

Bathurst Caribou Range Plan

Interim Discussion Document

For WG Discussion

December, 2016



Acknowledgements

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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'èezhì Renewable Resources Board	13. Chamber of Mines - Exploration
2. Tłı̨chǫ 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 Investment (ITI)
5. NWT Métis Nation	17. GNWT - Department of Environment and Natural Resources (ENR)
6. North Slave Métis Alliance	18. Aboriginal Affairs and Northern Development Canada - Nunavut
7. Athabasca Denesuline	19. NWT Wildlife Federation
8. Kitikmeot Regional Wildlife Board	20. Barren-ground Caribou Outfitters Association
9. Kugluktuk Hunters and Trappers Organization	21. Canadian Parks and Wilderness Society
10. Kitikmeot Inuit Association	
11. Nunavut Tunngavik Incorporated	
12. Chamber of Mines – Industry	

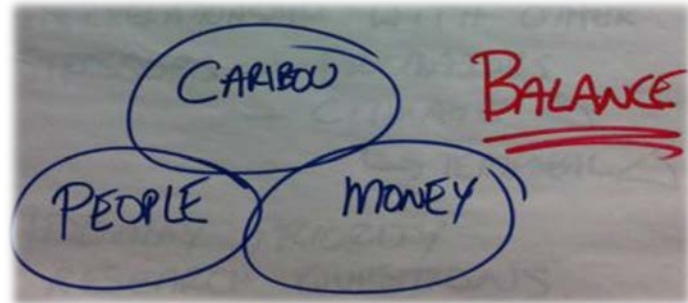
A Steering Committee, comprised of Government, Aboriginal and industry leadership, is overseeing the WG and is regularly updated on their progress. The Steering Committee and WG are supported by a Project Team of consultants (Compass Resource Management Ltd., EcoBorealis Consulting Inc., S. Francis Consulting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

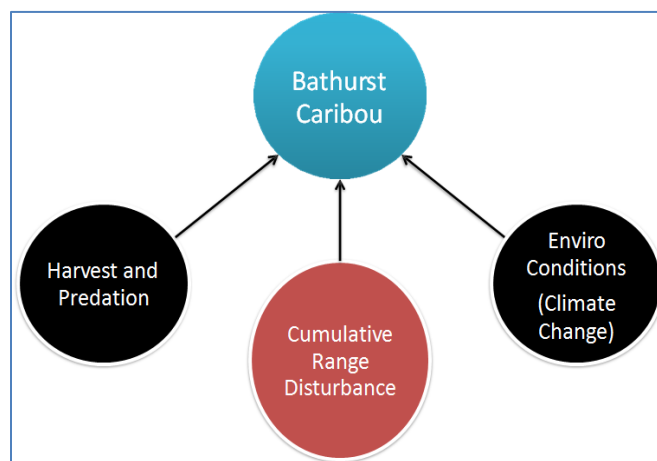


FIGURE 2: THE SCOPE OF THE BATHURST CARIBOU RANGE PLAN (IN RED)

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 project-specific 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	<ul style="list-style-type: none"> • Cumulative Disturbance Thresholds • Protected / Conservation Areas • Land Use Activity Restrictions • Access Management Planning
Project Level	<ul style="list-style-type: none"> • Best Management Practices: <ul style="list-style-type: none"> • 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.
2. **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.

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.

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 Alguna in TCS 2014

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

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

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 pre-defined distance from a project area. For example, Dominion Diamond currently implements road management measures that curtail road use and activity based on the number of caribou present and their distance.

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).

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

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.

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.

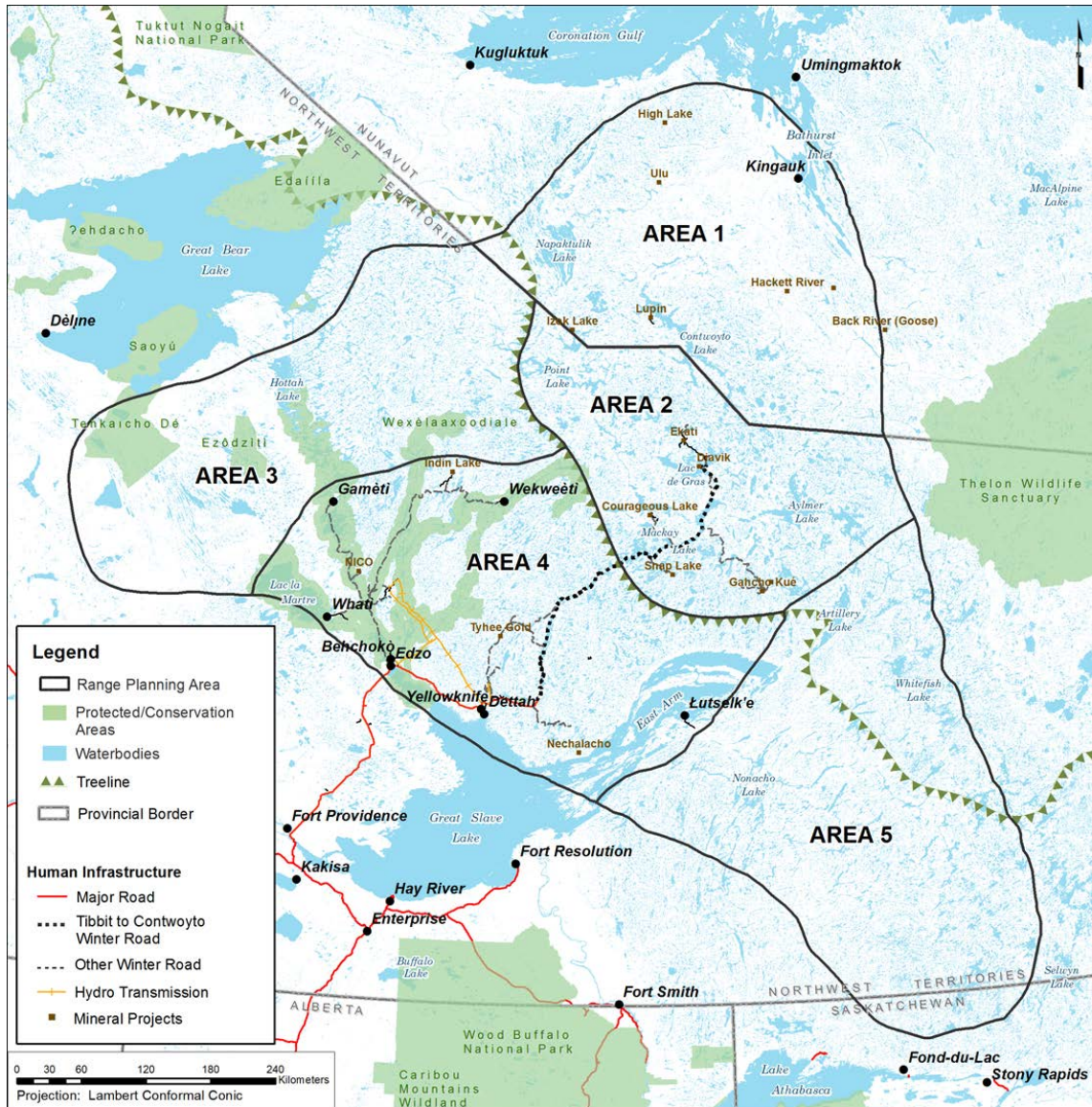


FIGURE 4: RANGE ASSESSMENT AREAS IN THE BATHURST CARIBOU RANGE PLANNING AREA.

TABLE 1: SUMMARY OF BATHURST CARIBOU HABITAT AND USE IN THE FIVE BCRP RANGE ASSESSMENT AREAS

Range Assessment Area	Caribou Habitat and Range Use
Area 1: Nunavut	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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.

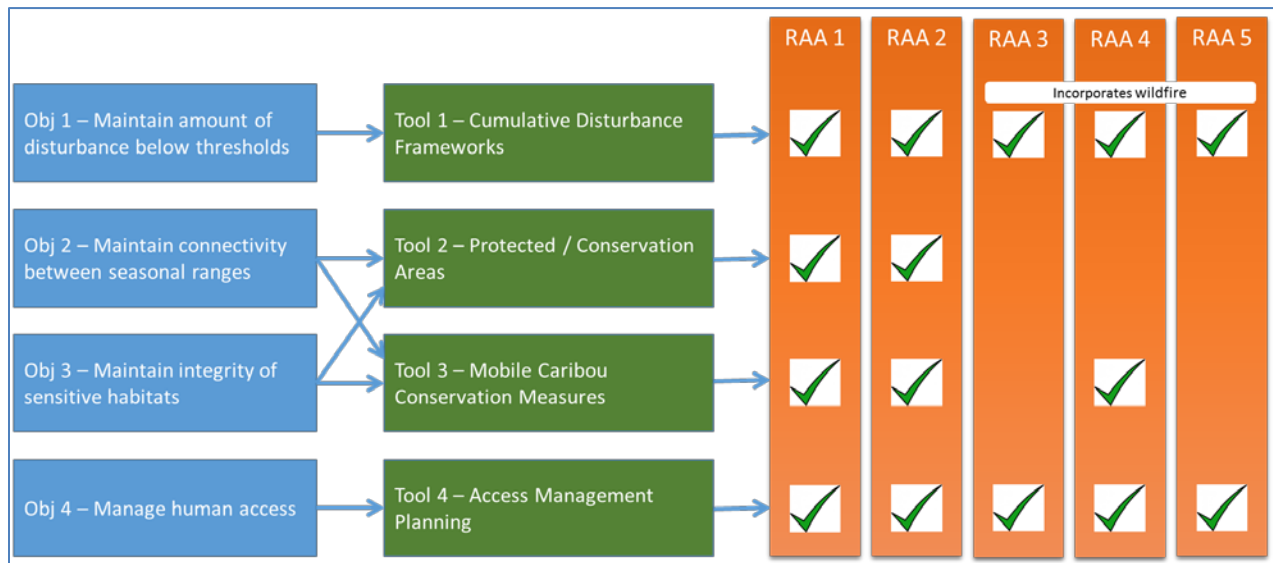


FIGURE 5: RANGE-SCALE OBJECTIVES AND MANAGEMENT TOOLS / APPROACHES FOR EACH RAA.

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 the amount 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

<p>Desirable Level</p> <p>Site-specific Best Management Practices (BMPs) – these include traffic management (e.g., haul truck conveying, 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.</p> <p>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).</p> <p>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.</p> <p>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.</p>
<p>Cautionary Level</p> <p>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:</p> <ul style="list-style-type: none"> • 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. <p>In addition to mitigation actions, increased monitoring and research efforts may include:</p> <ul style="list-style-type: none"> • 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 <p>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.</p> <p>† "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.</p>
<p>Critical Level</p> <p>No New Disturbance – New projects resulting in new disturbance are not allowed until existing active disturbances are minimized or removed.</p>

- 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, 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

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

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'ëezhii 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

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

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	<ul style="list-style-type: none"> No new disturbance until current disturbances are minimized or removed
Moderate	Cautionary	3,500 km ² < ZOI < 7,000 km ²	4,500 km ² < ZOI < 9,000 km ²	<ul style="list-style-type: none"> Compensatory mitigation Enhanced cumulative effects assessment (CEA)
Low	Desirable	ZOI < 3,500 km ²	ZOI < 4,500 km ²	<ul style="list-style-type: none"> Site-specific Best Management Practices Protect/maintain key habitats Minimize sensory disturbance of caribou Implement community-based monitoring programs

* 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*).

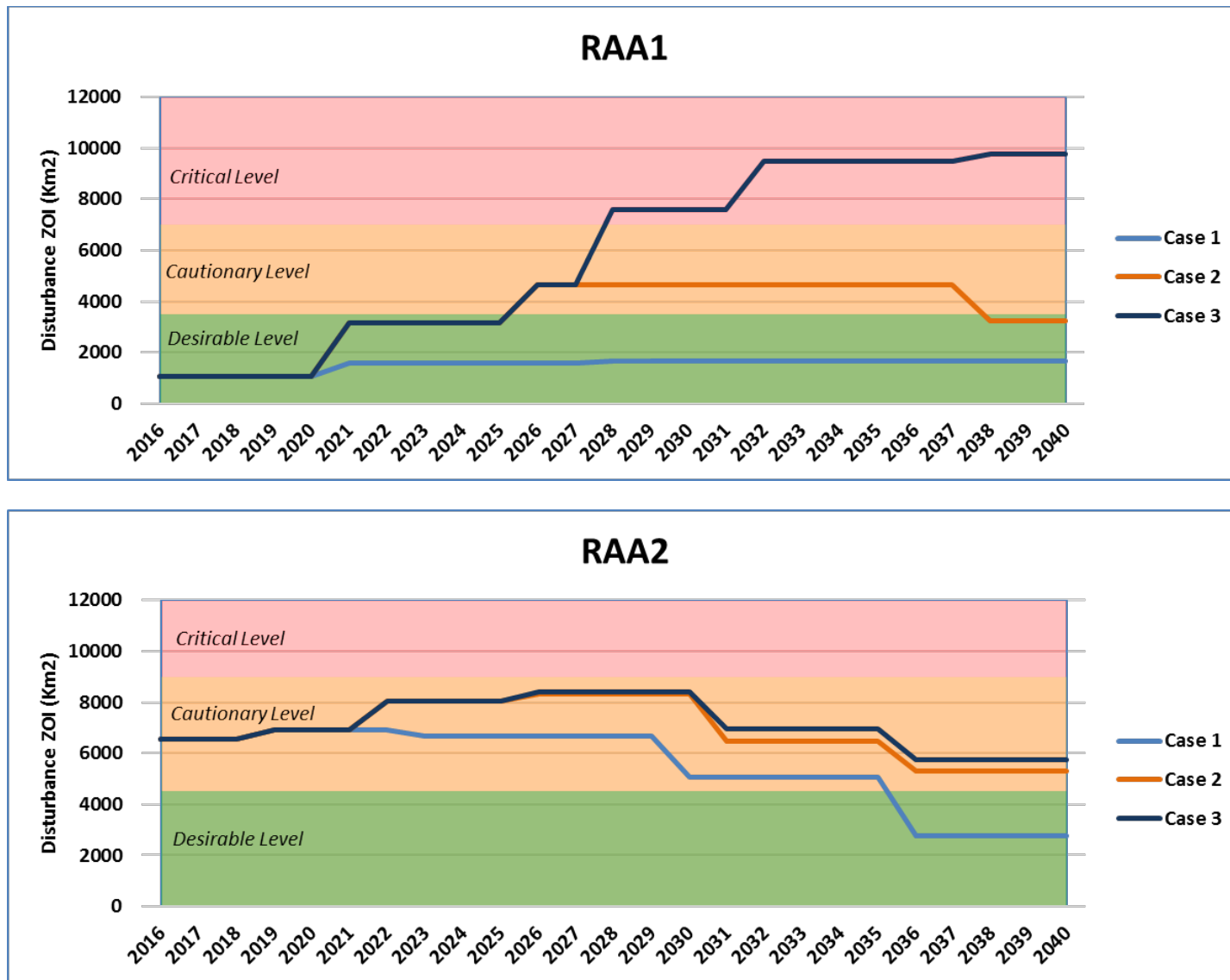


FIGURE 6: PROJECTION OF POTENTIAL DISTURBANCE ZOI FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1 AND RAA2.

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 ≤ 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 ≤ 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.

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

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	$\text{ZOI}^{\text{WF}} > 44,000 \text{ km}^2$	$\text{ZOI}^{\text{WF}} > 45,000 \text{ km}^2$	$\text{ZOI}^{\text{WF}} > 48,000 \text{ km}^2$
Moderate	Cautionary	$27,000 \text{ km}^2 < \text{ZOI}^{\text{WF}} < 44,000 \text{ km}^2$	$30,000 \text{ km}^2 < \text{ZOI}^{\text{WF}} < 45,000 \text{ km}^2$	$22,000 \text{ km}^2 < \text{ZOI}^{\text{WF}} < 48,000 \text{ km}^2$
Low	Desirable	$\text{ZOI}^{\text{WF}} < 27,000 \text{ km}^2$	$\text{ZOI}^{\text{WF}} < 30,000 \text{ km}^2$	$\text{ZOI}^{\text{WF}} < 22,000 \text{ km}^2$

* 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*).

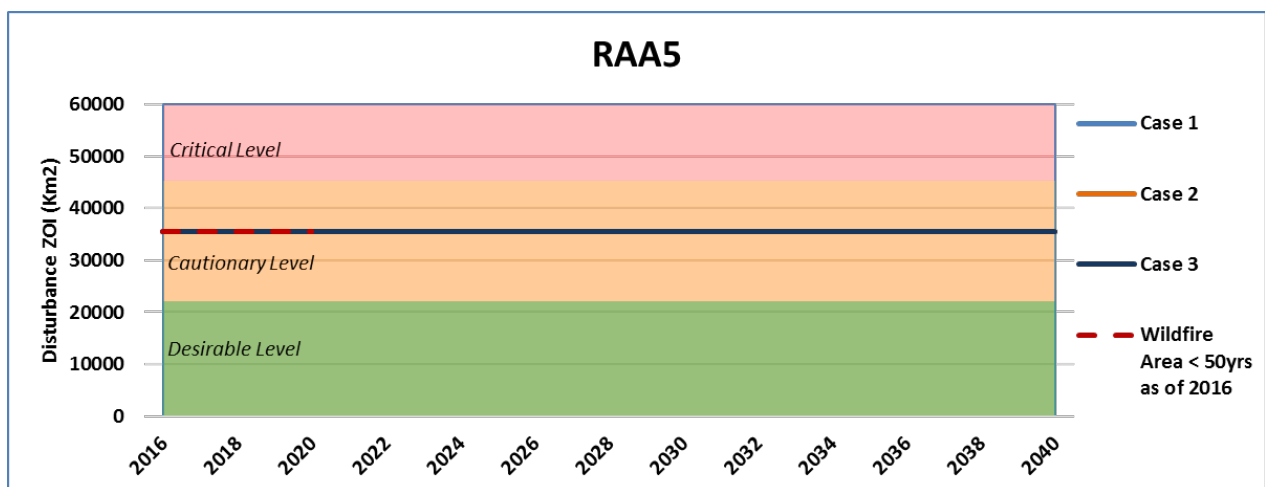
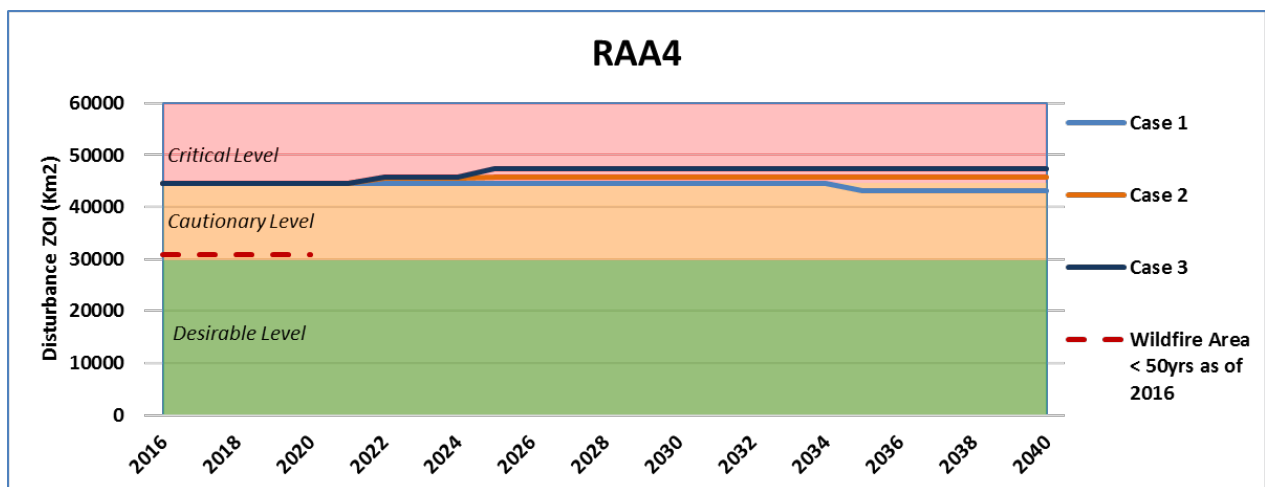
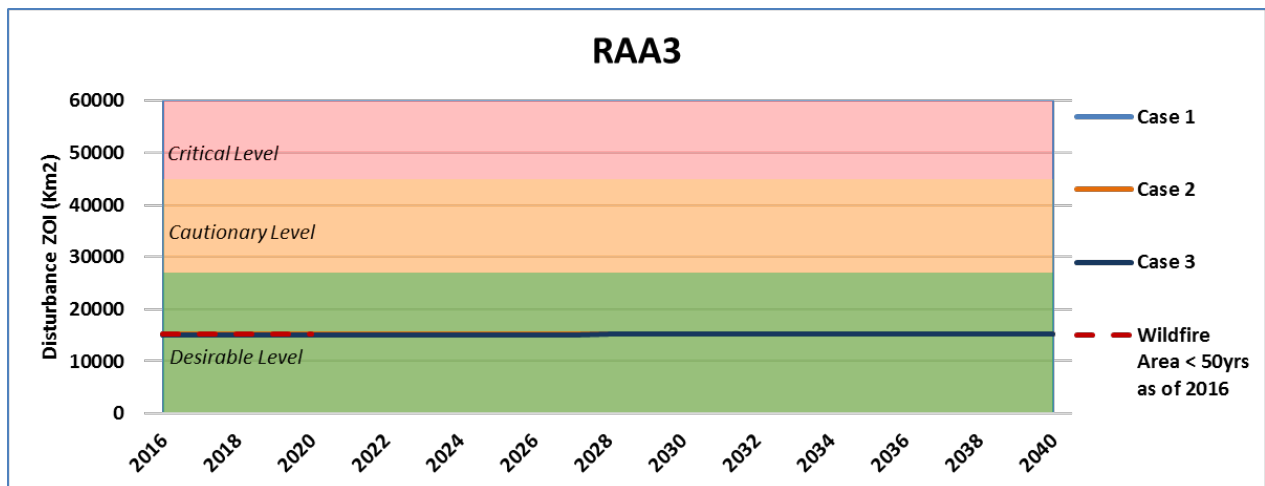


FIGURE 7: PROJECTION OF POTENTIAL DISTURBANCE ZOI FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA3, RAA4 AND RAA5

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.

TABLE 5: CURRENT CDF STATUS OF EACH RANGE ASSESSMENT 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

* 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 identity 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 defensible 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 barren-ground 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 barren-

ground 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.

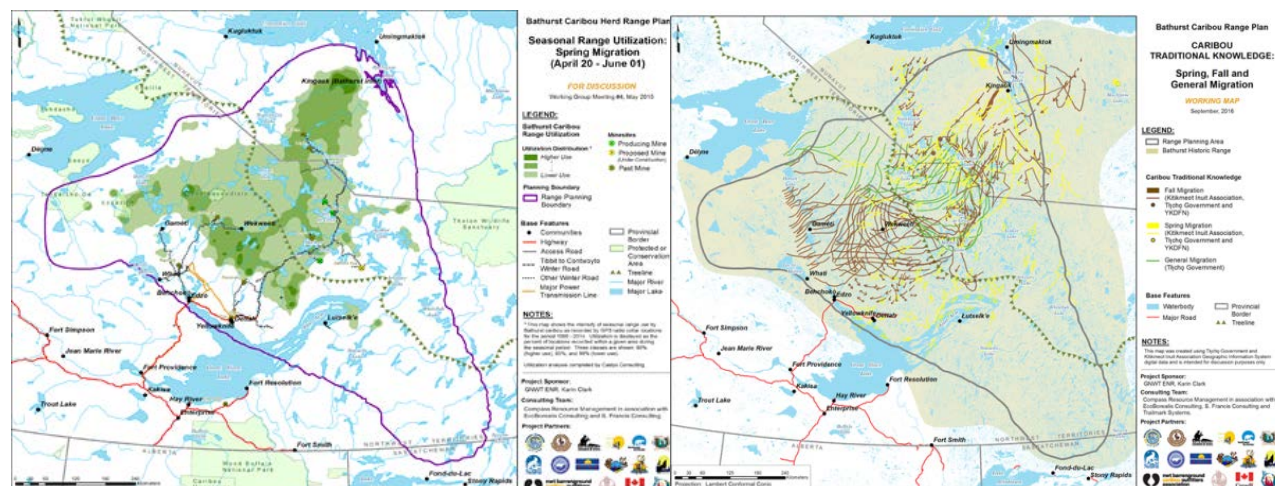


FIGURE 9: EXAMPLES OF MIGRATION PATTERNS RECORDED FROM CARIBOU COLLARS AND TK.

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), Ɂedacho kué (Artillery Lake), and Leryahda (Aylmer Lake) are other important crossings to be further confirmed during community consultations.

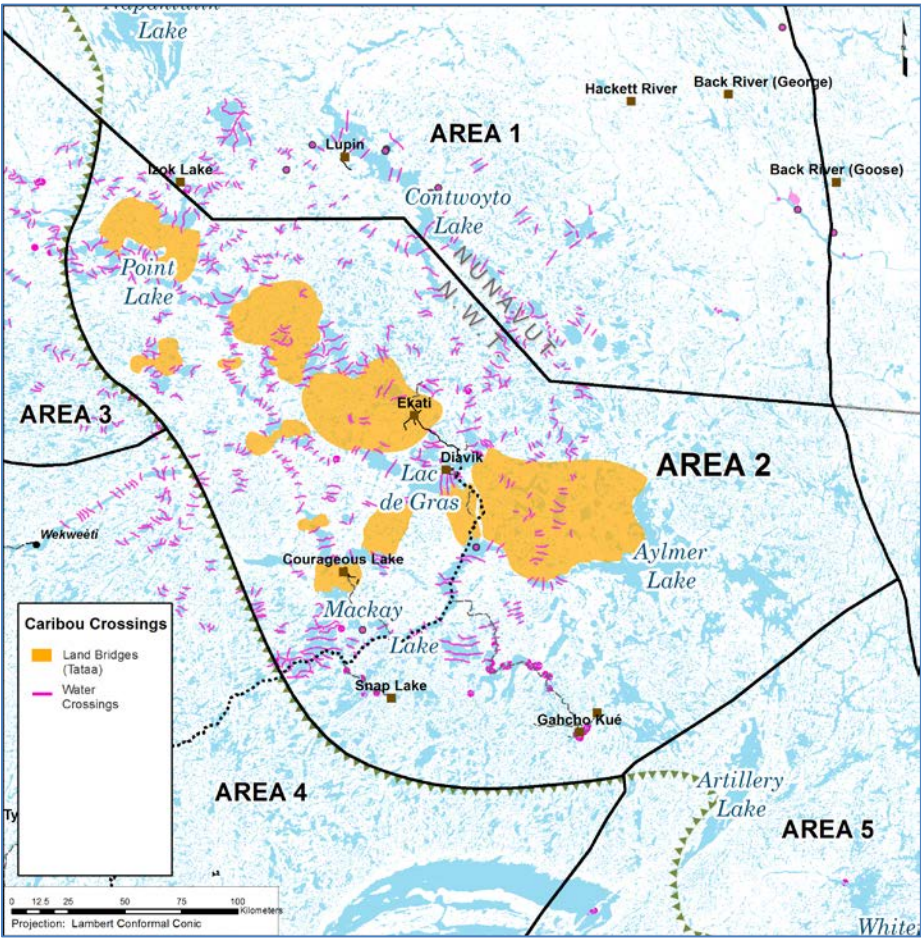


FIGURE 10: CARIBOU WATER CROSSINGS AND LAND BRIDGES IN THE CENTRAL PART OF THE BATHURST RANGE IDENTIFIED FROM TK.

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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> They may preclude future economic development or transportation opportunities. They are not as flexible as mobile caribou conservation measures. 	Challenges <ul style="list-style-type: none"> 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.

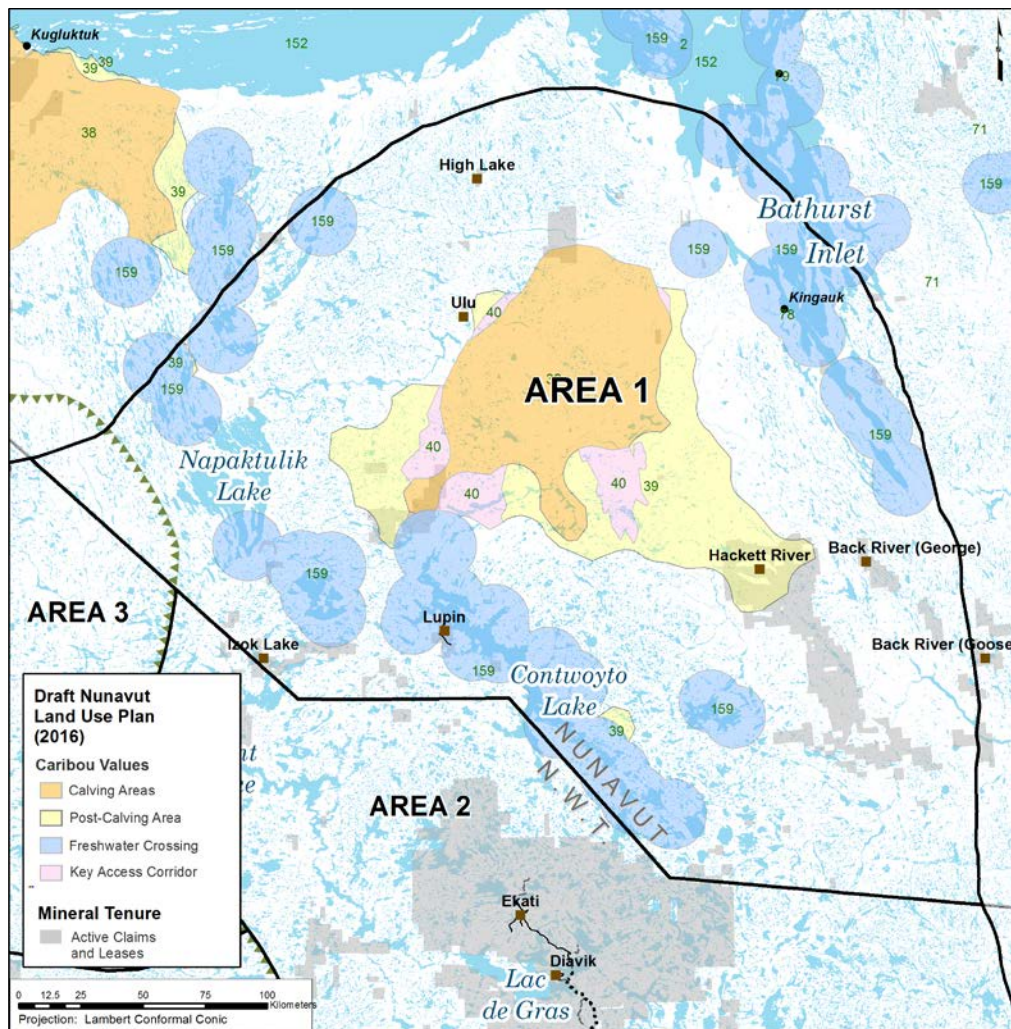


FIGURE 11: PROPOSED PROTECTED AREAS BASED ON CARIBOU VALUES IN THE BATHURST CALVING GROUNDS AND CONTWOYTO LAKE AREA INCLUDED IN THE DRAFT NUNAVUT LAND USE PLAN (2016).

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 facilitated 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 population-level 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).

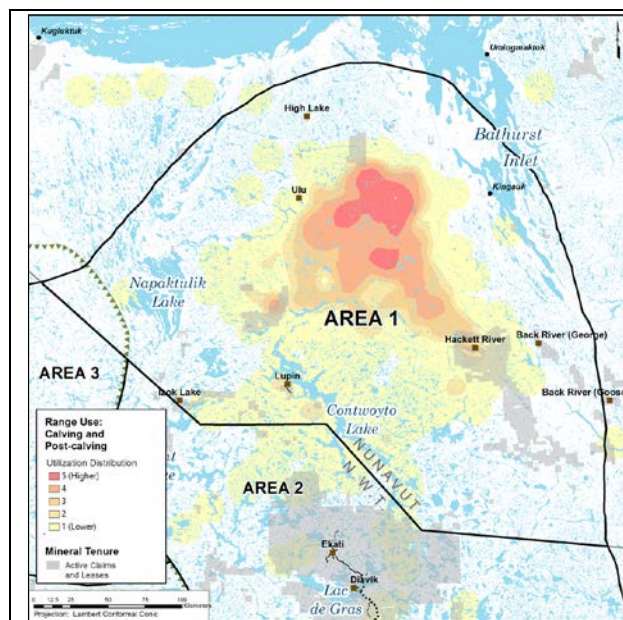


FIGURE 12: CALVING AND POST-CALVING RANGE USE IN RAA1 AS DETERMINED FROM RADIO COLLAR INFORMATION BETWEEN 1996 AND 2014.

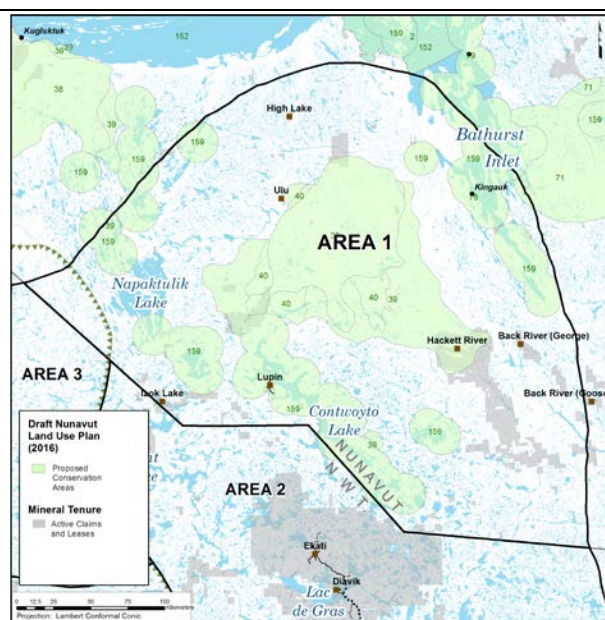


FIGURE 13: DRAFT NUNAVUT LAND USE PLAN (2016) BOUNDARIES FOR PROTECTED AREAS IN RAA1.

Taiga Biome

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 Tłı̄ch̄ 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).

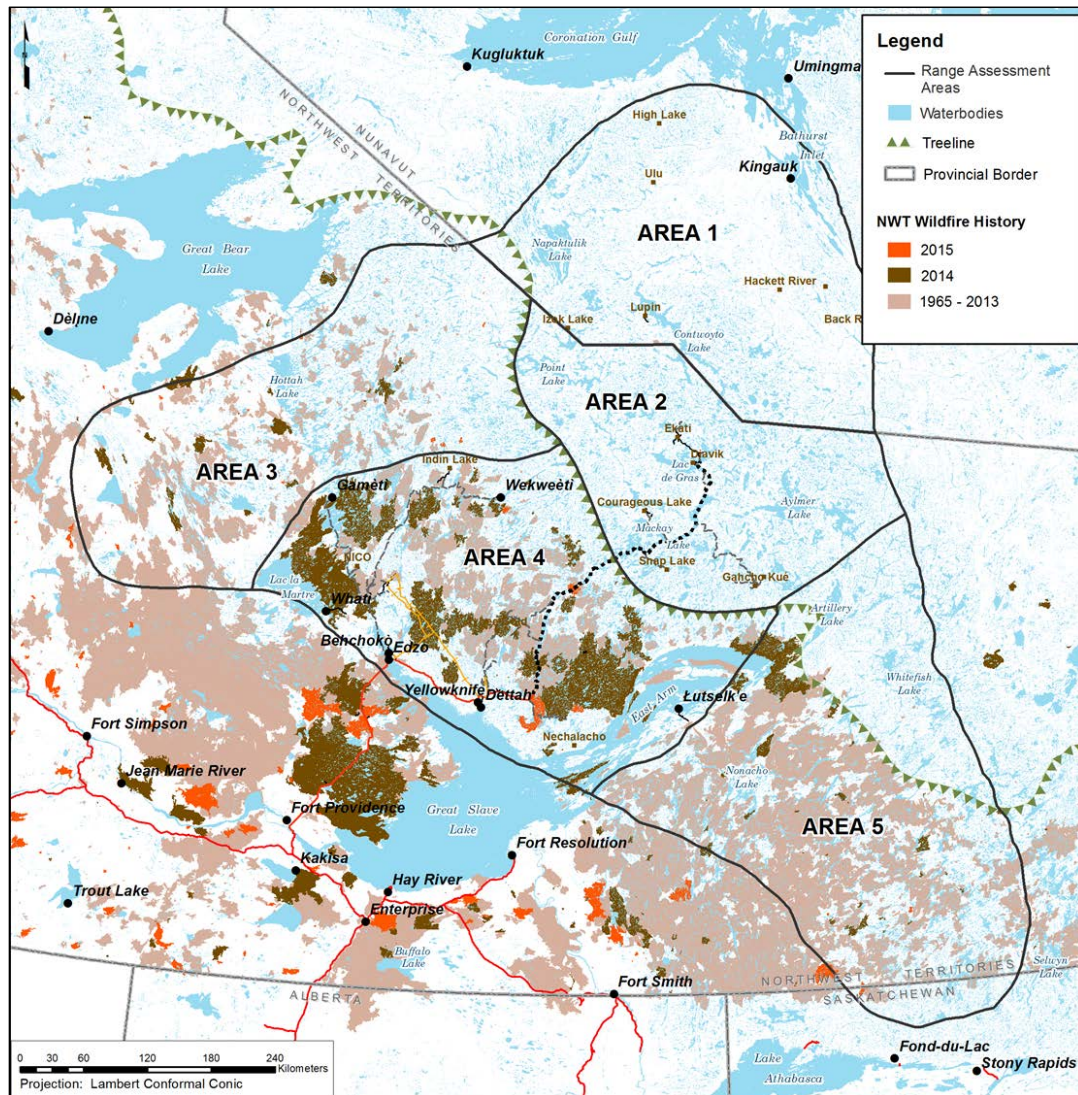


FIGURE 14: WILDFIRE HISTORY IN THE BATHURST CARIBOU WINTER RANGE.

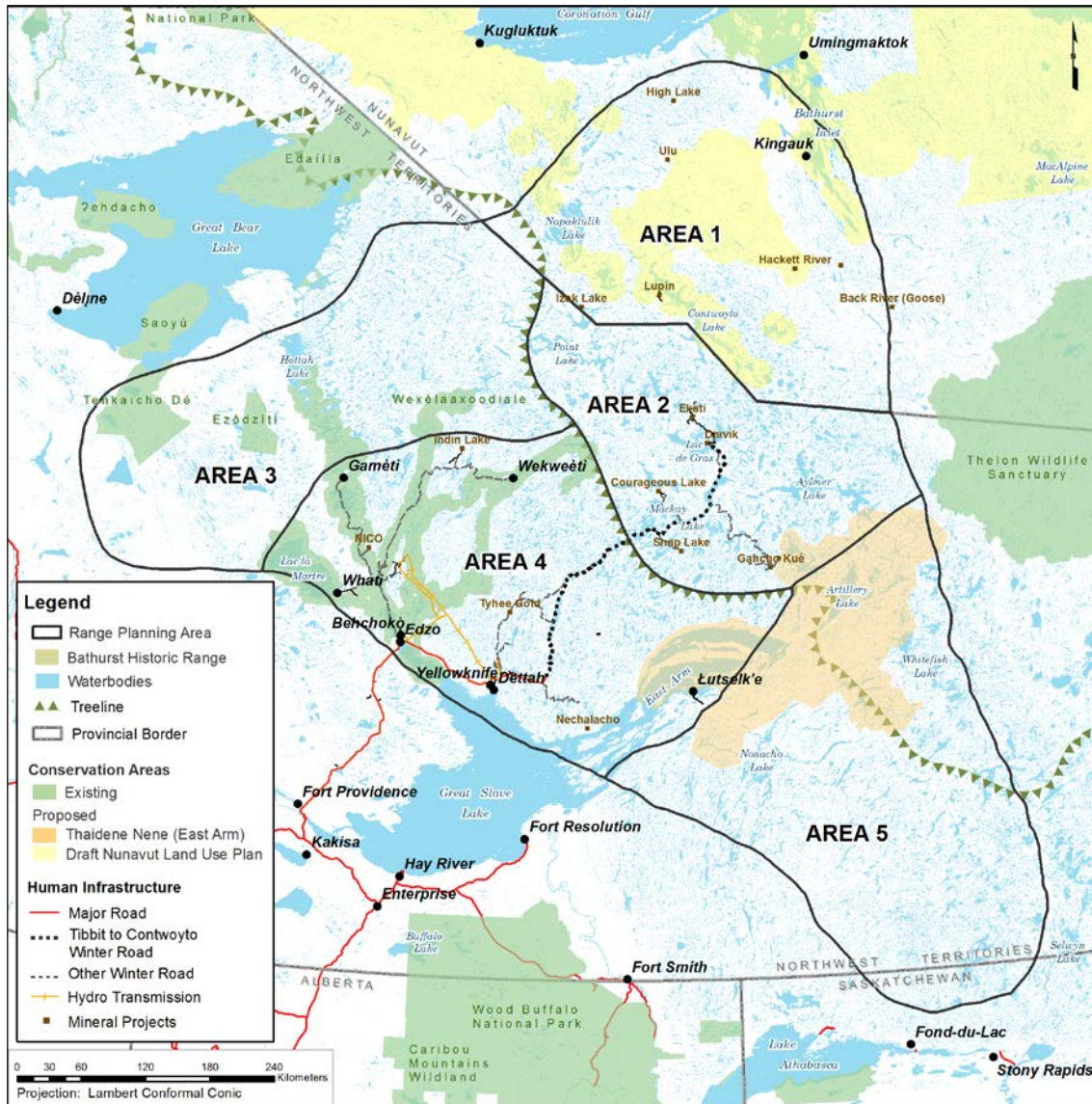


FIGURE 15: EXISTING AND PROPOSED PROTECTED / CONSERVATION AREAS IN THE BATHURST RANGE PLANNING AREA.

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 <ul style="list-style-type: none"> Identify specific areas in the calving and post-calving and summer ranges to receive protected / conservation area status. 	Option <ul style="list-style-type: none"> Implement mobile caribou conservation measures (timing windows) in the tundra ranges to avoid creating sensory disturbance during the early and mid-summer periods.
Benefits <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Wildfire and forest conditions are dynamic – establishing protected areas to protect older patches of forest as a long-term strategy is not practical. Define and rank important winter habitat areas for caribou (larger patches of unburned forest) and include these as “values at risk” for consideration by the ENR, Forest Management Division. These areas would become prioritized for wildfire suppression efforts. 	Option <ul style="list-style-type: none"> Re-forestation (tree planting) could be used to speed up recovery of recently burned areas.
Benefits <ul style="list-style-type: none"> Increasing the amount of older forest within the winter range may provide near-term benefits to caribou. 	Benefits <ul style="list-style-type: none"> At this time, the benefits of such an approach are uncertain. Forests naturally-regenerate following wildfires.
Challenges <ul style="list-style-type: none"> 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. 	Challenges <ul style="list-style-type: none"> 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 ʔekwö in association with the ice road, the ʔekwö do not like to cross roads unless they are in the migration mode. They become very skittish when trying to cross roads, as they can smell the human scent. When they are not in migration mode and simply foraging during the winter, if the ʔekwö sniff our scent, they will turn back (Romie Wetrade of Gameti in Whaèhdöo Nàowoö 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

Tundra Biome

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) Caribou-friendly 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).

Taiga Biome

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 Tłıch'q 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	<ul style="list-style-type: none"> • Winter roads should be used preferentially over all-season roads to access existing or new potential mine sites.
Benefits	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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)
<p>Options</p> <ul style="list-style-type: none"> • 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.
<p>Benefits</p> <ul style="list-style-type: none"> • 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.
<p>Challenges</p> <ul style="list-style-type: none"> • 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 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.

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

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 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.

7 References Cited and Consulted

- Anablak, Pauline, Natasha Thorpe, Kugluktuk Hunters and Trappers Organization and Golder Associates Ltd.. 2012 The Effects of Development on Barren-Ground Caribou According to Inuit Qaujiamajatuqangit and an Ecological Model. International Polar Year. Conference Presentation. Yellowknife, NT. April 25. 2012.
- Anderson, T. A., and C. J. Johnson. 2014. Distribution of barren-ground caribou during winter in response to fire. *Ecosphere* 5(10):140. <http://dx.doi.org/10.1890/ES14-00010.1>
- Athabasca Denesuline. 2016. Bathurst Caribou Range Plan – Traditional Ecological Knowledge Report. May 6, 2016. Submitted by the Denesuline Né Né Land Corporation to the Government of the Northwest Territories..11 pp.
- Bergerud, A. T., R. D. Jakimchuk, and D. R. Carruthers. 1984. The buffalo of the north: caribou (*Rangifer tarandus*) and human developments. *Arctic* 37:7-22.
- Canadian Environmental Assessment Agency. 1996. NWT Diamonds Project. Report of the Environmental Assessment Panel, Canada 92pp.
- Canadian Environmental Assessment Agency. 1999. Comprehensive Study Report: Diavik Diamonds Project, Canada 271pp
- Dedats'eetsa: Tlicho Research and Training Institute. 2016. A Summary Report of Tlicho TK of Ekwó (Barren-ground Caribou) for the Bathurst Caribou Range Plan. Submitted by Petter Jacobsen. Submitted to the Government of the Northwest Territories. April 5, 2016. 66 pp.
- Environmental Monitoring Advisory Board [EMAB], (2012). A Way of Life: Bridging Science and Aboriginal Knowledge in Caribou Monitoring at Diavik Diamond Mine. SENES Consultants Limited. Yellowknife, NT.
- Failing, L., and Beaudrie, C. 2015. CBFA Integrated Planning and Adaptive Management Framework. Prepared for the Canadian Boreal Forest Agreement. Compass Resource Management, Vancouver, BC. 38pp.
- Gwich'in Social and Cultural Institute [GSCI] (2015). Gwich'in Knowledge of Bluenose West Caribou: A part of the Nin Nihłinehch'ı' – Łı' hàh Guk'àndeht'inahtii (Animals at Risk - animals we are watching closely) Project. K. Benson. Fort McPherson, NT: 61.pp.
- Holling, C. S. 1973. Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4:1-23.
- Kennett, S. A. 2006. From science-based thresholds to regulatory limits: implementation issues for cumulative effects management. Report prepared for Environment Canada, Northern Division, Yellowknife, NT., Canadian Institute of Resources Law, Calgary, AB. 23 pp.

- Lutsel K'e Dene First Nation. 2016. Summary Report of TK Research on Bathurst Caribou and Mining. Submitted by LKDFN Wildlife, Lands and Environment. Submitted to the Government of the Northwest Territories. April, 2016. 18 pp.
- Mackenzie Valley Environmental Impact Review Board. 2003. Report of Environmental Assessment and Reasons for Decision on the DeBeers Canada Mining Inc. Snap Lake Diamond Project. Yellowknife, NT 308pp.
- Mackenzie Valley Environmental Impact Review Board. 2013. Report of Environmental Impact Review and Reasons for Decision: Gahcho Kué Diamond Mine Project, DeBeers Canada Inc. Yellowknife, NT 207pp.
- Mackenzie Valley Environmental Impact Review Board. 2016. Report of Environmental Assessment and Reasons for Decision: Dominion Diamond Ekati Corp. Jay Project. Yellowknife, NT 350pp.
- Martin, J., M. C. Runge, J. D. Nichols, B. C. Lubow, and W. L. Kendall. 2009. Structured decision making as a conceptual framework to identify thresholds for conservation and management. *Ecological Applications* 19:1079-1090.
- Nagy, J. 2011. Use of Space by Caribou in Northern Canada. PhD Thesis, University of Alberta, Edmonton, AB 184pp.
- Parlee, B., N. Thorpe and T. McNabb (2013). TK: Barren-ground caribou in the Northwest Territories. Edmonton, Alberta, University of Alberta.
- Rickbeil, G. J. M., T. Hermosilla, N. C. Coops, J. C. White, and M. A. Wulder. 2016. Barren-ground caribou (*Rangifer tarandus groenlandicus*) behaviour after recent fire events; integrating caribou telemetry data with Landsat fire detection techniques. *Global Change Biology*:n/a-n/a.
- Sangris, F. (2012). "Renewing Our Traditional Laws through Joint Ekwø (caribou) Management, The 13th North American Caribou Workshop." *Rangifer* 32(20): 75-80.
- Standish, R. J., R. J. Hobbs, M. M. Mayfield, B. T. Bestelmeyer, K. N. Suding, L. L. Battaglia, V. Eviner, C. V. Hawkes, V. M. Temperton, V. A. Cramer, J. A. Harris, J. L. Funk, and P. A. Thomas. 2014. Resilience in ecology: Abstraction, distraction, or where the action is? *Biological Conservation* 177:43-51.
- Thorpe Consulting Services. 2016. TK Panel Report, Session #9: Focus on Caribou. May 13-16, 2016 at Diavik Diamond Mine, NT. 12 pp.
- Thorpe, N. , N. Hakongak, S. Eyegetok and The Kitikmeot Elders. 2001. Thunder on the Tundra: Inuit Qaujimajatuqangit of the Bathurst Caribou.. Tuktu and Nogak Project. Vancouver, BC. Douglas and McIntyre.
- Trailmark Systems Ltd. 2016. Report on the Bathurst Caribou Range Plan TK Workshop. Report prepared by Natasha Thorpe and Joanne Barnaby. Yellowknife, NT. March 30-31, 2016. 29 pp.

Yellowknives Dene First Nation, Land and Environment, and Trailmark Systems. 2016. Preliminary TK of the Yellowknives Dene First Nation to support the Bathurst Caribou Range Plan. March 31, 2016. 23 pp.

Wray, K. (2011). Ways We Respect Caribou: Hunting in Teet'it It Zheh (Fort McPherson, NWT), University of Alberta. M.A. Thesis.

Wray, K. and B. Parlee. 2012. "Ways we respect caribou: rules in use in Tetl'it Zheh." *Arctic*. 65(4): 1.

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 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 NWT. Figure 18 shows the results of each scenario on the range map at year 2040.

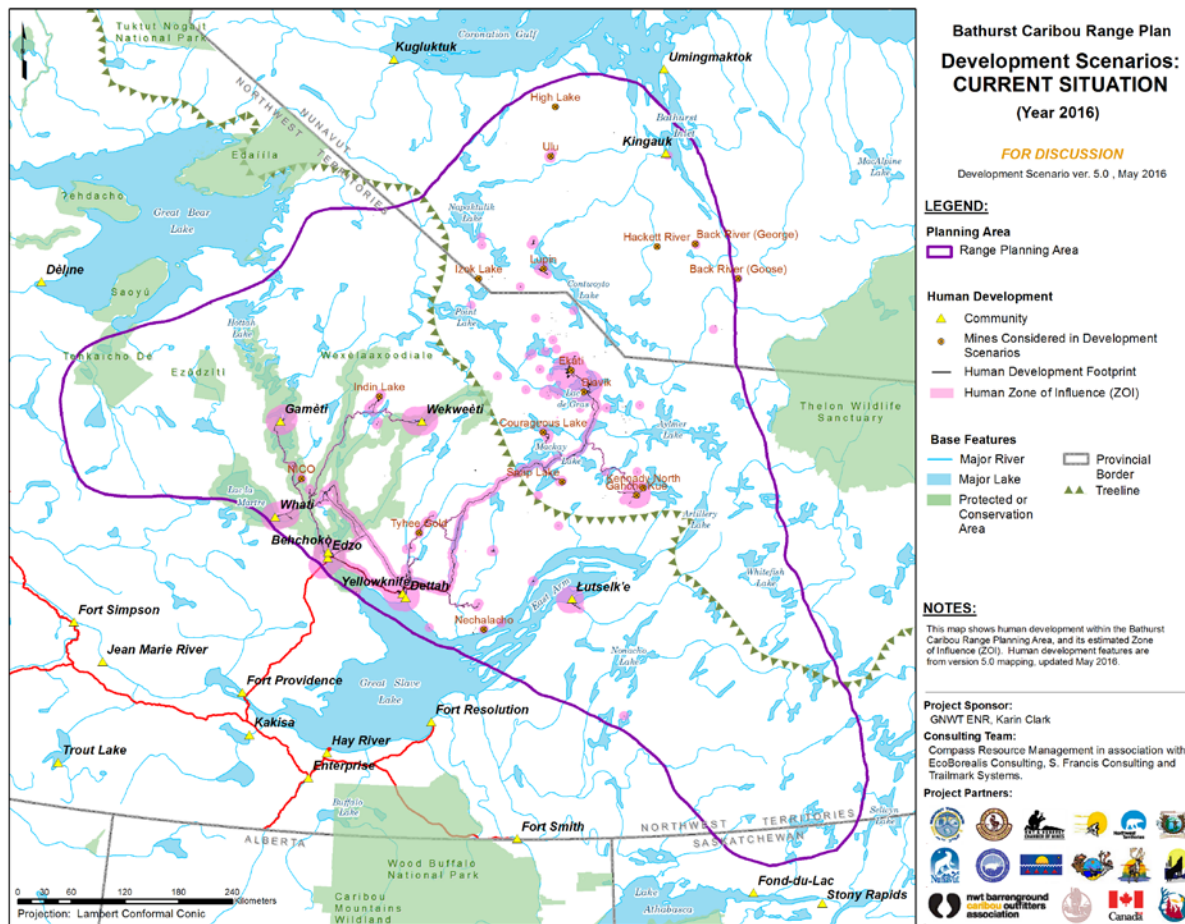
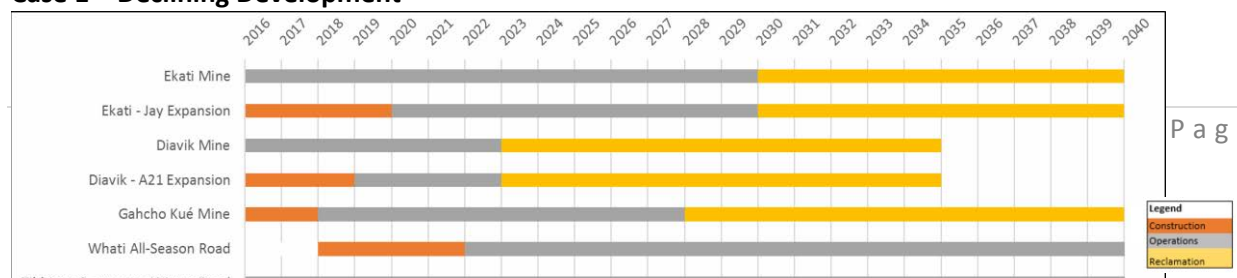
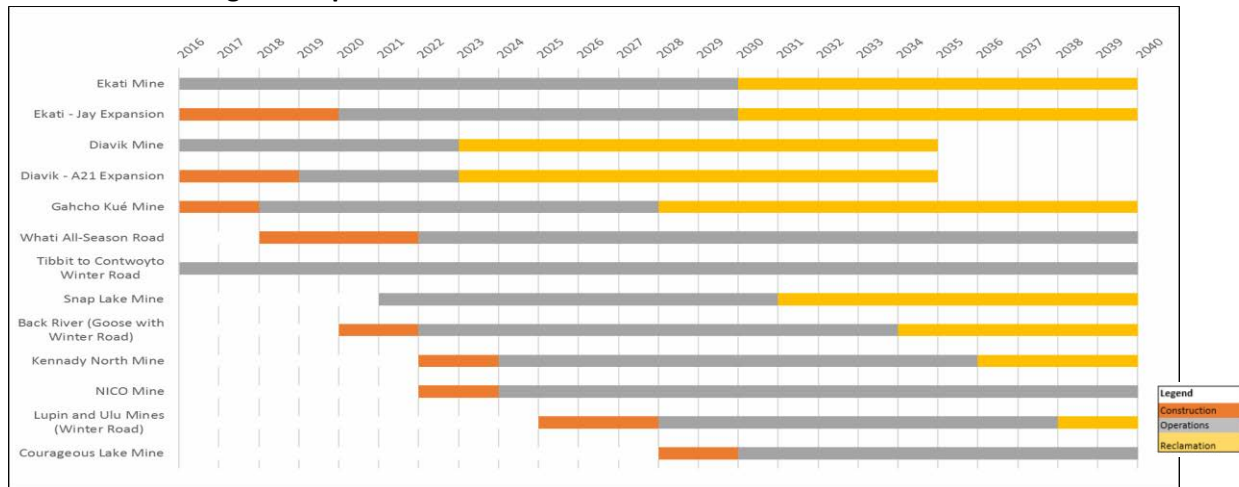


FIGURE 16: CURRENT DIRECT AND INDIRECT HUMAN DISTURBANCE IN THE BATHURST RANGE

Case 1 – Declining Development



Case 2 – Continuing Development



Case 3 – Increasing 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).

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 (km^2) 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 km^2). Total disturbance with wildfire (assuming constant at 2016 level) remains constant at $44,600 \text{ km}^2$ into the future, decreasing somewhat when the winter road is no longer required.
- **Case 2:** The NICO project begins in 2023 using an all-season road to Whati. Total disturbance with wildfire (assuming constant at 2016 level) then remains constant at $45,700 \text{ km}^2$ into the future.
- **Case 3:** In addition to Case 2:
 - The Nechlacho, Indin Lake and Tyhee projects all begin by 2029. The Tibbit to Lockhart all-season road is built in 2023, replacing that portion of the TCWR. Total disturbance then remains constant at $47,400 \text{ km}^2$ 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.

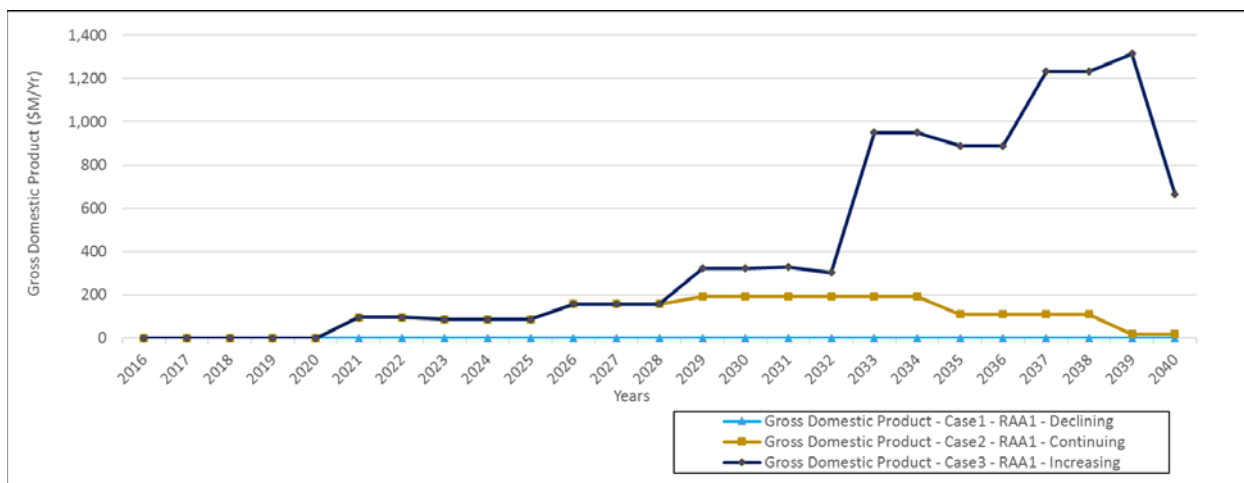


FIGURE 19: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1.

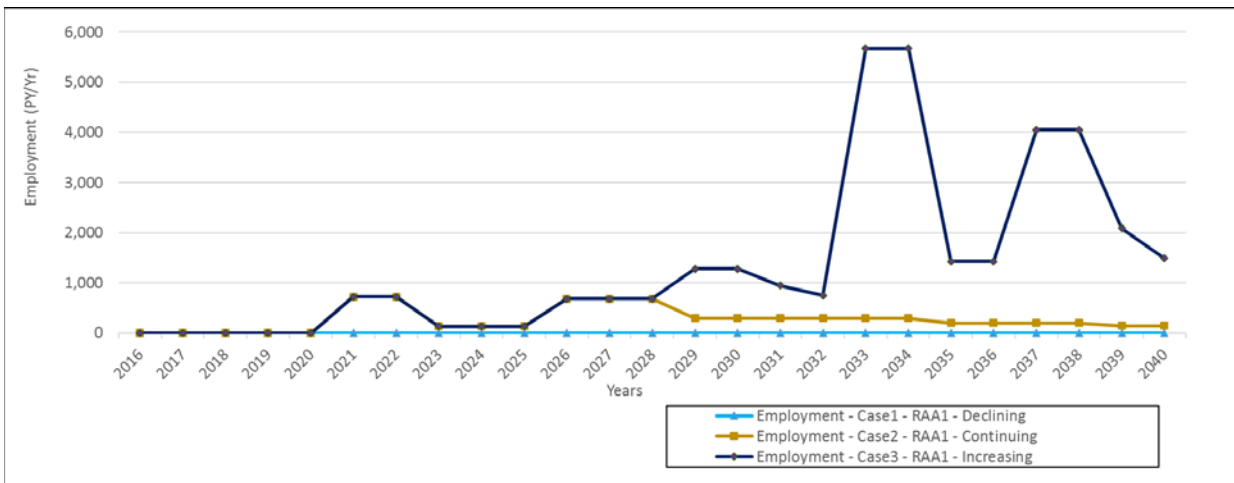


FIGURE 20: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA1.

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 (Case 2)	Without CDF (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.

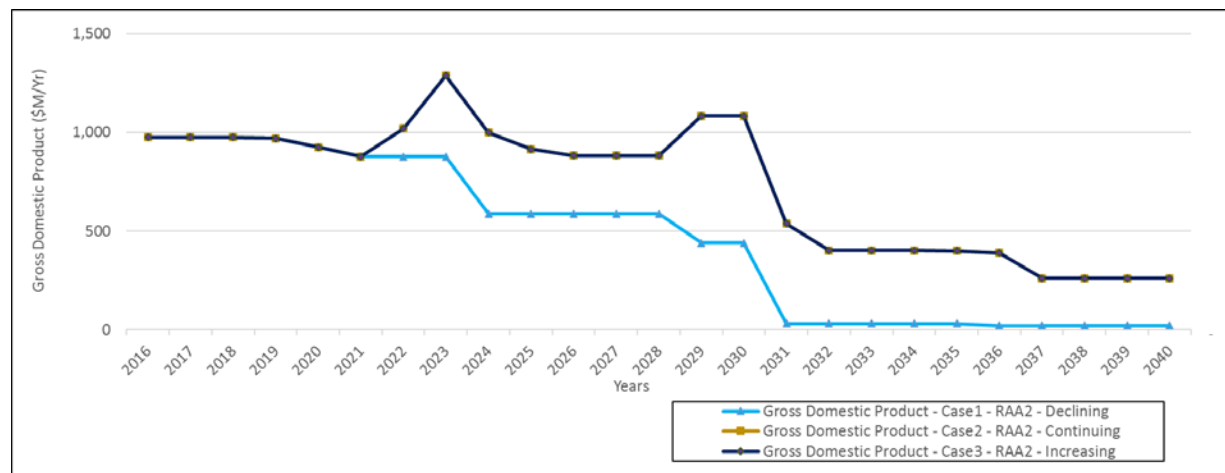


FIGURE 21: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA2.

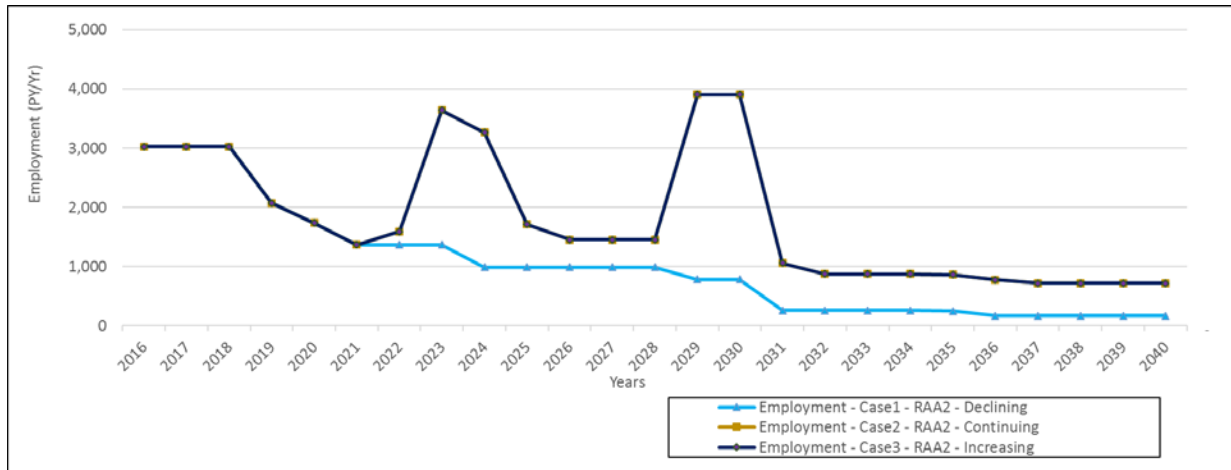


FIGURE 22: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA2.

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.

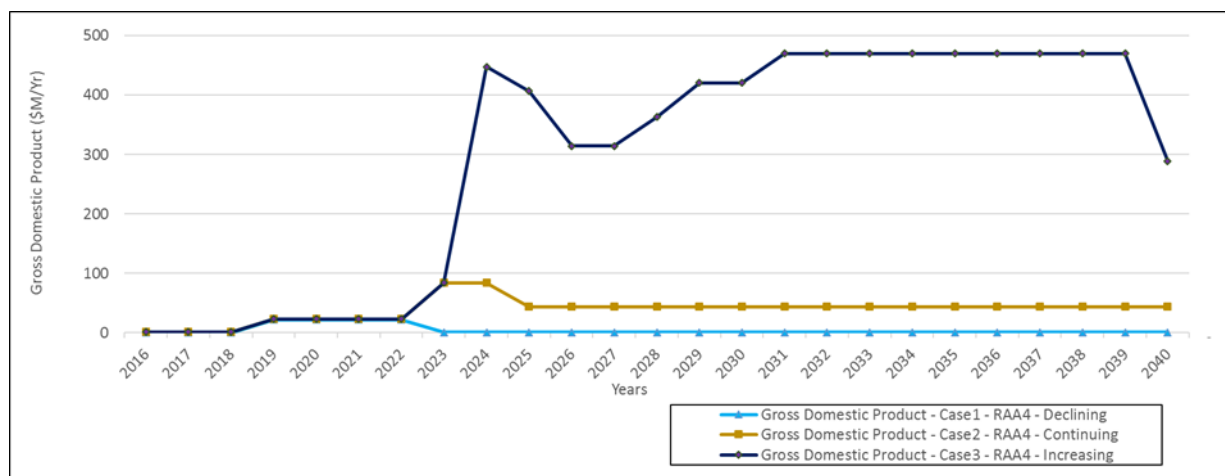


FIGURE 23: PROJECTION OF POTENTIAL GROWTH IN GROSS DOMESTIC PRODUCT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA4.

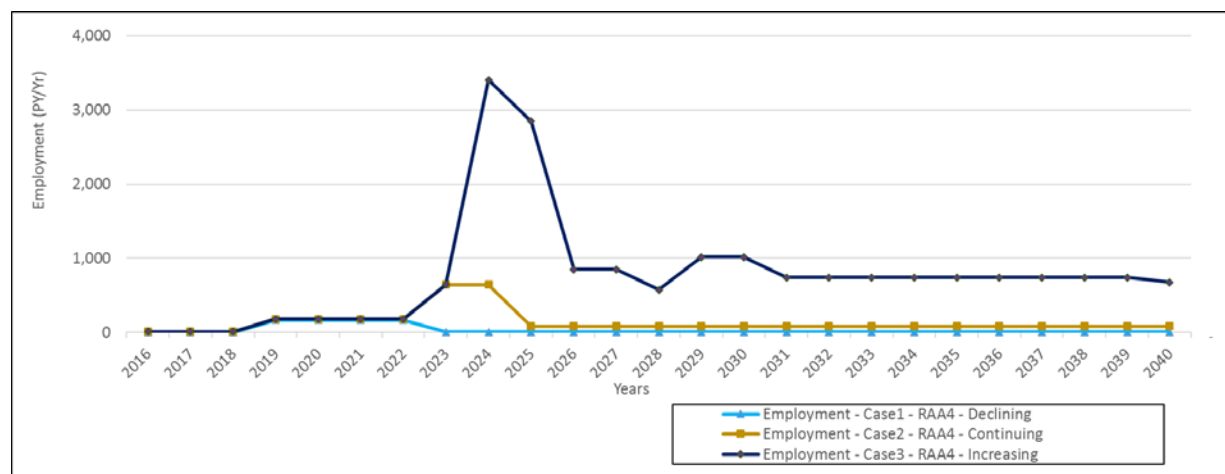


FIGURE 24: PROJECTION OF POTENTIAL GROWTH IN EMPLOYMENT FOR FUTURE DEVELOPMENT SCENARIO CASES 1, 2 AND 3 IN RAA4.

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 RAA4 FOR FUTURE YEAR 2034.

		With CDF (Case 2)	Without CDF (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