GNWT Response to:
WRRB IR#1

Topic
Caribou (boreal and barren-ground) – Application of Assessment Endpoint and Measurement Indicators

Comment
The importance of the Assessment Endpoint is in determining the significance of impacts (incremental and cumulative). The Adequacy Statement Response (ASR; sec 4.6) states that "*Residual effects were determined to be significant if a VC is expected to no longer be: (1) self-sustaining, or (2) ecologically effective*". The ASR (sec 4.1.2) describes self-sustaining populations as: "*healthy and viable populations, which are by definition robust and capable of withstanding environmental change and accommodating stochastic population processes*", and "a*n ecologically effective population differs from a self-sustaining population if the number of individuals needed to maintain ecological function is greater than the number required to maintain a viable population for the long term*." The ASR (sec 4.2) describes how the ability of a species to tolerate disturbance is evaluated using the concepts of ecological adaptability and resilience; for boreal caribou: "*At Base Case, boreal caribou are predicted to be self-sustaining and ecologically effective with a low risk, but are near their resilience limits*"; for barren-ground caribou: "*Barren-ground caribou are expected to have the capacity to adapt and be resilient to existing natural and human-related disturbances and associated variations in habitat availability, which at Base Case are not limiting.*" However, the ASR also states that "*Due to the current low abundance and harvest restrictions of Bathurst caribou and Bluenose-East barren-ground caribou are considered unlikely to be self-sustaining and ecologically effective at Base Case*" which raises questions about why barren-ground caribou can be expected to be resilient and adaptable. Several parties, including GNWT, raised questions regarding the definition of the Assessment Endpoint for caribou in previous environmental assessments for barren-ground caribou (e.g. MVEIRB's 2016 Reasons for a Decision Report for EA1314-01 Dominion Diamond Ekati Corp. Jay pit). Building on recent case studies is a useful step toward efficiency and effectiveness in environmental assessments.

Recommendation
1. Please summarize lessons that can be learnt about defining Assessment Endpoints for caribou from recent MVEIRB environmental assessments;
2. Please summarize evidence (demographic and habitat-related) supporting the statement that boreal caribou are "near" their resilience limits, and discuss the implications for the Assessment Endpoints and Measurement Indicators (see also IR#2);

3. Please describe (i) the implications for the TASR assessment if impacts are significant, given that barren-ground caribou herds currently can be considered neither self-sustaining nor ecologically effective; and (ii) relative to (i), please provide revised text for the Assessment Endpoints and Measurement Indicators and implications for proposed adaptive mitigation for barren-ground caribou (see also IR#2).

GNWT Response

The assessment endpoint of self-sustaining and ecologically effective wildlife populations was most recently used in the assessment of the Jay Project (Dominion Diamond 2014). During the review of the Jay Project Developer's Assessment Report, several communities, regulatory agencies, and the Review Board indicated they had concerns with the application of this assessment endpoint for wildlife and specifically for caribou.

For example, the GNWT indicated that it had "concerns that the choice of assessment endpoint (self-sustaining and ecologically effective caribou populations) has been problematic as a benchmark against which to measure changes in the measurement indicators and that there was not a clear enough methodology to link changes in the selected measurement indicators to the endpoint" (GNWT 2015a). The Review Board further pointed out that the use of self-sustaining and ecologically effective populations as an assessment endpoint was "inadequate because impacts to caribou could be significant for other reasons, such as a diminished ability of Aboriginal people to successfully and sustainably harvest caribou" (MVEIRB 2016). Both of these points are important and each is addressed in turn in the following paragraphs.

Identifying ecological benchmarks or threshold values for measurement indicators that can be used to determine whether a population will or will not be self-sustaining or ecologically effective is challenging. However, the difficulty of the task should not preclude its undertaking as part of environmental assessments. Self-sustaining and ecologically effective populations are concepts (values) ingrained in conservation biology (Hunter and Gibbs 2007). These concepts are related to the abundance and distribution and ecological function of each Valued Component. Self-sustaining populations are healthy, robust populations capable of withstanding environmental change and accommodating random demographic processes (Reed et al. 2003). Protection of ecological effectiveness is aimed at preserving a species role in an ecosystem because interactions with other species are important for maintaining ecosystem function (Soulé et al. 2003; Sabo 2008; Säterberg et al. 2013).

Achieving self-sustaining and ecologically effective populations is a primary goal of most species conservation, protection, or recovery plans. For example, achieving a self-sustaining population is the goal for the recovery strategy of woodland caribou (EC 2012). Similar goals are identified in plans developed for other species such as burrowing owls (AESRD 2012) or wolverines (EC 2014), and the 2011-2015 barren-ground caribou management strategy (GNWT 2011) includes management principals of herd health and persistence (i.e. ability to be self-sustaining). Environment and Climate Change Canada (ECCC) provides guidance about how much habitat is sufficient within a cumulative effects context, and the guidance focuses on maintaining sufficient habitat to achieve long-term species persistence and a wide range of ecological functions (EC 2013).

Although defining the precise point at which a population loses its self-sustaining and ecologically effective status is difficult, there is no reason to exclude this central conservation paradigm from environmental assessment. No alternative conservation-based assessment endpoints were proposed as part of recent MVEIRB environmental assessment reviews. This point was recognized by the GNWT in its final technical report for the Jay Project. The GNWT stated that, in the absence of specific targets for acceptable levels of change for barren-ground caribou, the assessment approach of using a weight of evidence to determine whether populations were self-sustaining and ecologically effective was "generally sound", even though the GNWT did not agree with all conclusions stemming from the analysis (GNWT 2015b).

Another important lesson that can be learned about assessment endpoints as an outcome of recent MVEIRB decisions is that the distinction between maintaining self-sustaining and ecologically effective populations and maintaining ecosystem services needs to be more clearly explained in environmental assessments. For example, the Review Board (MVEIRB 2016) concluded that "Dominion postulates that if the Jay Project does not reduce the Bathurst caribou herd's ability to be self-sustaining and ecologically effective, there is no significant adverse impact". This conclusion fails to consider that ecosystem services, which are the benefits people gain from the environment (IFC 2012), also constitute important aspects of the assessment, but these were considered in the assessment endpoints of the Traditional Land Use section of the Developer's Adequacy Statement, not the wildlife section. This may not have been sufficiently explained as part of previous environmental assessments.

Maintaining self-sustaining and ecologically effective wildlife populations should help maintain ecosystem services, such as the continued opportunity for consumptive use of animals by people or wildlife viewing opportunities, but this will not always be the case. Questions about whether the number of animals available

for harvest is adequate are not answered using self-sustaining and ecologically effective populations as an assessment endpoint. Instead, societal values and perspectives related to ecosystem services ought to be integrated into assessment endpoints presented in a Traditional Land Use assessment, which considers changes in human use of natural resources. Community input is typically required to determine whether such changes are significant.

The second aspect of this information request from WRRB is to provide evidence that boreal caribou are approaching a limit where a self-sustaining population would be retained. In the case of boreal caribou, where a measurable target has been set for self-sustaining caribou populations by ECCC (i.e., 65% undisturbed habitat), the approach to determining whether or not a VC population will be self-sustaining is simplified. Consequently, evidence supporting the conclusion of the Adequacy Statement Response that boreal caribou in the NT1 range may be approaching the limit for a self-sustaining population is primarily associated with the amount of undisturbed habitat in the NT1 range. At the Base Case, undisturbed habitat in the NT1 range was estimated at 66.8%, which is above but near the critical threshold of 65% needed for boreal caribou populations to be self-sustaining with moderate risk (EC 2012).

The third aspect of this information request from WRRB is to provide more information about whether the impacts of TASR contribute to the lack of a self-sustaining and ecologically effective population of barren-ground caribou in the Base Case (i.e., would the Project contribute to an existing significant adverse cumulative effect). As noted in the ASR (Section 4.4.2.2) and in responses to WRRB IR#3 and #6 (PR#134), collar data and Traditional Knowledge (PR#28) indicate that barren-ground caribou will have a distribution that interacts with the Project only when populations are near peak abundances. Furthermore, even though the road may extend the length of the potential winter harvest season, harvest restrictions for barren-ground caribou are likely to be in place until the population is better able to sustain harvest. The Project would not contribute to the significant adverse cumulative effect identified for barren-ground caribou in the Base Case.

References

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Dominion Diamond (Dominion Diamond Ekati Corporation). 2014. Developer's Assessment Report for the Jay Project. Dominion Diamond Ekati Corporation. Yellowknife, NWT.

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EC. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, ON.

EC. 2014. Proposed Recovery Strategy for the Wolverine (Gulo gulo), Eastern population, in Canada – 2014. Environment Canada, Ottawa, ON. Available at: http://www.sararegistry.gc.ca/default.asp?lang=En&n=A18B84C4-1#_05.

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MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2016. Report of Environmental Assessment and Reasons for Decision. Dominion Diamond Ekati Corporation's Jay Project – EA1314-10.

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Soulé ME, Estes JA, Berger J, Del Rio CM. 2003. Ecological effectiveness: conservation goals for interactive species. Conser Biol 17: 1238-1250.

GNWT Response to:
WRRB IR#2

Topic
Caribou (boreal and barren-ground) – Measurement Indicators

Comment
The ASR (sec 4.2) describes Measurement Indicators used to characterize impacts on an assessment endpoint. Residual effects analysis states that: "*the residual effects analysis for the Application Case is completed by calculating and predicting changes to measurement indicators*" (emphasis added). Changes in habitat availability and animal use were estimated quantitatively, and changes in habitat distribution (including the effects on wildlife movement and habitat connectivity) were estimated qualitatively. Changes in survival and reproduction (abundance) were identified qualitatively and quantitatively. Almost no data or analyses are presented except the spatial accounting for habitat availability. However, data are available directly for VCs, or from comparable situations. Indicators from previous environmental assessments can provide values that could be used to demonstrate the statistical power needed to detect changes in the Measurement Indicators as a result of impacts (e.g. movement rates and deflection rates). Recent environmental assessments, and their post-approval monitoring, have increased the statistical rigor and reporting of monitoring; a useful example are Baffinland's annual monitoring reports (e.g. see: http://www.baffinland.com/downloadocs/2016annualmonitoringreport20170404_2017-10-33-17.pdf). An annotated list of indicators and an analysis of statistical power required to detect changes can increase confidence in the assessment, and improve the effectiveness of monitoring.

Recommendation
1. Please summarize in tabular form, the Measurement Indicators for boreal and barren-ground caribou and annotate the indicators with: the number of years available for each indicator, mean values with coefficient of variation, and extreme values;
2. Provide an estimation of the applicability of the data to detect changes relative to the effect size of the potential impacts, and list how monitoring will be used to detect effect sizes.

GNWT Response
The measurement indicators considered in the Adequacy Statement Response (ASR, PR#110) included habitat availability, habitat distribution and survival and reproduction. The data and approach used to assess changes in each measurement indicator are presented in Table 1.

Table 1: Measurement indicators for boreal and barren-ground caribou

Measurement Indicator	Data used to support indicator
Habitat availability	Habitat availability was quantified using SPOT 4/5 20 m land cover data (Section 4.2.2) in conjunction with habitat suitability indices to quantitatively available habitat for each wildlife Valued Components (VC). The SPOT 4/5 20 m land cover data are a composite of imagery from 2005 to 2010 (Olthof et al. 2015).
Habitat Distribution	Habitat distribution was qualitatively assessed using maps of habitat availability. Habitat distribution was also quantitatively assessed in response to ECCC IR#6.
Survival and Reproduction	Survival and reproduction was assessed quantitatively based on changes to habitat availability and qualitatively based on knowledge of potential changes in abundance from other Project components and activities. Greater than 47 scientific studies related to caribou survival and reproduction are cited in the ASR.

The conclusions presented in the assessment are based on maximum predicted effects. That is, the assessment was precautionary and effects were overestimated where uncertainty was identified. For example, the Project footprint was buffered by 100 metres at water crossings because there was uncertainty about where precisely water crossings would be located. Moreover, all 13 potential borrow sites were included in the footprint for the assessment even though all may not be required for Project construction or maintenance. Because the maximum predicted effect was used, mean values of possible outcomes or coefficients of variation around expected possible outcomes were not presented and would not be applicable when using maximum predicted effect.

Data used to support predictions made as part of the assessment are suitable for application to monitoring the effects of the Project and comparing measured outcomes to the predictions made in the ASR. For example, after construction of the Project is complete, the actual changes in caribou habitat availability and distribution can be measured using the same spatial data used to make assessment predictions. The draft Wildlife Effects Monitoring Program (WEMP), which will include information about the effects monitoring the GNWT is proposing for the Project, will be available prior to the Technical Sessions.

The approach applied to the assessment was to make precautionary effects predictions to address uncertainties and provide confidence that effects have not been underestimated. The assessment approach used is appropriate for meeting the Terms of Reference (PR#69). Monitoring should demonstrate that the effects are less than predicted in the assessment.

References

Olthof I, Latifovic R, Pouliot D. 2015. Medium Resolution Land Cover Mapping of Canada from SPOT 4/5 data. Geomatics Canada, Open File 4, 37p., doi:10.4095/295751.

GNWT Response to:
WRRB IR#7

Topic
Boreal Caribou – Habitat Availability (quantification of)

Comment
The ASR states that approximately 60% of the Wek'èezhìı portion of the NT1 range is undisturbed boreal caribou habitat. The Project Description Report (PDR) states that the North Slave region portion of the NT1 range had 52.4% undisturbed habitat as of Fall 2015. The Recovery Strategy for the Boreal Caribou in the Northwest Territories states that there is approximately 55% of undisturbed habitat in Wek'èezhìı.

Recommendation
1. Recognizing the influence of North Slave and Wek'èezhìı boundaries and differences in spatial data layers and methodologies, please provide details explaining why the three estimates for the percent of critical habitat remaining in Wek'èezhìı differ among the ASR, the PDR, and the NWT Recovery Strategy;
2. Describe how the variability (52.4-60%) in the estimated amount of undisturbed habitat for boreal caribou in the Wek'èezhìı portion of NT1 range changes the uncertainty for assessing potential impacts, and the proposed monitoring and adaptive mitigation for boreal caribou;
3. Please clarify if buffering development included direct habitat changes or indirect habitat loss through behavior; if indirect habitat loss was included, please clarify how the avoidance distance was selected.

GNWT Response
The North Slave Region and the Wek'èezhìı Management Area have different southern boundaries and the North Slave Region is larger so values of undisturbed habitat reported for the North Slave Region may not be the same as for Wek'èezhìı Portion of the NT1 range. As well, the temporal scope of the PDR was through 2015 and the ASR through 2016. In 2016, there were 96,660 ha of burns from 1975 wild fire in the Wek'èezhìı Portion of the NT1 range that were considered suitable caribou habitat (i.e., >40 years old [EC 2012]), which would have been unsuitable in 2015. This amounts to a 2.1% increase of undisturbed habitat from 2015 to 2016.

The assessment was conducted at the NT1 range scale, not the Wek'èezhìı scale (see response to WRRB IR#8). The slight differences noted at the NT1 range scale for boreal caribou critical habitat relative to the various reports are the result of differences in the spatial data files and coordinate system projections applied in a Geographic Information System (GIS) platform. For example, the PDR used Canada

Albers Equal Area Conic projection with Landsat imagery that has a 30 metre resolution. The ASR (PR#110) used SPOT 4/5 land cover data with a 20 metre resolution for all wildlife valued component habitat mapping, which required LCC E008 (Lambert Conformal Conic) projection. Projection of the ASR's buffered development disturbance data using Canada Albers Equal Area Conic results in 3,924,820 ha of disturbance in the NT1 range. Projection of the same buffered development disturbance data using LCC E008 projection results in 3,697,667 ha of disturbance in the NT1 range, representing a difference of 227,153 ha based on projection alone. This would also affect measurements at smaller scales throughout the NT1 range such as the Wek'èezhìı Portion of the NT1 range.

The development disturbance data used in the Base Case also included the entire length of the existing old airport winter road, whereas the PDR only included parts that were visible on Landsat imagery in ECCC disturbance data. Reconnaissance information (PR#7; PR#54) on the existing route shows that the entire route is disturbed even though some disturbance is not visible in Landsat imagery. Additionally, the RFD Case in the ASR included the NICO and Mackenzie Valley Highway projects, which were not included in the PDR or preliminary screening calculations. The contribution of these data to the observed differences were small because they intersect existing development and fire disturbance already present in the Base Case. The RFD Case in the ASR reduced undisturbed habitat in the NT1 range by 0.2%, and these two future projects would represent only a fraction of this amount.

Importantly, no matter which data sources or projection are used, undisturbed habitat within the NT1 range remains above the 65% minimum threshold for undisturbed habitat identified by ECCC as necessary to support a self-sustaining boreal caribou population with a low to moderate risk (EC 2012). The methods used to calculate disturbance for the ASR were appropriate to meet the Terms of Reference (PR#69), and the degree of difference between calculations does not alter the confidence in the conclusions of the assessment.

Disturbance in the NT1 range is primarily from fire (e.g., calculations presented in the ASR indicate 73% of disturbance is due to fire and 27% is due to buffered development). The addition of the Project increases the amount of disturbance in the NT1 range by less than 0.1%. The addition of the Project and reasonably foreseeable developments increases the amount of disturbance in the NT1 range by about 0.2%. Consequently, as concluded in the ASR, habitat disturbance for boreal caribou is approaching the limits identified by ECCC for maintaining a self-sustaining caribou population, primarily as a result of fire. The limits have not been exceeded in the Base Case, will not be exceeded as a result of the Project and are not likely to be exceeded as a result of the current projected reasonably foreseeable

developments. This is true for all of the different approaches for calculating amount of disturbance in the NT1 range. Therefore, monitoring and adaptive management approaches do not change as a function of the methods used for calculating disturbance.

Following Environment and Climate Change Canada guidelines for mapping undisturbed critical habitat (EC 2012), a 500 metre buffer was applied to development to capture indirect effects (sensory disturbance and/or perceived predation risk). Consequently, the area measured as disturbed by development incorporates both direct and indirect effects.

References

Environment Canada. 2012. Recovery strategy for the woodland caribou (*Rangifer tarandus caribou*), boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138 pp.

GNWT Response to:
WRRB IR#9

Topic
Boreal Caribou – Habitat Availability (connectivity / fragmentation)

Comment
Nagy (2011) recognized different approaches to developing thresholds for sustainable levels of natural and anthopogenic impacts beyond which viable populations of boreal caribou cannot be maintained, and also recognized that spatial configuration of habitat is important when assessing habitat quality. In the ASR, it is mentioned that Nagy (2011) found a positive correlation between population growth rates and access to secure unburned habitat, particularly where most of the habitat was in patches greater than 500 km^2. Nagy's modelling suggested that viable populations of boreal caribou can be maintained in areas where ≥46% of the area is secure unburned habitat and 54% of that secure unburned habitat is in patches >500 km2, with the understanding that these areas must also have low predator and alternate prey diversity. The ASR states that: "Fragmentation effects have less influence than direct habitat loss when there is a large proportion of undisturbed habitat on the landscape, which is apparent across the NT1 range. Boreal caribou are predicted to be resilient to these small changes in physical habitat loss from development, and there should be a negligible effect on distribution or connectivity across the NT1 range." The ASR also states: "At Base Case, undisturbed boreal caribou habitat has a patchy distribution throughout the NT1 range. Fire disturbance also occurs in large patches throughout the NT1 Range. The NT1 range has existing linear disturbance, in the form of roads, trails, power transmission lines and seismic lines, particularly in the southern part of the NT1 range. Large but less common patches of undisturbed habitat are also present in the northwestern part of Wek'èezhìı Portion of NT1 Range". The ASR concludes that boreal caribou in the NT1 range appear to be within limits of capacity and resilience to the Base Case. However, commentary regarding limits of capacity and resilience at the Wek'èezhìı scale is not provided. It was clarified in the TASR ASR Technical Review Session that habitat distribution (i.e. arrangement and connectivity of quality habitat) was evaluated qualitatively (see PR#120). However, no qualitative assessment of the patch sizes in Wek'èezhìı and their possible viability as functional boreal caribou habitat is provided.

Recommendation
1. Provide a qualitative assessment of the patch sizes including a frequency distribution of the patch sizes of secure unburnt habitat in Wek'èezhìı (refer to methods outlined in Nagy 2011 regarding patch size classes) and provide a map

of Wek'èezhìı which clearly shows the spatial arrangement of secure unburnt habitat patches (>500km2) relative to the TASR corridor;
2. Compare the percentage of burnt habitat patches greater than 500km2 by burn age class to estimate trends in the total amount of critical habitat estimated in Wek'èezhìı (see also IR#7 and #8);
3. With reference 1) and 2) above, describe how boreal caribou in Wek'èezhìı are within the limits of adaptive capacity and resilience; consider connectivity (e.g., roads as semi-permeable barriers) and predation-related impacts in the response (see also IR#7 and #8).

GNWT Response

Boreal caribou habitat was mapped in accordance with methods and data described by the Federal Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population in Canada (EC 2012), which defines disturbed habitat as human disturbance buffered by 500 m and areas that were burned within the last 40 years. Please see response to ECCC IR#6 for additional information about the patch size and composition in the Base Case, Application Case, and Reasonably Foreseeable Development (RFD) Case at the NT1 scale.

The distribution of boreal caribou habitat in the Wek'èezhìı Resource Management Area portion of the NT1 range in the RFD Case is provided in **Figure WRRB-IR09-01**. Of the total amount of undisturbed habitat present in Wek'èezhìı portion of the NT1 range in the RFD Case, the majority is classified as undisturbed habitat patches greater than 500 km^2. Patches of undisturbed habitat less than 500 km^2 occur primarily in the southern portion of the Wek'èezhìı Resource Management Area, south of the location of the Project (**Figure WRRB-IR09-01**). As identified in the response to ECCC IR#6, the Project would result in no change in the distribution of large patches of undisturbed habitat because it overlaps an existing linear disturbance. Habitat patches greater than 500 km^2 on either side of the Project would be maintained after the application of the Project and RFDs (**Figure WRRB-IR09-01**).

As part of the Adequacy Statement Response (ASR, PR#110), areas of burn age were categorized according to their ecological value and related patterns of wildlife use. These categories included 0 to 5 years (2011 – 2016), 6 to 10 years (2006 – 2010), 11 to 20 years (1996 – 2005), 21 to 40 years (1976 – 1995), and greater than 40 years (1975 and earlier). Fire history data obtained from the GNWT indicates that nine fires greater than 500 km^2 have occurred in the Wek'èezhìı Resource Management Area between 1976 and 2016; one in 1981 burning 842 km^2, three in 1994 burning 4,453 km^2, one in 1995 burning 2,119 km^2, one in 2008 burning 676 km^2, two in 2014 burning 4,042 km^2, and one in 2015 burning 515 km^2 (GNWT-CG 2017).

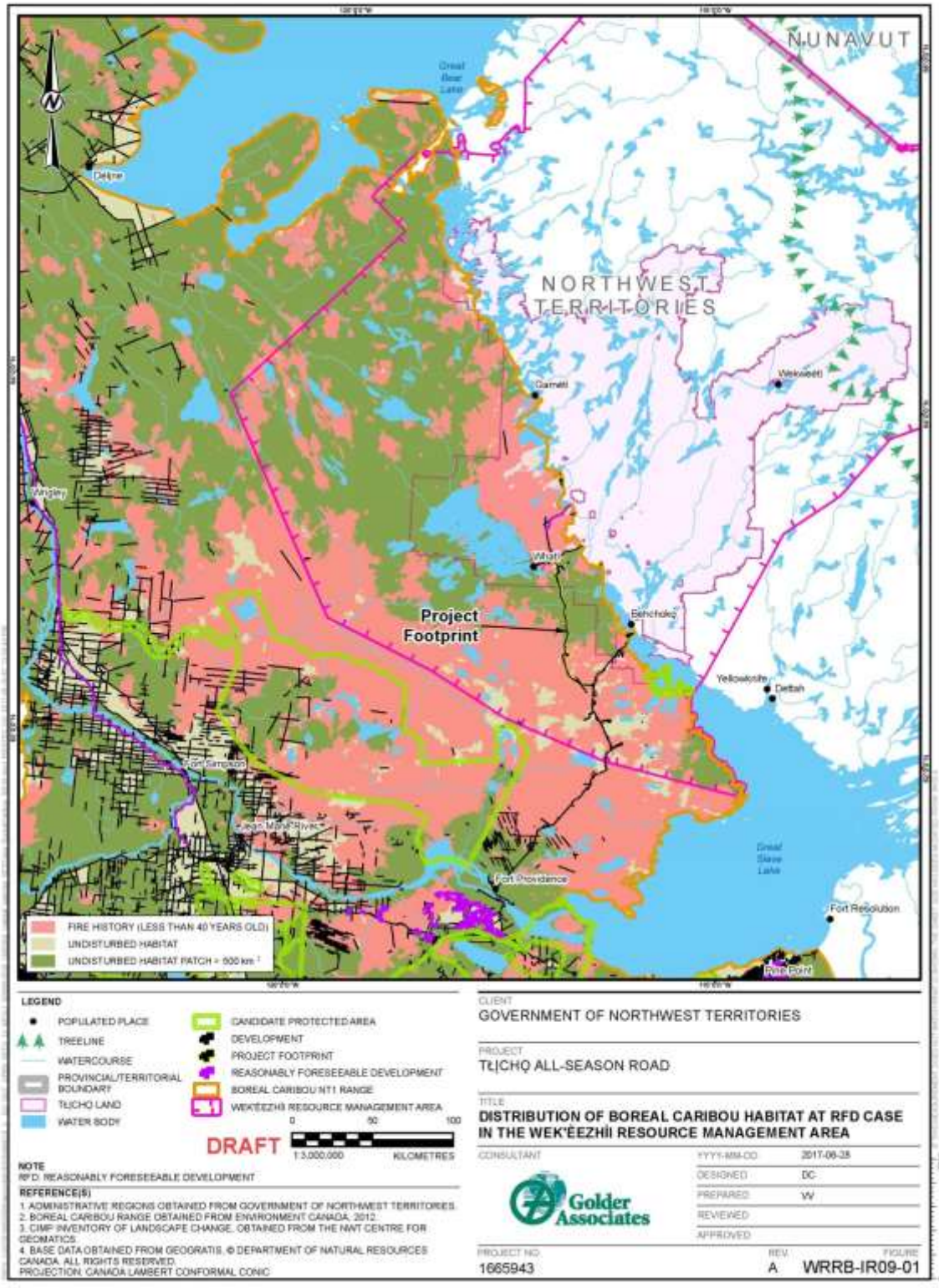
A comparison of burned habitat patches greater than 500 km² by burn age category defined in the ASR indicates that the relative proportion of burned habitat patches greater than 500 km² in the Wek'èezhìı Resource Management Area has been consistent over the past 40 years (Table 1). The lack of an obvious temporal pattern is consistent with both the stochastic nature of lightning strikes, which account for 90% of wildfires in the NWT (GNWT-ENR 2017), and the lack of fire suppression activities in the Wek'èezhìı Resource Management Area and elsewhere in the NWT.

Table 1: Amount of Burned Habitat Greater than 500 km² by Burn Age Class in the Wek'èezhìı Resource Management Area

Land Cover Code	Land Cover Name	Area (km²)	Area of Burned Habitat Patches >500 km² (km²)	Percentage of Area Burned in Patches >500 km²
17	Burn: 0-5 yrs (2011-2016)	6,475	4556.1	70.4
18	Burn: 6-10 yrs (2006-2010)	901	676.1	75.0
19	Burn: 11-20 yrs (1996-2005)	661	0	0.0
20	Burn: 21-40 yrs (1976-1995)	10,093	7413.9	73.5

Several undisturbed habitat patches within the NT1 range that are greater than 500 km² span the western boundary of the Wek'èezhìı Resource Management Area (**Figure WRRB-IR09-01**). Thus, boreal caribou present in the Wek'èezhìı Resource Management Area have the ability to use large connected patches of undisturbed critical habitat outside of the Wek'èezhìı Resource Management Area boundary to meet survival and reproductive requirements and interact at a population level with other caribou in the NT1 range. Therefore, the Wek'èezhìı Resource Management Area boundary does not contain a biologically discrete caribou population.

Because the Wek'èezhìı Resource Management Area boundary does not contain a biologically discrete caribou population, the ASR did not determine whether boreal caribou in the Wek'èezhìı portion of the NT1 range are self-sustaining and ecologically effective. The relationship between undisturbed habitat in the Wek'èezhìı portion of the NT1 range and the dynamics of the boreal caribou occupying the Wek'èezhìı portion of the NT1 range is unknown, and uncertainty about whether the Wek'èezhìı portion of the NT1 range may represent a source or sink within the broader NT1 range is high. However, as depicted in **Figure WRRB-IR09-01**, fire is the most important driver of the amount of intact habitat in the Wek'èezhìı portion of the NT1 range, and human disturbance is not an important factor influencing either the amount of intact habitat or the number of intact habitat patches greater than 500 km².


NUNAVUT
NORTHWEST TERRITORIES
Project Footprint
Great Bear Lake
Great Slave Lake
Deline
Colville Lake
Norman Wells
Tulita
Fort Good Hope
Wrigley
Fort Simpson
Jean Marie River
Trout Lake
Fort Providence
Kakisa
Fort Resolution
Rae Point
Gamètì
Wekweètì
Whatì
Behchokǫ̀
Yellowknife
Dettah
FIRE HISTORY (LESS THAN 40 YEARS OLD)
UNDISTURBED HABITAT
UNDISTURBED HABITAT PATCH > 500 km²
LEGEND
POPULATED PLACE
TREELINE
WATERCOURSE
PROVINCIAL/TERRITORIAL BOUNDARY
TŁĮCHǪ LAND
WATER BODY
CANDIDATE PROTECTED AREA
DEVELOPMENT
PROJECT FOOTPRINT
REASONABLY FORESEEABLE DEVELOPMENT
BOREAL CARIBOU NT1 RANGE
WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA
0 50 100
DRAFT
1:3,000,000
KILOMETRES
NOTE
RFD: REASONABLY FORESEEABLE DEVELOPMENT
REFERENCE(S)
1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: CANADA LAMBERT CONFORMAL CONIC
CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES
PROJECT
TŁĮCHǪ ALL-SEASON ROAD
TITLE
DISTRIBUTION OF BOREAL CARIBOU HABITAT AT RFD CASE IN THE WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA
CONSULTANT
Golder Associates
YYYY-MM-DD 2017-06-28
DESIGNED DC
PREPARED VV
REVIEWED
APPROVED
PROJECT NO. 1665943
REV. A
FIGURE WRRB-IR09-01

References

Environment Canada. 2012. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138 pp.

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GNWT Response to:
WRRB IR#10

Topic
Boreal Caribou – Increased Traffic Collisions

Comment
The ASR and PDR clarify that vehicle collisions are a significant source of mortality for bison, for example indicating that that since 1998 there have been nearly 300 collisions resulting in over 400 bison killed. However, the number of collisions with boreal caribou is not specified. Experience from other jurisdictions documenting boreal caribou collisions and effective mitigation are also not provided.

Recommendation
To determine the risk of traffic collisions for boreal caribou, please summarize relative boreal caribou densities, traffic frequencies, and collisions for the jurisdictions with the available data.

GNWT Response
Records of collisions reported for Highway 3 are the most applicable to the Project. This is because Highway 3 is adjacent to the Project area and would include similar valued components and traffic traveling between communities that may also use the Project. Traffic collisions reported for other jurisdictions are less relevant because traffic, wildlife communities, habitat and other landscape factors that influence collision rates will be different. Records of collisions reported for Highway 3 between wildlife and motor vehicles indicate that from 2006 to 2016, one caribou was struck on Highway 3 near Fort Providence. The incident occurred on January 25, 2009 and whether the caribou was boreal or barren-ground was not recorded. If other collisions occurred during this period, they were not reported.

Annual daily average and peak summer average daily traffic volume on Highway 3, which has a posted speed limit of 90 km/hr, during 2006 to 2015 are provided in Tables 1 and 2 (DOT 2016). Both annual daily average and peak summer daily average traffic volume have fluctuated through time. Given that only one caribou-traffic collision was reported, caribou vehicle strikes appear to be extremely infrequent.

Traffic volume of up to 40 vehicles per day was assumed in the assessment for the Project with a 70 km/hr speed limit. Traffic volume, speed limit and visibility are key factors that influence the frequency of wildlife-vehicle strike mortalities (EBA 2001; Neumann et al. 2012). Given that lower traffic volumes and speed limits are expected for the Project compared with Highway 3, the available data support the

conclusion presented in the Adequacy Statement Response that the potential for the Project to cause caribou mortality through vehicle collisions is low.

Table 1: Estimated Annual Average Daily Traffic on Northwest Territories Highway 3, 2006 to 2015

Kilometre	Counter ID	Description	Annual Average Daily Traffic									
			2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
25	3-25	1 km north of Enterprise, south of Paradise Gardens	380	370	300	300	270	270	250	320	300	270
175	3-175	53 km north of Chan Lake, 62 Km south of Edzo	360	350	280	280	250	240	250	310	300	210
240	3-240	3 km south of Rae access, south of Frank's Channel	530	890	950	820	760	840	620	770	780	780
324	3-324	21 km east of Boundary Creek	660	740	790	680	670	750	640	640	640	640
338	3-338	0.8 km west of Highway 3 and 4 Intersection	6020	6600	6990	6050	5880	6730	5600	5600	5500	5680

Table 2: Estimated Peak Summer* Average Daily Traffic on Northwest Territories Highway 3, 2006 to 2015

Kilometre	Counter ID	Description	Peak Summer Average Daily Traffic									
			2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
25	3-25	1 km north of Enterprise, south of Paradise Gardens	460	480	400	370	360	390	340	400	360	290
175	3-175	53 km north of Chan Lake, 62 Km south of Edzo	480	460	370	370	330	350	**	360	280	**
240	3-240	3 km south of Rae access, south of Frank's Channel	1240	1190	1260	1110	830	910	**	750	770	860
324	3-324	21 km east of Boundary Creek	740	810	1050	850	750	790	820	**	**	**
338	3-338	0.8 km west of Highway 3 and 4 Intersection	8030	8810	9330	7970	7010	7470	**	**	6120	6730

*Summer = June, July and August.

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GNWT Response to:
WRRB IR#11

Topic
Boreal Caribou – Predation-related Impacts (influence of moose and bison)

Comment
In the ASR, increased predation as a result of new access was identified by the Review Board as one of the "key areas of concern". Increased predation as a result of new access is discussed under secondary pathways as the changes in predator and prey use of linear corridors and converted habitat is expected to have negligible net residual effects. The focus of the potential impacts of bison and moose is discussed under primary pathways with regards to impacts to habitat (e.g. loss of functional habitat due to competition). The Draft Mackenzie Bison Management Plan mentions that in recent years Tlicho community members have observed bison both along the highway and in wooded areas between Behchokǫ̀ and Whatì (PR#80). In the SARC Species Status Report for the Wood Bison (http://www.nwtspeciesatrisk.ca/sites/default/files/wood_bison_status_report_final_w_assessment_-_may1716_-_w_nyarling_correction.pdf), it is mentioned that an increase in both bison range and population is viewed as a reason for increased wolf numbers in the North Slave region, and that this is a concern with regards to ungulates, "in particular" with regards to boreal caribou (see also IR#3). The ASR mentions that fire is beneficial to bison as it opens up new foraging areas, but clarifies that recently burned forest may not influence habitat selection given bison do not use heavily forested patches around small patches of recently burned forest. The ASR provides some details on the possible impacts of white tailed deer and moose with regards to increased predation risk clarifying that neither moose nor deer currently occur at high densities in Wek'èezhìı. However, the ASR also mentions that studies have found moose populations are expected to increase approximately 10-30 years post fire, and the predicted increase would increase the probability of encounter and predation rates on boreal caribou.

Recommendation
1. Provide a spatial and temporal assessment for bison range expansion relative to the likelihood of increased wolf and black bear predation risk to boreal caribou in Wek'èezhìı; please refer to information from March 2017 boreal caribou collaring survey (see also GoC ECCC IR#7);
2. Provide clarification on the possible impacts of an increasing moose population on increased predation risk to boreal caribou; timeframe is 10-30 years from 2017;
3. Provide specific suggestions for how changes in predation could be measured.

GNWT Response

The Adequacy Statement Response (ASR; PR#110) provides a spatial and temporal assessment for bison range expansion in Section 4.3.3. Habitat availability in the Base Case considers all previous and existing fire and development disturbance across the bison study area. Habitat mapping was based on bison habitat preferences from the scientific literature (Jensen et al. 2003; Larter 1988) and recovery plans (ECCC 2016). An area of potentially suitable, but currently unoccupied, bison habitat was identified at the north end of the regional study area (RSA), north of Whatì. This area was recently burned and forested habitat is expected to recover over time, reducing potential value for bison. While the road corridor itself has the potential to facilitate northward movement of bison given vegetation and ease of travel, as is seen on other NWT highways, overall habitat change in the area due to fires and succession is not expected to support extensive northward expansion of bison,. Traditional Knowledge indicates that bison habitat in the vicinity of the Project is limited (PR#28). For these reasons, the assessment concluded that bison range expansion had a weak linkage to the Project. The potential increase in bison range expansion (and abundance) from the Project would be small and have a negligible adverse influence on predation risk for caribou.

The boreal caribou collaring survey completed by ENR, March 7 to 12, 2017, indicated the presence of bison and bison tracks along the existing old airport winter road and in adjacent areas (see Maps in response to ECCC IR#7 (PR#128)). While the survey only covered part of the Mackenzie Bison Sanctuary, the locations of bison in or near areas recently burned are consistent with habitat mapping results provided in the ASR (PR#110). The survey results are consistent with Section 4.2.3.4 of the ASR, which notes that the Mackenzie range population has expanded their range to the north over the last 20 to 30 years (SARC 2016) in the Base Case. Gates and Larter (1990) reported that expansion of the Mackenzie range was driven primarily by population density. Once a critical threshold was reached, individuals went in search of new, unoccupied habitats. Range expansion is often initiated by bulls (SARC 2016), and is limited by distribution of available habitat (Gates and Larter 1990).

Moose populations respond positively to forest fire because fire increases the availability of deciduous browse species that moose depend on throughout the winter (MacCracken and Viereck 1990; Collins and Helm 1997). Moose densities were found to be greatest in 10 to 26 year old burned areas (Maier et al. 2005). LeResche et al. (1974) and Weixelman et al. (1998) also found that moose populations tended to peak 20 to 30 years post-fire. Thus, moose abundance can be expected to increase in areas 10 to 25 years post-burn. Consequently, predation risk to boreal caribou may increase as wolf populations respond to increased moose densities in the vicinity of the Project within 10 to 30 years from 2017. Human harvest of moose (and wolf) may also increase with a positive change in moose (and wolf) abundance, and benefit caribou. These expected changes are largely related to existing fire disturbance, not to the Project, and would occur with or without the Project.

Although moose are expected to increase and this may result in higher wolf abundance and predation risk for boreal caribou, the effect this may have on boreal caribou populations remains uncertain. Black bear, wolf and moose occur at much lower densities in the NT1 range than they do in southern jurisdictions where apparent competition has led to boreal caribou declines in more highly fragmented landscapes (Latham et al. 2011). Preliminary results for the SK1 range, where black bear, wolf and moose densities are similar to the NT1 range, indicates that the boreal caribou are secure, stable or increasing slightly (McLoughlin 2016). Like the NT1 range, the SK1 range has very low development disturbance, but the SK1 range has 55% burn disturbance, which is greater than the 24.4% in the NT1 range at the Base Case.

Changes in predation could be measured by undertaking an intensive study of the survival of collared boreal caribou, including rapid field investigation of mortality signals to determine cause of death.

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GNWT Response to:
WRRB IR#13

Topic
Mitigation Measures - Reclamation

Comment
In relation to assessing existing habitat conditions, the PDR, and WMMP mention reclamation, progressive reclamation and/or regeneration as a means by which habitat loss can be offset (e.g. PDR Table 8-5 Summary of Wildlife-Related TASR Design Mitigation Measures, WMMP Table 2 Habitat Loss and/or Alteration Mitigation Measures). The ASR clarifies that reclamation plans are not available for Reasonably Foreseeable Developments (RFDs), and the PDR clarifies that reclamation of the current winter road alignment "...will occur upon permanent closure of the road; however this reclamation does not fall under the current application. It is mentioned herein because this section of land helps offset the disturbance created by the proposed TASR corridor", and "...if further details pertaining to reclamation are required, an updated Closure and Reclamation Plan will be submitted post permit approval"; the Preliminary Closure and Reclamation Plan provided in the PDR focuses on camp reclamation and the closure of temporary access roads. Similar to the request for details regarding the approach to measuring available habitat (e.g. see IRs #7 and #8), there is concern how accounting for "online" and "offline" habitat can influence the quantification of available functional habitat, and assessment of the effectiveness of the proposed mitigation measures.

Recommendation
1. Please provide a definition for when disturbed habitat will be considered to be "reclaimed" (e.g. be considered functional habitat for boreal caribou);
2. Please provide additional clarity on the approaches that will be used to quantify and track habitat changes regarding reclamation of anthropogenic features.

GNWT Response
To predict maximum effects and provide a conservative assessment, the Adequacy Statement Response (PR#110) assumed direct disturbance to wildlife habitat by the Tłı̨cho All-Season Road (TASR) was permanent. Consequently, the assessment did not consider habitat to be reclaimed (e.g., considered functional habitat for boreal caribou).

Instead, the Adequacy Statement Response indicates that if the existing winter road were reclaimed, this reclamation could benefit wildlife and may offset impacts from the TASR corridor. The draft Wildlife Management and Monitoring Plan (WMMP)

that was submitted with the water licence and land use permit applications is being updated to reflect that the existing winter road is outside of the boreal caribou range and would not provide an offset to boreal caribou. The draft WMMP is also being updated to reflect that the current Tłı̨chǫ winter road falls under the authority of the Tłı̨chǫ Government and therefore the GNWT cannot commit to reclamation of the winter road at this time. As per section 19.8.1 of the Tłı̨chǫ Agreement, the Government of the Northwest Territories only has a right of free access to the Tłı̨chǫ winter road's right of way in order to establish, build, manage, control, vary and close up the Tłı̨chǫ winter road. Any reclamation activities planned for the terrestrial portions of the Tłı̨chǫ winter road (KM 0-60) will be managed and addressed jointly by the Tłı̨chǫ Government and the GNWT by way of a bilateral agreement.