Road. Winter roads are seasonal features	1	200 m ZOI used for Back River Project (Rescan 2013). 5 km ZOI used for Meliadine Project (Golder Associates Ltd. 2014) and

Table 1. Linear Human Development Features and ZOI Extents

Feature Code	Feature Name	Feature Width (m)	Feature Description	ZOI (km)	ZOI Discussion
			that exist only during the January- early April period.		Gachu Kué Project (Golder Associates Ltd. 2010). Johnson and Russell (2014) observed that Porcupine caribou showed relatively little avoidance of wells, trails, winter roads, and seismic lines once they achieved a distance of 6 km during 1999–2012 and 11 km during 1985–1998. For this disturbance type, the data suggested a habituation or vegetation recovery effect that reduced the zone of influence by nearly 50%; although, this relationship was imprecise. <u>WR includes many different winter road types ranging from</u> <u>lower to higher use intensity; therefore 1 km average ZOI</u> <u>selected</u> .
WR_TC	Tibbitt to Contwoyto Winter Road	40	The main Tibbit to Contwoyto Lake Winter Supply Road. This is a seasonal feature that exists only during the January-early April period.	4	Same references as WR, Winter Road. <u>Given the high level of seasonal industrial truck traffic (and</u> <u>potentially public use) on Tibbit to Contwoyto Lake Winter Road,</u> <u>a 4 km average ZOI was selected (more than WR, less than HW)</u> .

Table 2. Polygonal Human Development Features and ZOI Extents

Feature Code	Feature Name	Feature Description	ZOI (km)	ZOI Discussion
AIRSTRIP	Airstrip	Airstrip	5	No literature references available. <u>Most airstrips are associated with Camps, Mineral Exploration,</u> <u>Settlements, or similar; therefore 5 km ZOI selected</u> .
САМР	Camp	A variety of camp types (mineral exploration, lodges, outfitting, highway, research, etc.)	5	4 km ZOI identified for tourism and recreation camps by Vistnes and Nelleman (2001) and Vistnes et al. (2008). 5 km ZOI used for outfitting camps in Gahcho Kué Project (Golder Associates Ltd.

Feature Code	Feature Name	Feature Description	ZOI (km)	ZOI Discussion
				2010). 5 km ZOI applied to mineral exploration camps/sites in Gahcho Kué Project (Golder Associates Ltd. 2010) and Meliadine Project (Golder Associates Ltd. 2014).
				The most common Camp type identified in mapping database is mineral exploration camp; therefore 5 km ZOI selected.
СОММ	Communications	Communications towers	1	No literature references available. Communication towers are point features with limited human activity.
				<u>1 km ZOI selected</u> .
GEN_IND	General Industrial	General industrial features from CIMP database (culverts, staging areas, storage, etc.)	1	No literature references available. The General Industrial feature class contains a range of feature types. Most are located adjacent to existing All-Season Roads or Settlements.
				<u>1 km ZOI selected</u> .
MIN_EXPL	Mineral Exploration	Mineral exploration activities (drilling, trenching, etc.)	5	5 km ZOI applied to mineral exploration camps/sites in Gahcho Kué Project (Golder Associates Ltd. 2010) and Meliadine Project (Golder Associates Ltd. 2014), with 5 km ZOI applied to all active exploration permits for the entire 5-year period, over the entire year.
				<u>5 km ZOI selected</u> .
MINE_ACTIV	Minesite (Active)	Active minesites (e.g., Ekati, Diavik, Snap Lake, etc)	14	Observed lower probability of occurrence of caribou within 6-14 km of combined mines and roads (Boulanger et al. 2012). Hypothetical 15 km ZOI around active mines used by Johnson et al. (2005). The Back River Project considered two ZOIs at 4 km and 14 km (Rescan 2013). The Meliadine Project considered a three ZOI range with variable disturbance coefficients 0-1, 1 to 5, 5 to 14 km based on Boulanger (2012) (Golder Associates Ltd. 2014). The Gacho Kué Project assumed a 15 km ZOI was applied to all active mine sites regardless of the size of the footprint or the level of activity for each mine (Golder Associates Ltd. 2010).

Feature Code	Feature Name	Feature Description	ZOI (km)	ZOI Discussion
				Average 14 km ZOI selected.
MINE_PAST	Minesite (Past or Closed)	Past Minesites under care and maintenance or being actively reclaimed/remediated (e.g., Lupin, Jericho, Tundra, etc.)	5	No literature references available. Past Minesites are assumed to have levels of human activity and potential aerial traffic similar to Mineral Exploration or Camp features. <u>Average 5 km ZOI selected</u> .
MISC	Miscellaneous	Miscellaneous/uncertain features from CIMP database (most are located along highways)	1	No literature references available. There are relatively few Miscellaneous features in the Bathurst range. <u>1 km ZOI selected</u> .
PORT	Marine Port	Proposed marine ports or laydown areas associated with potential future mineral development projects in Nunavut (e.g., Grays Bay-Izok, Bathurst Inlet).	5	No literature references available. Future Marine Ports along the Nunavut Arctic coast are assumed to have similar levels of activity as Mineral Exploration sites or Camps. Depending on season of use and shipping methods, they may receive limited human activity for much of the year.
				<u>5 km ZOI selected</u> .
POWR_GEN	Power Generation Facility	Major hydro dams and associated power generation facilities (e.g., Snare River, Bluefish River and Taltson)	5	No literature references available. Nelleman et al. (2003) found reduced caribou use up to 4 km ZOI from hydro reservoirs. Gacho Kué Project (Golder Associates Ltd. 2010) and Meliadine (Golder Associates Ltd. 2014) used a 1 km ZOI for on-site power plants. Major hydro facilities have Airstrips, Major Electrical Transmission Lines, and may receive a relatively high level of human activity.
				Assumed to be similar to Airstrips or Mineral Exploration; therefore 5 km ZOI selected.
QUARRY	Quarry	Sand, gravel or rock quarries	5	No literature references available. <u>Assumed to be similar to Mineral Exploration or small-scale</u> <u>mining activities; therefore 5 km ZOI selected</u> .

Feature Code	Feature Name	Feature Description	ZOI (km)	ZOI Discussion
SETTLEMENT	Settlement	Permanent settlements (communities and municipal areas)	15	 15 km ZOI used by Gahcho Kué Project (Golder Associates Ltd. 2010) and Meliadine Project (Golder Associates Ltd. 2014). Although most communities were on the periphery of the winter range, Johnson and Russell found an avoidance distance of ~34.5 – 38 km to settlements by collared Porcupine caribou. <u>Settlement ZOI is assumed to be extensive due to potential high harvest pressure and multiple land uses; therefore 15 km ZOI selected</u>.

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Bird and	ZOI		References	N .
Disturbance activity	(km)	Published literature	Similar environmental assessments	Notes
MU — Municipalities (Polygon)	15	Hypothetical 1,000 m (Johnson et al. 2005), but no disturbance coefficients identified.	Meliadine FEIS (Golder Associates Ltd. 2014) and Gahcho Kué (De Beers Canada Inc. 2010) used a 15 km extent with variable disturbance coefficients from 0.05 to 0.75	Presume community ZOI is extensive due to likely high harvest pressure and other land uses (e.g., traffic, noise). Use ZOI similar to other likely high disturbance activities; extend to 15 km, precedent set for Meliadine FEIS.
ASR — All Season Roads WR — Winter Road (Line)	4 (ASR) 0.2 (WR)	 4 km (Vistnes and Nellemann 2001, Nellemann et al. 2003, Weir et al. 2007); Hypothetical 95% (i.e., DC = 0.05) reduction with 1 km radius of operating mine road (Misery road, (Johnson et al. 2005); Abundance of calving caribou less than expected within 4 km of a road (Cameron et al. 2005). 	Hypothetical: All weather <u>construction</u> : 4 km radius (Rescan 2013); All weather <u>operations</u> : 1.5 km (Rescan 2013); Winter Road: 200 m (Rescan 2013); ZOI extended to 5 km for the Meliadine Project (Golder Associates Ltd. 2014) and the Gahcho Kué project (De Beers Canada Inc. 2010) with variable disturbance coefficients from 0.05 to 0.75.	
EX — Exploration (Point)	5	Mineral exploration sites affected a hypothetical 50% reduction [i.e., DC = 0.5] in the value of habitats found within a 10 km radius of the assumed development site, and a 25% reduction [i.e., DC = 0.75] within a 5 km zone around that buffered area [total 15 km] (Johnson et al 2005, pg. 16).	For the Meliadine and Gahcho Kué Project assessments, exploration projects were assumed to have a 500 m radius footprint (Golder Associates Ltd. 2014; De Beers Canada Inc. 2010b). Also for both projects, a 5 km ZOI was applied to all active exploration permits for the entire five-year period, and over the entire year.	The CEA for the Back River Project did not include exploration projects as disturbance activities. A review conducted by Areva showed that exploration footprints likely to represent a 7.4 ha area (~154 m radius)
MI — Mining (Polygon or Point)	14	Observed lower probability of occurrence of caribou within 6–14 km around combined mines and road (Boulanger et al. 2012). Hypothetical (not modelled) 15 km ZOI (Johnson et al. 2005). Caribou numbers decreased within 6 km of mine centre in late winter through calving seasons (Weir et al. 2007).	The Back River Project considered two ZOIs at 4 km and 14 km (Rescan 2013). The Meliadine Project considered a three ZOI range with variable disturbance coefficients 0-1, 1 to 5, 5 to 14 based on Boulanger (2012) (Golder Associates Ltd. 2014). The Gacho Kué Project assumed a 15 km ZOI was applied to all active mine sites regardless of the size of the footprint or the level of activity for each mine (De Beers Canada Inc. 2010).	
ERG — Energy corridors Point (plant); line(transmission)	4	Transmission lines: 4 km ZOI (Vistnes and Nelleman 2001 and Nelleman et al 2003)	Meliadine (Golder Associates Ltd. 2014); Gacho Kué (De Beers Canada Inc. 2010) used a 500 m radius footprint and a 1 km ZOI for power plants, and a 200 m footprint for transmission lines. A ZOI ranged from 0 to 5 km with variable disturbance coefficients from 0.05 to 0.75.	
TR — Tourism (e.g. guide and outfitting) Point	4	4 km ZOI (Vistnes and Nelleman 2001 and Vistnes et al 2003); 10% i.e., DC = 0.9) reduction in areas influenced by outfitters in a 500 m buffer (Johnson et al. 2005).	Not considered in cumulative effects for Meliadine or Back River CEAs. Gahcho Kue used a 200 m radius footprint and a 5 km radius ZOI with a DC of 0.1 (De Beers Canada Inc. 2010).	Accounts for seasonality and presumed quota (i.e., managed) harvest around outfitter camps.
TR — Traditional Harvest and Land Use	na	Johnson et al. (2005) noted specifically that they did not consider responses to subsistence harvest.	Not considered in cumulative effects for Meliadine, Gacho Kué or Back River CEAs	Not a spatial reference, background conditions

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Developer's Assessment Report Jay Project Section 12, Barren-Ground Caribou October 2014

Table 12.4-15 Extent and Disturbance Coefficients for Development Footprints and Associated Zones of Influence for Caribou Seasonal Resource Selection Functions

		Fo	otprint	Concentric Zon	e of Influence #1	Concentric Zone	e of Influence #2	Concentric Zone of Influence #3	
Disturbance Type	Feature Type	Extent (m)	Disturbance Coefficient	Range ^(a) (km)	Disturbance Coefficient ^(b)	Range ^(a) (km)	Disturbance Coefficient ^(b)	Range ^(s) (km)	Disturbance Coefficient ^(b)
Campgrounds	Point	250	0.00	n	/a	n	/a	n/	a
Community	Polygon ^(c)	Actual	0.00	0 to 1	0.05	1 to 5	0.50	5 to 15	0.75
Communications	Point	250	0.00	0 to 1	0.90	n	la	n/	a
Contaminated Site High and Medium Priority for Action ^(d)	Point	250	0.00	n	/a	n	la	n/	a
Fuel Storage	Point	250	0.00	n	/a	n	/a	n/	a
Mine	Polygon ^(c)	Actual	0.00	0 to 1	0.05	1 to 5	0.50	5 to 15	0.75
Mineral Exploration	Point	500	0.00	0 to 1	0.50	1 to 5	0.75	n/a	
Power Plant	Point	500	0.00	0 to 1	0.50	n	/a	n/a	
Quarrying	Point	250	0.00	0 to 5	0.75	n	/a	n/a	
Staging Area	Point	250	0.00	0 to 5	0.75	n	/a	n/a	
Tourism (lodge)	Point	250	0.00	0 to 5	0.10	n	/a	n/a	
Transmission and Power Lines	Line	250	0.25	0 to 1	0.50	1 to 5	0.75	n/	a
All-season Roads and Highways	Line	250	0.00	0 to 1	0.05	1 to 5	0.75	n/	a
Winter Road	Line	250	0.00	0 to 1	0.05	1 to 5 0.75		n/a	
Winter Road Portage	Line	250	0.00	n	/a	n/a		n/a	
Miscellaneous (Bridge, Culvert)	Point	250	0.00	0 to 1	0.90	n	a	n/	a

a) From edge of actual or hypothetical footprint.

b) Disturbance coefficient (applied as a multiplier to cell RSF value), based on assumed disturbance.

c) Footprints were delineated from remote sensing imagery.

d) As defined by the Federal Contaminated Sites Inventory (TBCS 2013).

n/a = Not applicable; km = kilometre; m = metre.

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APPENDIX E:

Land Use Economic Evaluation Methods

1 Introduction

This document summarizes methods used to estimate the economic outputs of potential future mineral sector and transportation projects within the Bathurst range planning area. At this time, only future potential mineral development and transportation projects have been considered¹. Potential economic outputs of projects included in the BCRP Future Development Scenarios (see **Appendix B**) have been estimated based on known or estimated project parameters.

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.

The methods and results of this evaluation should be interpreted in the following context:

- The methods and results should be interpreted as relative economic outputs or contributions; the methods used are not suitable to forecast detailed absolute values; and
- The methods used result in economic outputs specific to the Bathurst range planning area. They are not intended to provide a detailed economic model for the entire NWT or Nunavut economy, nor do they consider contributions to the national or global economy.

2 Methods

2.1 General Approach

Different economic models and modeling approaches are available to estimate the economic contributions of potential future economic development. Potential economic models include *Statistics Canada's Interprovincial Input-Output Model* and the *Northwest Territories Economic Impact Model*. However, using such detailed economic models can be time intensive and require high levels of expertise. The role of economic modeling within the BCRP is not to make precise estimates of economic contributions resulting from potential future development to the territorial or national economy, but to understand the relative changes that may occur while exploring different caribou habitat management strategies.

Recognizing this situation, the BCRP Working Group aimed to estimate the approximate and relative economic outputs associated with a range of potential mineral development and transportation

¹ In the future, economic outputs associated with mineral development may be considered.

scenarios in the 2016 to 2040 time period. For each mineral development or transportation project included in the BCRP Development Scenarios (see **Appendix B**), published economic multipliers from the NWT Bureau of Statistics (2012) and expert opinion were used to estimate the future economic output of individual projects, based on known or estimated parameters for construction, operations and reclamation costs for each project. Detailed methods are described below.

2.2 Economic Multipliers

The NWT Bureau of Statistics (2012) has published tables of economic multipliers that relate a given amount of economic output within a sector to three different economic indicators: **Gross Domestic Product (GDP), Labour Income,** and **Employment**. As stated by the NWT Bureau of Statistics (2012), such economic multipliers are considered to be intensity ratios, and are intended to be used as follows:

- The intensity ratios are appropriate for very general assessments of economic impacts.
- When estimating economic impacts, it is preferable to use multipliers to make relative, rather than absolute, comparisons. Where multipliers are used to estimate the impacts of a single activity, the results should be treated only as a general estimates, indicating the order of magnitude of the impacts rather than exact levels.

Economic multipliers are therefore well suited as a means to consider the relative changes in economic output that may occur while exploring different caribou habitat management strategies. The following example from NWT Bureau of Statistics (2012) illustrates how economic multipliers can be used to estimate economic output associated with a specified level of spending in the construction industry.

Example: Construction Industry Expansion

Intensity ratios are often used when all that is known about a project is the gross change in economic activity. For example, if there were a \$50 million increase expected in the output of the territorial construction industry, then using the construction industry intensity ratios from Table 1, the total direct and indirect economic effects would be as follows:

GDP at Basic Prices (\$): [GDP intensity ratio for Const.] x [Gross output] [0.46] x [\$50 million] = \$23 million Labour Income (\$): [Labour income intensity ratio for Const.] x [Gross output] [0.33] x [\$50 million] = \$16.5 million Employment (PYs): ([Gross output] / [1 million]) x [Employment intensity ratio for Const.] [\$50 million/1 million] x [3.5] = 175

Therefore, a \$50 million expected increase in the output of the construction industry has a potential GDP impact of \$23.0 million; labour income impact of \$16.5 million; and the potential creation of 175 person-years of employment.

2.3 Applying Economic Multipliers to Mineral Sector Activity

The two main parts of the mining life cycle (**Figure 1**), exploration and development, provide a useful framework to understand activities considered by the BCRP economic evaluation.

Mineral Exploration

Mineral Exploration may include all activities prior to mine development (the Exploration and Discovery phases of the mining life cycle, as shown in **Figure 1**). Specific activities may include mineral claim staking and early investigations, exploration associated with land use permits, and advanced exploration and deposit appraisal.

Mineral Development

Mineral Development refers to the life cycle phases of mine Development (i.e., construction), Production (operations) and Reclamation (**Figure 1**). Mine development results in the construction of long-term industrial facilities as well as air or ground transportation infrastructure.

At this time, only the mineral development part of the mining life cycle has been considered in the BCRP economic evaluation.

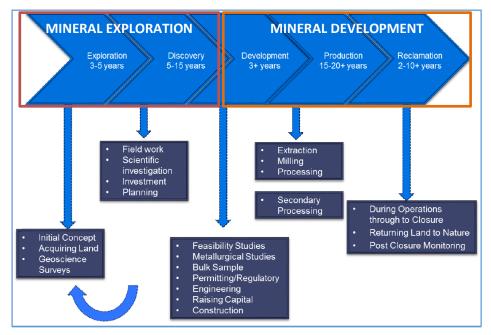


Figure 1. The mineral exploration and development life-cycle (Source: Government of Northwest Territories, Department of Industry, Tourism and Investment).

The BCRP Working Group has used published NWT economic multipliers to estimate economic output associated with mineral development and transportation projects included in the BCRP Future Development Scenarios (see Appendix C). Published economic multipliers relevant to the NWT mineral exploration and development sectors are listed in **Table 1**². A similar approach was used in a recent socio-economic assessment for the Łue Túé Sulái Candidate Protected Area in southern NWT (Stantec 2015).

Mineral Sector	NWT Economic Indicators and Economic Multipliers							
Activities	GDP per	Labour Income per	Jobs per million dollars					
	dollar of expenditure	dollar of expenditure	of expenditure (PYs)					
MINERAL EXPLORATION *								
Support Activities for Mining and	0.79	0.57	5.5					
Oil and Gas Extraction								
MINERAL DEVELOPMENT								
Construction	0.46	0.33	3.5					
Diamond Mining	0.71	0.13	1.1					
Truck Transportation	0.55	0.44	5.7					
Waste Management and	0.82	0.47	6.7					
Remediation Services								

Table 1. NWT economic indicators and multipliers, organized by mineral sector exploration and development activities. Source: NWT Bureau of Statistics (2012).

* Note: At this time the BCRP economic evaluation focuses on potential future mineral development and transportation projects.

2.3.1 Estimating Economic Outputs of Mineral Development and Transportation Projects Considered in the BCRP Development Scenarios

Estimating the potential future economic outputs of mineral development is dependent on the size of the mine, operating costs, and potentially the level of production and/or mineral commodity. BCRP Working Group members held meetings with Government of Northwest Territories and NWT and Nunavut Chamber of Mines representatives between October 2015 and March 2016. During these meetings, and through subsequent research, known or estimated costs were identified for the construction, operations and reclamation phases of mineral development projects considered within the BCRP development scenarios.

Table 2 provides a summary of the known or estimated project costs and calculated economic outputs for three indicators—GDP, labour income and employment—based on NWT published economic multipliers. Results are shown for the construction and operations phases of each mineral development project.

² The published NWT economic multipliers are assumed to also be relevant for similar activities in the Nunavut portion of the Bathurst range planning area.

Table 2. Calculated economic outputs (GDP, labour income and employment) resulting from mineral development and transportation projects considered in

 the Bathurst development scenarios.
 Economic outputs are based on published NWT economic multipliers (NWT Bureau of Statistics 2012).

SCENARIO	PROJECT	PHASE															
		CONSTRUCTION				OPERATIONS											
		Total Cost (\$M)	Duration (years)	GDP (\$M) Annual	Total	Labour Income (\$M) Annual	Total	Jobs (PY) Annual	Total	Annual Costs (\$M)	Duration (years)	GDP (\$M) Annual	Total	Labour Income (\$M) Annual	Total	Jobs (PY) Annual	Total
r	Ekati	520	4	60	239	43	172	455	1,820	600	14	426	5,964	78	1,092	660	9,240
CASE 1	Diavik	386	3	59	178	42	172	450	1,351	423	7	300	2,102	55	385	465	3,257
	Gahcho Kué	1,019	2	234	469	168	336	1,783	3,567	212	12	151	1,806	28	331	233	2,798
	Whati Road	190	4	22	87	16	63	166	665	1	18	1	10	0	8	6	103
	Snap Lake	0	0	0	0	0	0	0	0	200	10	142	1,420	26	260	220	2,200
CASE 2	Back River (Goose)	415	2	95	191	68	137	726	1,453	121	12	86	1,031	16	189	133	1,597
	Kennady North	1,019	2	234	469	168	336	1,783	3,567	212	12	151	1,806	28	331	233	2,798
	NICO	357	2	82	164	59	118	625	1,250	59	16	42	670	8	123	65	1,038
	Tibbit-Lockhart Rd	230	3	35	106	25	76	268	805	2	14	1	15	1	12	11	160
	Lupin and Ulu	470	4	54	216	39	155	411	1,645	150	10	107	1,065	20	195	165	1,650
	Courageous Lake	1,520	2	350	699	251	502	2,660	5,320	300	10	213	2,130	39	390	330	3,300
	Nechalacho	1,580	2	363	727	261	521	2,765	5,530	300	15	213	3,195	39	585	330	4,950
	Indin Lake	250	2	58	115	41	83	438	875	150	13	107	1,385	20	254	165	2,145
	Tyhee Gold	250	2	58	115	41	83	438	875	150	10	107	1,065	20	195	165	1,650
CASE 3	Izok Road	400	4	46	184	33	132	350	1,400	4	8	2	18	2	14	23	182
1	Izok Lake	2,000	2	460	920	330	660	3,500	7,000	600	6	426	2,556	78	468	660	3,960
	High Lake	1,000	2	230	460	165	330	1,750	3,500	400	6	284	1,704	52	312	440	2,640
1	BIPAR Road	170	3	26	78	19	56	198	595	1	3	1	2	0	1	6	17
	Hackett River	1,500	2	345	690	248	495	2,625	5,250	600	2	426	852	78	156	660	1,320
	TOTALS	12,756	43	2,752	5,868	1,974	4,209	20,937	44,646	3,885	184	2,757	22,832	508	4,208	4,310	35,766

		Labour	
Sector	GDP	Income	Jobs (PY)
Construction	0.46	0.33	3.5
Mining	0.71	0.13	1.1
Transportation	0.55	0.44	5.7

TRANSPORTATION

CONSTRUCTION COSTS

NOTES

1. Duration of Operations phase is only showing the number of years prior to end of scenario (2040).

2. Values in red indicate estimated costs based on similar-sized projects.

2.3.2 Estimating Economic Outputs of Transportation Projects Considered in the BCRP Development Scenarios

An average of \$2 million/km was used to represent construction costs associated with a typical northern all-season road. This value was used based on estimates created for the proposed Whati all-season road (NWT Department of Transportation estimates a construction cost of approximately \$1.6 million/km).

Table 2 shows calculated economic outputs for potential future transportation projects based on averageconstruction costs of \$2 million/km and published Transportation economic multipliers.

2.3.3 Estimating Economic Outputs Associated with Mine Reclamation

Information regarding the reclamation costs for existing mines is available (Diavik and Gacho Kué). A coarse level assumption was made to estimate reclamation costs for mines without this type of information (future conceptual projects). Both Diavik and Gacho Kué's reclamation costs are in the range of 20%-35% of annual operating costs. This estimation method assumes that annual operating costs will be proportional to reclamation costs at a level indicated by available information on the Diavik and Gacho Kué mine. So as not to overestimate economic outputs associated with reclamation, a value of 25% annual operating costs was used to estimate reclamation costs for all projects. While this method has a high level of uncertainty, reclamation costs associated with specific mine sites was found to be a relatively minor contribution to the total economic outputs associated with the scenarios, relative to Construction and Operations.

2.3.4 Tracking Economic Contributions of BCRP Development Scenario Projects

A custom-developed spreadsheet was designed to track the economic parameters associated with each mineral development and transportation project included in the BCRP Development Scenarios, for a period 24-years into the future (2016 to 2040). Appendix B of the *Interim Discussion Document (2016)* contains results of the economic assessment by Range Assessment Area.

3 References

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

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Bathurst Caribou Range Plan: Draft Range Assessment and Technical Methods Report (March 2017)

APPENDIX F:

Methods and Summary of Key Results for Bathurst Caribou Range Plan using the CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Integrated Caribou Model

1. Caribou computer model

While traditional and scientific knowledge provide us with 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 key factors and stressors may influence caribou populations in the future. The BCRP Working Group used a computer simulation model to explore and understand the relative effects of different natural and human-caused disturbances that may influence the population health of the Bathurst caribou. Figure 1 illustrates an important impact pathway of human land use to barren-ground caribou, which was simulated in the model as the cumulative disturbance that caribou are subjected to when they encounter multiple anthropogenic footprints¹ and associated disturbances on their annual range.

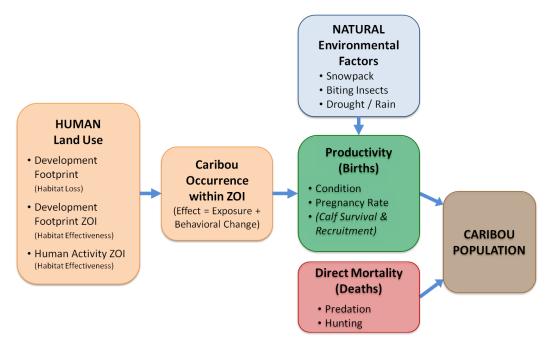


Figure 1. Conceptual impact pathway of human land use disturbance and other key factors that influence vital rates and caribou population health

¹ Anthropogenic footprints are the human-made permanent or temporary features that occupy space on the landscape such as winter and all-season roads, towns, cities, mineral exploration sites, transmission lines, mines, and industrial plants.

In the model, each footprint type on the range was assigned a zone of influence (ZOI), which was the associated area around the direct footprint that corresponds with an avoidance response by caribou. The model simulated and tracked the cumulative number of encounters that a caribou may have with each type of anthropogenic footprint and associated ZOI on its annual range. Thus the cumulative number of days a caribou encountered a footprint ZOI throughout a year, represented the total time when a caribou's daily food intake (i.e., energy and protein intake) and activity budget may be influenced by human-caused disturbance. This encounter rate provided a means of simulating how seemingly small impacts to daily food intake and activity budgets on individual caribou may have cumulative population-level effects on herd productivity through reductions in pregnancy rate and/or early calf survival (Figu).

The CircumArctic Rangifer Monitoring and Assessment (CARMA) integrated caribou model (Russell et al. 2005, Gunn et al. 2013, White et al. 2013, White et al. 2014) was the simulation tool used by the Working Group to develop a deeper understanding of the potential cumulative effects of industrial development and anthropogenic footprints on Bathurst caribou. The CARMA caribou model was comprised of several interacting components including a movement model, energy-protein model and a population model. In addition to evaluating the magnitude of disturbance effects to population productivity (and potentially mortality), the CARMA modeling framework permitted an assessment of the relative contributions of natural environmental factors, as well as assumptions about direct sources of mortality that were attributed to predation and/or hunting (Figu).

The methodology and assumptions adopted for running the integrated model on the Bathurst herd were described by Russell et al. (2015) in their project report commissioned by the Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP), and are summarized below.

The initial inputs were satellite or GPS collar movement data, spatial layers for vegetation, climate, harvest risk areas, the initial industrial development footprint, and future development rates and the ZOI. These inputs were then integrated in to several modeling components.

- A caribou movement model estimated the daily environment encountered by an individual caribou and included activity budgets, forage biomass and climate variables. Based on telemetry data, the movement model used observed caribou migration patterns across the herd's range, and tracked all encounters with development footprints (and associated ZOIs), and harvest risk areas. The model estimated the consequences of those daily movement patterns on caribou behaviour (i.e., activity budgets) and available forage. For example, when caribou encountered a ZOI, their daily activity budget is adjusted in the model through reductions in feeding time (6%) and feeding intensity (3%) and an increase in activity (3%) (D. Russell pers. comm.).
- 2) Those data become inputs in to an individual caribou energy-protein (body condition) model, which tracked daily food intakes and metabolic requirements, combined with any future projections of vegetation change, to predict changes in body condition of an individual caribou over time.
- 3) The output of the body condition sub-model was then used to simulate changes in caribou fecundity and survival which, along with the harvest risk projections of the movement model, became inputs to a population model that was used to simulate dynamics in future size and age-sex composition of the caribou herd.

For the Bathurst Range Plan, scenarios were designed by the range planning team in collaboration with the modelers (D. Russell and A. Gunn). The goals of the scenario analyses were to:

- address broad questions about the CARMA caribou model and report (Russell et al. 2015), which had been posed and discussed by the Bathurst Range Plan Working Group (September 2015);
- provide simulation results to illustrate and discuss educational value of the CARMA caribou model and scenario modeling to the Working Group; and
- engender support from the Working Group to conduct additional analyses with the CARMA caribou model (and modelers) and further explore relative potential impacts of industrial development and disturbance to caribou within a cumulative effects context.

2. Scenarios

Two sets of scenario analyses were conducted. The first focused on using the model as a learning tool and to address questions posed by the BCRP Working Group, and the second set of analyses were conducted to further explore effects of development and disturbance to caribou. Although both sets of scenario analyses were based on contrasting different future trajectories of landscape development, a key distinction was that in the first set of analyses the anthropogenic footprints remained constant over the entire 16-year simulation period within each level of development². Whereas in the second set of analyses, footprint amounts changed over a 24-year simulation period according to development lifecycle assumptions that were defined for all mining projects, which included the different stages of construction, operations, closure and reclamation (see **Section 3.4** of main report).

Scenario Set 1

The simulations conducted in Scenario Set 1 were designed to learn more about the model, the relative importance of key factors on a caribou population, and to address questions discussed and posed by the BCRP Working Group, which included the following:

- 1. What is the relative importance of initial population size, population trend, and development scenario (i.e., footprint) on a caribou population?
- 2. How do predation and hunting affect caribou population trend?
- 3. How do environmental conditions affect a caribou population?

Caribou Population and Other Model Input Assumptions

Table 1 summarizes the key risk factors, along with associated input assumptions and caribou response variables for the scenario modeling. Table 2 summarizes the respective scenario designs and specific input assumptions that were used to address the three questions posed by the Working Group.

² The initial analyses were conducted using an early version of the Development Scenarios, where a Current, Future Low, and Future High scenario was created. These three scenarios included project assumptions and timelines very similar to the later CASE 1, CASE 2 and CASE 3 scenarios but did not incorporate changes in footprint dynamics over the duration of the scenario period.

For the caribou population assumptions, the input variables centered on the initial population size and mortality rates. Three options were used for initial population sizes that included 50,000, 15,000, and 7500 caribou respectively (Table 2). Assumptions for high, medium, and low mortality rates are summarized according to five age classes for female and male caribou in Table 3, with corresponding population growth rates shown in Figure 2. The mortality assumptions were considered to largely be a reflection of natural mortality rates primarily due to predation.

A "low" hunting level resulted in an annual offtake of 200 caribou with a sex ratio of three bulls to every cow (i.e., 150 bulls and 50 cows); and "high" hunting was determined as 3% of the population removed every year with 2 females taken for every male (Table 2). Environmental conditions were based on average temperatures from mid-May to early August and expressed as average growing degree days (GDD) for that period. A low GDD condition was based on 1.5°C cooler than average temperatures, and the high GDD level was 1.5°C warmer than average (Table 2) in spring and summer months.

Table 1. Key factors, input assumptions, and response variables for caribou model simulations in Scenario Set 1.

Key Factors for Model Simulations	Input Variable Assumptions	Caribou Population Response Variables	
Initial Population Conditions	 Population Size Population Trend (mortality) 		
Development Scenarios	• No Development • Current Development • Future – Low • Future – High	Population Trend Pregnancy Rate Calf Mortality Encounter Rate	
Population Risk Factors	 Mortality Predation & Harvest Productivity Environmental conditions (climate) 		

Table 2. Comparative summary of scenario designs in Scenario Set 1 to address three modeling questions posed by Bathurst Caribou Working Group.

	: relative importance pulation size, trend, pment	b) Question 2 hunting	: predation and	c) Question 3 conditions	: environmental
Key Factors	Input Assumptions	Key Factors	Input Assumptions	Key Factors	Input Assumptions
1) Initial Population Size	• 50,000 (50K) • 15,000 (15K)	1) Initial Population Size	• 15,000 (15K) • 7,500 (7.5K)	1) Initial Population Size	• 50,000 (50K) • 15,000 (15K)
	• 7,500 (7.5K)		 Low Mortality 	1 optimion Size	• 7,500 (7.5K)
2) Population Trend (Mortality)	Low MortalityMedium Mortality	2) Population Trend (Mortality)	Medium MortalityHigh Mortality	2) Population Trend (Mortality)	Low MortalityMedium Mortality
	High Mortality	3) Development	Comment		 High Mortality
2) Development	No Development	Scenarios	Current	3) Development	• Current
3) Development Scenarios	 Current Future-Low Future-High 	4) Hunting	 No Hunting Low Hunting: 200 caribou (1F:3M) 	Scenarios 4) Environmental Growing Degree	• Low (-1.5°C) • Average
3 x 3 x 4 = 36 simulations		.,	High Hunting:	Days (GDD)	• High (+1.5°C)
		3% of population (2F:1M)		3 x 3 x 1 x 3 = 27 simulations	
		2 x 3 x 1 x 3 = 18 s	mulations		

		High Mortality			Me	Medium Mortality			Low Mortality		
Sex	Age Class	mean	min	max	mean	min	max	mean	min	max	
Female	Calves	0.450	0.405	0.495	0.430	0.387	0.473	0.350	0.315	0.385	
Female	Yearlings	0.130	0.117	0.143	0.100	0.090	0.110	0.080	0.072	0.088	
Female	2-yr olds	0.160	0.144	0.176	0.130	0.117	0.143	0.080	0.072	0.088	
Female	3-8 yr olds	0.300	0.270	0.330	0.160	0.144	0.176	0.100	0.090	0.110	
Female	9+ yr olds	0.350	0.315	0.385	0.210	0.189	0.231	0.150	0.135	0.165	
Male	Calves	0.500	0.450	0.550	0.480	0.432	0.528	0.400	0.360	0.440	
Male	Yearlings	0.200	0.180	0.220	0.150	0.135	0.165	0.130	0.117	0.143	
Male	2-yr olds	0.210	0.189	0.231	0.180	0.162	0.198	0.130	0.117	0.143	
Male	3-8 yr olds	0.350	0.315	0.385	0.210	0.189	0.231	0.150	0.135	0.165	
Male	9+ yr olds	0.400	0.360	0.440	0.260	0.234	0.286	0.200	0.180	0.220	

Table 3. Annual mortality rate assumptions for female and male Bathurst caribou in five age classes.

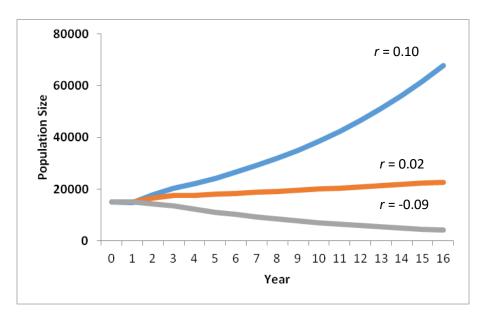


Figure 2. Mean annual exponential rates of increase for a modelled caribou population starting at 15,000 individuals and corresponding to simulated levels of low (r = 0.10), medium (r = 0.02), and high (r = -0.09) mortality rates from Table 3.

Industrial Development and Anthropogenic Footprint

- Landscape disturbance was simulated based on plausible and contrasting range-scale mine development trajectories over a 16-year period (i.e., 2 caribou generations).
 - With the assistance of a mineral task group, the BCRP Working Group defined future development scenarios to explore plausible patterns and amounts of development footprint within the Bathurst range. In summary, four development scenarios were defined to compare different relative amounts of future industrial activity including: "No Development", "Current Development", "Future-Low", and "Future-High" (see Footnote 2, above).
 - A ZOI was attributed to each identified project and anthropogenic footprint, as described in Appendix D. The disturbance for each development trajectory was represented by the

anthropogenic footprint (& ZOI) and was held constant for the duration of the simulation period.

 To estimate the potential encounter rates of caribou to anthropogenic footprints in each of the development trajectories, 100 movement paths were randomly selected from the 2007-2014 GPS collar locations of Bathurst caribou.

Scenario Set 2

The simulations in Scenario Set 2 were conducted to describe relative potential impacts of industrial development and disturbance to caribou. The development scenarios were updated by the mineral task group and BCRP Working Group to reflect more plausible temporal trajectories for mineral development projects based on a simplified mine life-cycle approach that consisted of three phases including construction, operations, and reclamation (see **Section 3.4** of main report)

Caribou Population and Other Model Input Assumptions

Table 4 shows that the focus of Scenario Set 2 was on the relative effects of development scenarios on caribou population response variables. The initial population size was set at 20,000 caribou to reflect results from the 2015 Bathurst calving ground photographic survey (Boulanger et al. 2016). Population trend was based on assumptions for high, medium and low natural mortality rates (Table 3), and hunting was assumed to be zero. Environmental conditions reflected average temperatures and GDD's for the period of mid-May to early-August. Table 5 summarizes the scenario design and specific input assumptions that were used to further assess potential impacts of industrial development scenarios on caribou.

Key Factors for Model Simulations	Input Variable Assumptions	Caribou Population Response Variables
Initial Population Conditions	Population Trend (mortality)	Population Trend
Development Scenarios	No Development Case 1 – Declining Development Case 2 – Continuing Development Case 3 – Increasing Development	Pregnancy Rate Encounter Rate

Table 4. Key factors, input assumptions, and response variables for caribou model simulations in Scenario Set 2.

Table 5. Summary of scenario design in Scenario Set 2 to explore relative effects of development scenarios on caribou.

Key Factors	Input Assumptions
1) Initial Population Size	• 20,000 (20K)
2) Population Trend (Mortality)	 Low Mortality Medium Mortality High Mortality
3) Development Scenarios (5 time steps per Case)	 No Development Case 1 - Declining Case 2 - Continuing Case 3 - Increasing
4) Hunting	None
5) Environmental Growing Degree Days (GDD)	• Average

1 x 3 x (5 x 4) x 1 x 1 = 60 simulations

Industrial Development and Anthropogenic Footprint

- Landscape disturbance was simulated from four industrial development scenarios that were based on plausible mine life cycle trajectories over a 24-year period from 2016 to 2040 (i.e., 3 caribou generations) for the annual Bathurst range.
 - In addition to a "No Development" base-case, three development cases represented plausible future scenarios for industrial development in the Bathurst range, and each case represented a different relative amount of future industrial activity. 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. CASE 1 represented a situation of declining development, where the existing operating diamond mines and TCWR cease operations by 2040, and no new mines were brought to production. CASE 2 projected 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 TCWR is replaced by an all-season road. CASE 3 represented 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. Figure 11 of main report shows the results of each scenario on the range map at year 2040 and Section 3.4 of main report provides a more detailed description of the scenarios.
- The ZOIs described in **Appendix D**, were attributed to each of the anthropogenic footprints represented within each development trajectory of Scenario Set 2. To reflect the changing amount of industrial footprint over the 24-year simulation period, each development trajectory was broken into five discrete time steps that occurred at 6-year intervals. Thus, the disturbance during each time slice was represented by the anthropogenic footprint (and associated ZOI) that occurred at 2016, 2022, 2028, 2034, and 2040 respectively.
- Fifty movement paths were selected from the 2009-2015 GPS collar locations of Bathurst caribou to simulate potential encounter rates of caribou to anthropogenic footprints at each of the five time steps within the respective development trajectories.

3. Key Results and Findings

Future land use scenarios provide insight into the amount of human-caused change that may occur in different parts of the range in the future.

Scenario Set 1 - Results

The key results in this section are organized according to the three questions posed by BCRP Working Group.

1) <u>What is the relative importance of initial population size, population trend, and development</u> <u>scenario (i.e., footprint) on a caribou population?</u>

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 (Figure 3). 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 shown by the declining slopes in population growth rate (*r*) as development levels changed from no development to a future-high scenario (Figure 4). This was most clearly shown for populations that had a medium level of mortality (red lines in Figure 4), where under a no development scenario the population would be increasing (i.e., it had a positive *r* value) but 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 (i.e., it had a negative *r* value).

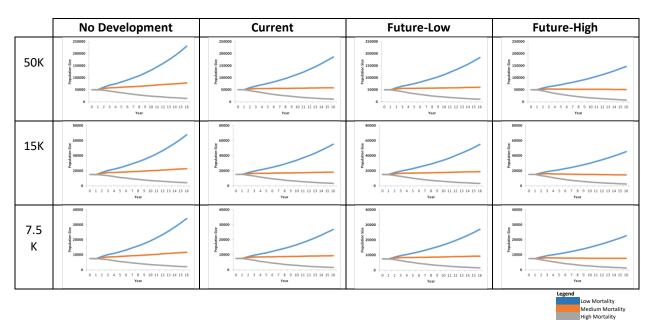
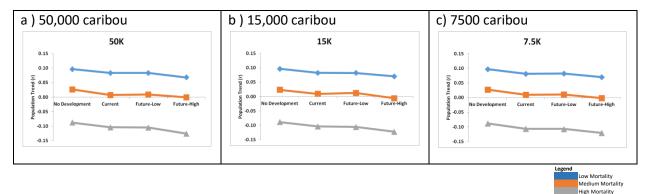


Figure 3. Comparison of simulated caribou population trends showing the relative influence of industrial development levels (no development, current, future-low, and future-high), initial population sizes (50K, 15K, and 7.5K), and different rates of natural mortality (low, medium, and high).





Increased industrial development levels resulted in incrementally higher encounter rates of caribou with human footprints (Figure 5a), which in turn imposed higher energetic costs to adult females and reduced their fall pregnancy rates (Figure 5b). 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.

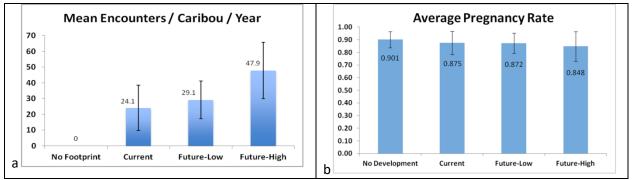


Figure 5. Influence of industrial development scenarios on a) average encounter rates (\pm 1 *standard deviation) of caribou with a human footprint , and b) average pregnancy rate* (\pm 1 *standard deviation).*

2) How do predation and hunting affect caribou population trend?

The model simulations 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) (Figure 6).
- 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 (Figure 7).
- c) High and selective harvest mortality of females may have strong additive and negative effects on population trend (Figure 7) because it not only contributes to increasing mortality rates, but also reduces future rates of productivity (i.e., numbers of newborn calves).

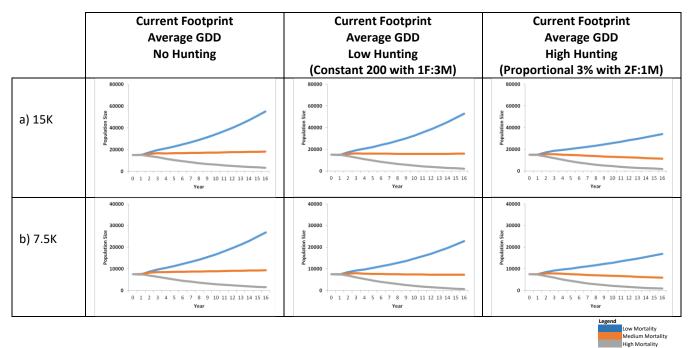


Figure 6. Comparing the influence of mortality and hunting levels on caribou population trend over time with initial population size at a) 15,000 caribou and b) 7500 caribou.

The additive and interactive effect of hunting with natural mortality rates is illustrated in Figure 7, 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 Figure 7a and 7b 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 7500 caribou, although 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 $\sim 2\%$ 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 7b). In comparison, the high hunting strategy shifted both scenarios (with different initial population sizes) to a declining trend (Figure 7b). Under high mortality assumptions and no hunting, the population was declining at \sim -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.

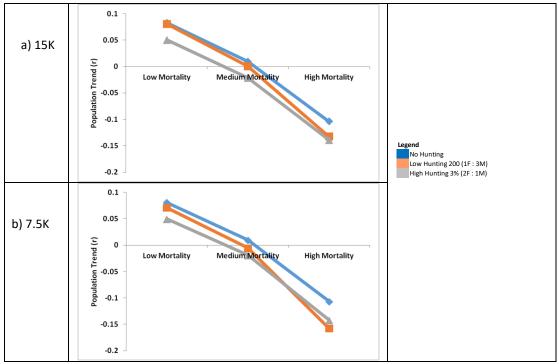


Figure 7. Comparing the influence of mortality and hunting levels on population rate of growth (r) with initial population size at a) 15,000 caribou and b) 7500 caribou.

3) How do environmental conditions affect a caribou population?

The model simulation results to explore the influence of environmental conditions are shown in Figure 8. A key finding was that environmental variability is also an important factor that influences caribou population productivity, through effects on 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).

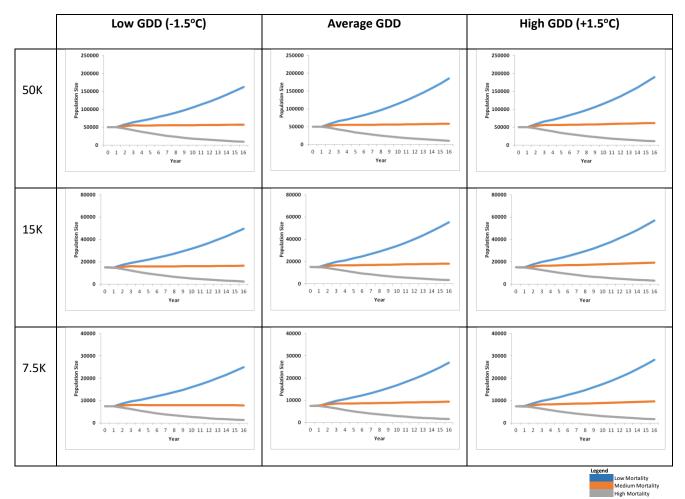


Figure 8. Simulated caribou population trends that compared the relative influence of environmental conditions from mid-May to early August, defined as low growing degree days (GDD), average GDD, and high GDD. Simulations were based on current development with three initial population sizes (50K, 15K, and 7.5K), and three rates of natural mortality (low, medium, and high).

Figure 9 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 9 expressed 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.

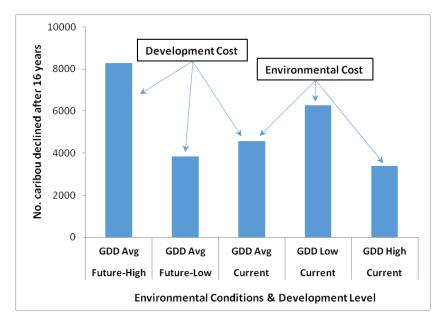


Figure 9. Relative decline in caribou abundance after 16-year simulation period compared to a reference case scenario with average mortality assumptions, average GDD environmental conditions, and no development footprint.

Scenario Set 2 - Results

The simulations in Scenario Set 2 provided insight in to potential effects of development scenarios on Bathurst caribou, and key results are summarized in this section starting with encounter rates of individual animals, followed by an overview of the potential impact on productivity, and concluded with a description of population-level responses.

1) Encounter rates of caribou with anthropogenic footprints

Caribou encounters were simulated in the movement model based on the intersection of 50 Bathurst caribou movement pathways with current and future footprints (including ZOIs) that were defined for each of three development cases over a 24-year simulation period. The average number of encounters was lowest in development Case 1, intermediate in Case 2, and highest in Case 3 (Figure 10). Within a development Case, the temporal pattern of encounter rates across five timesteps reflected the net amount of footprint that was active on the range during the development scenario. The first 5 bars in Figure 10 shows that average encounter rates for caribou declined over time in Case 1, which corresponded to the declining level of industrial activity for this scenario over the 24 year simulation period. In comparison, the trend in encounter rates for Case 2 (timesteps 1-5) showed a rapid increase within the first 6 years, followed by a steady decline in encounter rates for the rest of the simulation period (bars 2-1 to 2-5 in Figure 10). Similarly, under the assumption that industrial development would steadily increase for Case 3, the average encounter rate of caribou also increased from the start of the simulation period to the end (bars 3-1 to 3-5 respectively in Figure 10). Although there was considerable seasonal variability when caribou encountered anthropogenic footprints in the development scenarios, most encounters occurred during fall, summer and winter respectively (Figure 10).

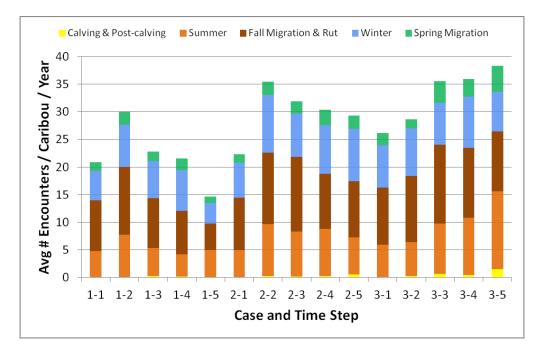


Figure 10. Magnitude and seasonality of encounter rates of caribou with three development case scenarios, with each case comprising of five time steps spanning a 24-year simulation period.

Because encounters are based on the overlap between a sample of caribou movement paths (2009 – 2015 GPS collars) and the spatial extent of the current and future footprints, the absence of one or both of those features results in the absence of an encounter between caribou and footprint. Thus, the virtual absence of current and future anthropogenic footprint in RAA3 and RAA5 results in there being no encounters in either area. Conversely, in areas where there is current and future footprint and is used by caribou, then there is a correlation between total footprint and average encounter rates (Figure 11). There was a stronger correlation between total footprint and encounter rate in RAA1 and RAA2, compared to RAA4 (Figure 11). Although at the annual range-scale the correlation was strong (Figure 11d).

A comparison of temporal trends in encounter rates for the three development cases at the RAA-level suggests: a) encounter rates in RAA1 will increase the most according to the development case assumptions (Figure 12a); b) encounter rates are highest in RAA2 and will likely remain relatively constant especially for development Cases 2 and 3 (Figure 12b); and c) encounter rates in RAA4 are comparatively lower, but encounters are consistent across all cases, with the exception of Case 1, timestep 5, which showed a marked decline (Figure 12c). At the annual range scale, the average encounter rate would remain elevated and increase compared to current conditions for development Cases 2 and 3 (Figure 12d). In contrast, the average encounter rate would decrease over time under assumptions of Case 1 (Figure 12d).

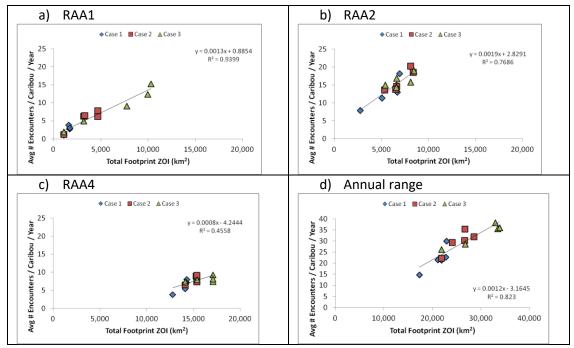


Figure 11. Relationship between average number of encounters/caribou/year and total anthropogenic footprint km² (including ZOI) within RAAs and at the annual range scale.

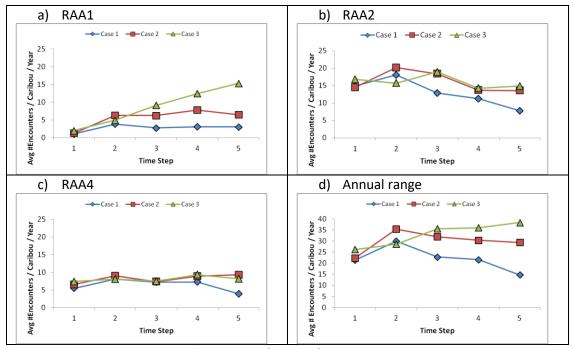
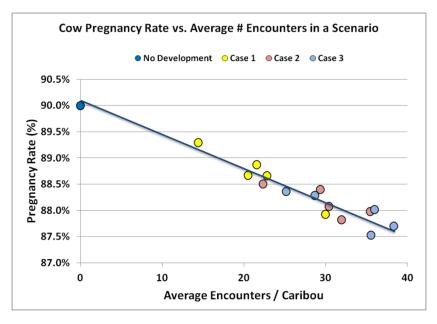


Figure 12. Average number of encounters/caribou/year within RAAs and at the annual range scale for each development case.

2) Productivity of a caribou herd

Productivity reflects the potential for a caribou population to increase and generally refers to the number of surviving offspring produced during a year. Thus, rates of pregnancy or fecundity³ in adult cows are fundamental indicators that establish herd productivity. Calf survival also contributes to herd productivity because it determines what proportion of viable calves that are born may be added to the population in the future. Thus, high calf survival increases herd productivity while low calf survival reduces productivity.

With respect to herd productivity, a key finding of Scenario Set 2 was the relationship between average annual encounter rates of female caribou with anthropogenic footprints and expected pregnancy rates in fall, where pregnancy rate declined inversely to an increase in average encounter rates (Figure 13). This output from the CARMA integrated model was based on the energetic and nutritional consequences of cumulative disturbance to a caribou cow, which was determined from the encounter rate with human footprints and subsequent effects on daily activities.





3) Population-level responses of caribou to disturbance

Modelling results suggested that the effect of anthropogenic disturbance on caribou productivity (primarily pregnancy rates) would result in a reduction in population growth rate, with the magnitude of effect related to the cumulative disturbance the population was exposed to. In those model runs, the level of disturbance encountered by caribou was simulated based on the intersection between a)

³ Fecundity is defined as the proportion of adult females calving in a given year, which is not the same as the proportion of adult females that become pregnant during the rut. Fecundity rates are generally lower than pregnancy rates because not all females that become pregnant will carry the fetus for the full gestation term and produce a viable calf.

current and future anthropogenic footprint on the Bathurst herd's annual range, and b) random selection of multiple (n=50) caribou movement pathways that were defined based on previous annual movement patterns of collared individuals. Because the impact pathway was estimated through a spatial intersection of future anthropogenic footprint development scenarios and previously documented movement pathways of caribou, the model simulated plausible and comparable risks of impact to caribou; it was not forecasting or predicting specific population-level impacts.

In this context, Figure 14 illustrates that each development case scenario results in a lower rate of population growth compared to the base case scenario of 'No Development'. Although the curves visually appear to show differing magnitudes of effects across mortality levels, the relative influence of the development cases on population growth rates is similar when scaled to exponential rates of increase (*r*).

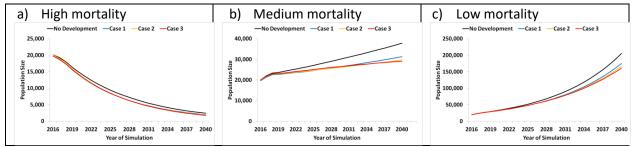


Figure 14. Comparative population trends of Bathurst caribou starting from an initial size of 20,000 animals and simulated 24-years in to the future based on three different industrial development case scenarios, and organized by (a) high, (b) medium, and (c) low rates of natural mortality.

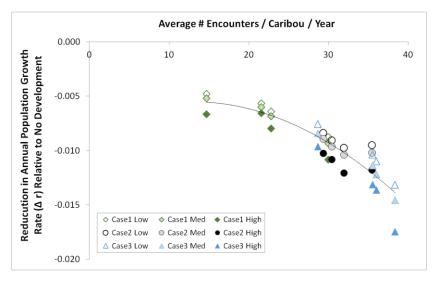


Figure 15. Simulated influence of average annual encounter rates of caribou on reductions in population growth rate (Δ r). Encounter rates of caribou to anthropogenic footprints were estimated for each of three industrial development Cases, and paired with annual growth rates at timesteps 2 to 5 in the 24-year development trajectories. Population growth rates were calculated from data in Figure 14.

Figure 15 shows the relative reduction in annual population growth rates (*r*) imposed by encounter rates of caribou with varying amounts and distributions of human footprints on its annual range, relative to a population with 'No Development' on its range. For these simulation results, the key input variable was the anthropogenic footprint and scenario assumptions for Case 1, Case 2, and Case 3, which were developed by the Mineral Task Group and BCRP Working Group, which was the main influence. The movement pathways of the 50 caribou cows were held constant across the three cases to maximize comparability and minimize any spatial variability and differences in encounter rates, which would have occurred if different movement paths were used for each of the three development cases (D. Russell pers. comm.).

All decisions are based on models... All models are wrong, but some are useful.

This one is useful

4. References

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APPENDIX G:

Water Crossings and Land Bridges Identified by Traditional Knowledge in the Bathurst Range Planning Area

Aboriginal Placename	English Placename	Meaning	Description	Reference
>edacho kué	Artillery Lake		Caribou crossing sites including those located at 2edacho kué or Artillery Lake (Kendrick, Lyver, and Nation 2005, Parlee, Manseau, and Lutsel K'é Dene First Nation 2005b) are well known to be of key importance to caribou and to Denés9liné. The crossings at both the north and southern points of Artillery Lake have always been gathering places for the Denés9liné in fall Prior to the last 10-15 years 2edacho, recognized to be one of the most frequently used crossing sites, was known to have large and heavily used caribou trail networks. (11-12)	Lutsel K'e Dene First Nation 2016. Summary Report of Traditional Knowledge Research on Bathurst Caribou and Mining.
eda cho kué	at Artillery Lake		Studies with Inuit of Arviat, the Denesoliné and Tłį Cho peoples reveal detailed knowledge of river crossings such as לeda cho at Artillery Lake (לeda cho kué). (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
edacho tué	Artillery Lake	"the lake of the big caribou crossing"	 Among the most significant caribou crossings were those on McKay Lake, Aylmer Lake, and Artillery Lake. These lakes are known as "the big water": Tha K'ai Tué, Tla Kai Tué, and Edacho Tué. They stretch over 300 km from west to east across the landscape. At their widest points, however, McKay Lake, Aylmer Lake, and Artillery Lake form a barrier to the fall migration. Although caribou are good swimmers and their dense coats provide them with buoyancy, they will travel along the shoreline until they can find a narrow point or crossing (eda). There the animals can easily cross in minutes or seconds. (31) 	Parlee, Brenda, Micheline Manseau and ÅUTSŸL K'É Dene First Nation 2005. "Using Traditional Knowledge to Adapt to Ecological Change: Denésôåiné Monitoring of Caribou Movements." Arctic 58 (1):26- 37
			The southern crossing of Artillery Lake was one such area where families commonly gathered. Aptly named edacho tué (the lake of	

Aboriginal	English Placename	Meaning	Description	Reference
Placename				
			the big caribou crossing), this was a place where people knew large numbers of caribou would pass each fall. Some families would stay there only in the fall for the caribou harvest and then would move on to trap in other areas of the barren lands or portage back to Tue Nedhe. For others, however, the security associated with the crossing was so great that they began to stay there all year round. In the early 1900s, many people built cabins on Artillery Lake at the place just north of Timber Bay, and from time to time would stay there year-round. (33)	
?edacho tlazi	Timber Bay, Artillery Lake		For example, many Lutsel K'é elders lived at a site known as ?edacho tlazi (Timber Bay, Artillery Lake), located slightly inland from a major caribou water crossing (?edacho). (183)	Kendrick, A. with P. O. B. Lyver and Lutsel K'é Dene First Nation 2005. Denésoliné (Chipewyan) Knowledge of Barren-Ground Caribou Movements. Arctic 58 (2):175-191.
	north shore of Artillery Lake		The identified TK and TLU information suggests that some LKDFN hunters were concerned that there were "less animals than there used to be in that area" (eastern side of Artillery Lake) and that the caribou were late and were "crossing at different locations than they used to, migrating more towards the north shore of Artillery Lake and not through the traditional crossings." Two explanations were proposed for why the caribou were migrating further away from Łutselk'e. One explanation suggests that forest fires have burned caribou habitat. Another explanation is that mining and other development activity is stressing the caribou. (27-28)	De Beers Canada Inc. 2010. Gahcho Kué Project, Environmental Impact Statement, Section 5: Traditional Knowledge.
?edaàtsotì / ?edaàchotì	Artillery Lake		Named for an important caribou crossing (9)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2001. Habitat of Dogrib Traditional Territory: Placenames as Indicators of Biogeographical Knowledge.

Aboriginal Placename	English Placename	Meaning	Description	Reference
⊃ek'atì			Tataa is a channel of land between two lakes forming a land bridge that caribou are forced to migrate through. The interpretation of the land formations throughout the area reveals how caribou move over the landscape. The large lakes in the region, such as pek'atì, Nodìikahtì and pewaànit'iiti, create boundaries which compel the caribou to migrate through specific tataa` between the large lakes. (10)	Jacobsen, Petter 2016. A Summary Report of Tłįcho Traditional Knowledge of Ekwò (Barren-ground Caribou) For the Bathurst Caribou Range Plan. Dedats'eetsa: Tłicho Research and Training Institute.
Ek'ati Island			 Yellowknives Dene reviewed TK also includes the following references to places named for their relation to the caribou migration. From the East point of Ek'ati Island across the water to the East mainland Ehda, where the caribou swims across. When migrating, caribou swim from Ek'ati Dee to the mainland. (11) 	Yellowknives Dene First Nation 2016. Preliminary Traditional Knowledge of the Yellowknives Dene First Nation to support the Bathurst Caribou Range Plan.
	North east of Ekati		On the north east of 15 [Ekati] lake there is a creek there a caribou crossing. (15)	Thorpe Consulting Services 2016. DDMI Traditional Knowledge Panel Session #9: Focus on Caribou.
	North and west sides of East Island		On the north and west sides of East Island and at important caribou crossings. (5)	Thorpe Consulting Services 2016. DDMI Traditional Knowledge Panel Session #9: Focus on Caribou.
Nçdìikahtì			 An analysis of the land formations and tataa in the pewaànıt'ııtìregion reveals four main areas that the caribou travel through: In the north; the tataa between Starfish Lake and pewaànit'iitì. The esker in the centre of pewaànıt'ııtì. The tataa between the south side of pewaànıt'ııtìand the north side of Nçdìikahtì; and Along the islands on Nçdìikahtì. The majority of the migration moves through the tataa between 	Jacobsen, Petter 2016. A Summary Report of Tłįchǫ Traditional Knowledge of Ekwò (Barren-ground Caribou) For the Bathurst Caribou Range Plan. Dedats'eetsa: Tłichǫ Research and Training Institute.

Aboriginal Placename	English Placename	Meaning	Description	Reference
			>ewaànıt'ııtìand Nodìikahtì. This tataa is significant for the westward migration, as it directs the caribou towards Tłįcho lands and especially towards Wekweètì's winter hunting grounds. (10)	
⊃ewaànıt'ııtı			 An analysis of the land formations and tataa in the pewaànıt'ııtìregion reveals four main areas that the caribou travel through: In the north; the tataa between Starfish Lake and pewaànit'iitì. The esker in the centre of pewaànıt'ııtì. The tataa between the south side of pewaànıt'ııtìand the north side of Nçdìikahtì The majority of the migration moves through the tataa between pewaànıt'ııtìand Nçdìikahtì. This tataa is significant for the westward migration, as it directs the caribou towards Tłįchǫ lands and especially towards Wekweètì's winter hunting grounds. (10) 	Jacobsen, Petter 2016. A Summary Report of TłĮchǫ Traditional Knowledge of Ekwò (Barren-ground Caribou) For the Bathurst Caribou Range Plan. Dedats'eetsa: TłIcho, Research and Training Institute.
Nodinka narrows			Additionally, some caribou migrate across the water crossings at the Nodinka narrows and other crossings on Nodikahti. (10)	Jacobsen, Petter 2016. A Summary Report of Tłįchǫ Traditional Knowledge of Ekwò (Barren-ground Caribou) For the Bathurst Caribou Range Plan. Dedats'eetsa: Tłicho, Research and Training Institute.
	Matthews Lake		"There are lots of caribou trails through there [around Matthews Lake], because it's the only narrow part the caribou has. They always go through the (Old Tundra and Salmita] mine. And, they always go through that area, the whole [area between <code>vewaànıt'ııtı</code> and Nodìikahtì]. This is where the caribou travel a lot, at that narrow part." ~ Joseph Judas, May 9th 2012, Wekweètì. (10)	Jacobsen, Petter 2016. A Summary Report of Tłįchǫ Traditional Knowledge of Ekwò (Barren-ground Caribou) For the Bathurst Caribou Range Plan. Dedats'eetsa: Tłicho, Research and Training Institute.
	MacKay Lake		Yellowknives Dene reviewed TK also includes the following references to places named for their relation to the caribou	Yellowknives Dene First Nation 2016. Preliminary Traditional

Aboriginal	English Placename	Meaning	Description	Reference
Placename				
			migration - North bay on MacKay Lake Gla da, where the caribou cross. This bay is significant for caribou because they cross MacKay Lake at this bay when they migrate. The area is a favourite camping place for the Weledeh people because there are many caribou and because there is a patch of trees for firewood. The Weledeh spent many winters here. (12)	Knowledge of the Yellowknives Dene First Nation to support the Bathurst Caribou Range Plan.
Tha K'ai Tué	MacKay Lake		Among the most significant caribou crossings were those on McKay Lake, Aylmer Lake, and Artillery Lake. These lakes are known as "the big water": Tha K'ai Tué, Tla Kai Tué, and Edacho Tué. They stretch over 300 km from west to east across the landscape. (31)	Parlee, Brenda, Micheline Manseau and ÅUTSŸL K'É Dene First Nation 2005. "Using Traditional Knowledge to Adapt to Ecological Change: Denésôåiné Monitoring of Caribou Movements." Arctic 58 (1):26- 37
	Peel River		The Teetf'it Gwich'in would look for caribou at key locations, such as crossing points on the Peel River. (72)	Wray, Kristine and Brenda Parlee 2013. "Ways We Respect Caribou: Teetł'it Gwich'in Rules." Arctic 6 (1):68-78
Kwek'aghoti	Point Lake, southern end		there is a place called Kwek'aghoti (southern end of Point Lake) and that is where there is a lot of ?ekwò, that is where the water crossing is. Thatis why there is people living around that area. (20)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
?ehdaaghoò			For example, they expect ?ekwò will swim across Deèzàatideè at ?ehdaaghoò and "over here on this lake, over beyond Deèzhàatì a place called Kwik'ìi?edaà it is said the ?ekwò swim across this great lake at this point." (39)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.

Aboriginal Placename	English Placename	Meaning	Description	Reference
Kwik'ìi?edaà			For example, they expect ?ekwò will swim across Deèzàatideè at ?ehdaaghoò and "over here on this lake, over beyond Deèzhàatì a place called Kwik'ìi?edaà it is said the ?ekwò swim across this great lake at this point." (9))	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
Ts'oti			The people would continue on to Wekweèti, using birch-bark canoes along here [checking the spot where ?ekwò swim across the lake] and on to Be?aitì 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 Deèzàatìdehtì Again, if there was nothing to be found there, they would proceed along the great route leading to Sodeè then the people would go north to Deèzàatii- all the way to Kwik'ìi?edaàts'ahti. (39)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
Kwek'ak'e?o			Then it was also said that on our land by a rock called Kwek'ak'e?o on Tsotì near a point a lot of ?ekwò were killed Before, the ?ekwò used to come in this direction into our land so that there were ?ekwò trails going in this direction from ?ezhatì [they] told us stories. He said that there are a lot of ?edaetì [Living Lakes]. There, an ?edaetì [place where [?ekwò swim across] is located; that is called ?edaetì. ?edaetì is called that because ?ekwò swim across. (40-41)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
Kwedashii			Since I became aware - and before my time - the people used to travel past Wekweètì, to a place called Kwedashii. The people used to go there by canoe for ?ekwò. There, they killed ?ekwò with spears. So it was said. At the end of the place called Kwedashii the ?ekwò used to swim across here. The killed a lot of ?ekwò there. (40)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
?edaetì			Diavikís biologists did not know or observe the important water crossing associated with ?edaetì. (82)	Whahdoo Naowoo Ko, Dogrib Treaty 11 Council 2001. Caribou Migration and the State of their Habitat: Final Report.
Nalluarjuk		"little caribou crossing" (12)		Golder Associates Ltd. 2003. Inuit Qaujimajatuqangit Literature Review, Gap Analysis

Aboriginal Placename	English Placename	Meaning	Description	Reference
				and Workshop Results Related to the Doris North Project Hope Bay Belt, Nunavut.
Qalgilik		"It has a Qalgiq or large dancing tent."	People would gather here to hunt caribou during the season ukiakhaaq. The caribou would be crossing here just at freeze-up. There is a very old story told by Paul Omilgoetok about a big fish – Iqaluaqpalik – that swallowed a bull caribou while crossing here. Mary [lady from Umingmaqtuuq] added that the people became afraid to hunt caribou here because of this big fish that ate caribou. She was told the story by Kannujaujaq – Archie Komak's father. She says that this area was still hunted when Inuit had guns. Paul Omilgoetok added that people would be cautious in this area and would wait for the crossing caribou more inland away from the water [instead of hunting by qajaq] due to their fear of the Iqaluaqpalik. Frank Analok told a story about another place where a hunter with a qajaq was attacked by an Iqaluaqpalik, but was saved because he was in the shallows. When the fish splashed the man ran on to shore. From then on the people were cautious. (13)	Golder Associates Ltd. 2003. Inuit Qaujimajatuqangit Literature Review, Gap Analysis and Workshop Results Related to the Doris North Project Hope Bay Belt, Nunavut.
Kimaktun - at Kimaqtuut (part of Hiukitak River)		I have no idea why it is called by that name."	Inuit, in the old days have named the place, often people who lived around that area often would bear the name for instance, Kimaktut may have lived around there so people would start calling the place by his name, they often did that (LN). There is a nalluq (caribou crossing) there at Kimaktun (LN). (13-14)	Golder Associates Ltd. 2003. Inuit Qaujimajatuqangit Literature Review, Gap Analysis and Workshop Results Related to the Doris North Project Hope Bay Belt, Nunavut.
Tununiq Point	on Richard Island		Tununiq Point of Richards Island is known to have caribou crossings and associated archaeological sites. (8)	Inuuvik Community Corporation, Tuktuuyaqtuuq Community Corporation, Aklarvik Community Corporation 2006. Inuvialuit Settlement Region Traditional Knowledge Report.

Aboriginal Placename	English Placename	Meaning	Description	Reference
Piqqaq	on the lower Kazan River		studies with Inuit of Arviat, the Denesoliné and Tłį Cho peoples reveal detailed knowledge of river crossings such as beda cho at Artillery Lake (beda cho kué) or Piqqaq, Akunni'tuaq, and Qavvavaujarvik on the lower Kazan River (Parlee et al. 2005; Stewart 2004). Crossing sites on the Kazan River have been the most studied sites associated with the movements of the Beverly caribou. (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
Akunni'tuaq	on the lower Kazan River		studies with Inuit of Arviat, the Denesoliné and Tłį Cho peoples reveal detailed knowledge of river crossings such as beda cho at Artillery Lake (beda cho kué) or Piqqaq, Akunni'tuaq, and Qavvavaujarvik on the lower Kazan River (Parlee et al. 2005; Stewart 2004). Crossing sites on the Kazan River have been the most studied sites associated with the movements of the Beverly caribou. (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
Qavvavaujarvik	on the lower Kazan River		studies with Inuit of Arviat, the Denesoliné and Tłį Cho peoples reveal detailed knowledge of river crossings such as beda cho at Artillery Lake (beda cho kué) or Piqqaq, Akunni'tuaq, and Qavvavaujarvik on the lower Kazan River (Parlee et al. 2005; Stewart 2004). Crossing sites on the Kazan River have been the most studied sites associated with the movements of the Beverly caribou. (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
Akunni'tuaq		"big interval"	Akunni'tuaq, the "big interval," alludes to its relatively weak or subsidiary location between two powerful crossing sites. (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
Qavvavaujarvik		"place of ghosts"	Qavvavaujarvik, the "place of ghosts," also suggests a kind of transitional existence Oral accounts simultaneously support the notion of permanence of crossings like Piqqiq and the unpredictable element—the awareness that caribou may pass over a certain crossing in a given year to use another one, or that they might not come at all. (50)	Thorpe Consulting Services Inc. 2013. Izok Corridor Project IQ/TK Report.
?edaàgodeè			crossing (9)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2001. Habitat of Dogrib Traditional Territory:

Aboriginal Placename	English Placename	Meaning	Description	Reference
				Placenames as Indicators of Biogeographical Knowledge.
?etsaà?jjtì	Rawalpindi Lake		there is a caribou crossing here at a narrow spot on the lake where there is a place to lie in wait for caribou (12)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2001. Habitat of Dogrib Traditional Territory: Placenames as Indicators of Biogeographical Knowledge.
Njtsaghòò?edaà			This is a caribou crossing. Because this is an old word it is not known what the parts of the name mean. (23)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2001. Habitat of Dogrib Traditional Territory: Placenames as Indicators of Biogeographical Knowledge.
Wèet'aà			Nothing is known about this very old placename. A narrow peninsula. A caribou crossing which was a place where caribou were trapped in among the surrounding islands before there were guns. This name is also pronounced something like Wòot'aà. (31)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2001. Habitat of Dogrib Traditional Territory: Placenames as Indicators of Biogeographical Knowledge.
?etsaà?jjedaà		"Crossing of ?etsaà?jj [Lake]" (21)		Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2002. Dogrib Knowledge on Placenames, Caribou and Habitat.
Kwik'ìi?edaà		"Gun Crossing" (21)		Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2002. Dogrib Knowledge on Placenames, Caribou and Habitat.
Tl'à?edaà		"Bay Crossing"	A major crossing for caribou on their trail. (89)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council

Aboriginal Placename	English Placename	Meaning	Description	Reference
				2002. Dogrib Knowledge on Placenames, Caribou and Habitat.
?etsaà?jj?edaà			A caribou crossing ?ekwò nòo?ò The name includes the points of land on either side of the water. N of this area is a grave on the large- ish island there. (89)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2002. Dogrib Knowledge on Placenames, Caribou and Habitat.
Tl'à?edaà'òotsèa / Tl'à?edaà'òochèa			"bay-crossing-PNSuff-willow-river mouth?-SmSuff (145)	Whàehdòo Nàowo Kò, Dogrib Treaty 11 Council 2002. Dogrib Knowledge on Placenames, Caribou and Habitat.
Degha?à	on the Coppermine	The Narrows?	This crossing of the Coppermine ['The Narrows/Degha?à(?)'], by the way, is an important spot in the history of the Dog-Ribs and Yellow Knives. It has always been a favourite swimming- place for the caribou.	Thorpe Consulting Services 2016. DDMI Traditional Knowledge Panel Session #9: Focus on Caribou.
Leryahda	at Aylmer	"the ice is moving slowly"	There is a place where the caribou cross at Aylmer and that caribou crossing is called Leryahda [the ice is moving slowly]. (63)	Parlee, Brenda with Marcel Basil and Nancy Casaway 2001. Traditional Ecological Knowledge in the Kaché Tué Study Region.