A RANGE ASSESSMENT FOR THE KLAZA CARIBOU HERD IN THE DAWSON RANGE OF WEST-CENTRAL YUKON

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SUMMARY

This range assessment summarizes the current habitat and population status of the Klaza woodland caribou (*Rangifer tarandus caribou*) herd in the Dawson Range of west-central Yukon. The Klaza herd, formerly known as the Klotassin herd (Jingfors 1989), is one of 26 northern mountain herds recognized in the territory (Hegel and Russell 2013).

This range assessment was prepared by Environment Yukon in response to management concerns resulting from high levels of mineral exploration activity in the Dawson Range area. It draws upon Environment Yukon technical reports and other studies including: Farnell et al. (1991), Hegel and Russell (2013), EDI (2013), Hegel (2012, 2013, 2014 and 2015), and Russell (2014b). It also considers and reflects the broad management goals, objectives and recovery measures that have been recommended in the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012).

Key risk factors[1] affecting the Klaza herd are described, and the factors representing the greatest risk to the herd's long-term viability are identified. Both current and future potential human-caused (anthropogenic) and natural factors that may affect the herd and its habitat are considered. A future land use scenario and fire risk maps were used to examine anticipated levels of future human and natural disturbance.

Management objectives, recommendations and strategies for maintaining the integrity of the herd's seasonal habitats and reducing population-level impacts are provided. The assessment and recommendations focus on the late-winter range, as this period (February 1 – April 30) is considered the most critical for northern mountain caribou populations (Farnell 2009).

KEY FINDINGS

1. Current Situation

At this time, it appears there are relatively few immediate risks facing the Klaza herd. Mineral exploration activities that occurred over the past decades, and the recent mineral exploration boom of 2009-2011, have likely had a relatively small, long-term, negative impact on the Klaza herd population and its habitat. While there is a high level of recent mineral exploration activity, most occurs during the summer season, when caribou are on their alpine and sub-alpine summer range. Most of the range remains relatively inaccessible during the winter season, and the two areas of highest late-winter utilization by Klaza caribou: 1) Hayes Creek – Selwyn River – Big Creek, and 2) Upper Klotassin River – Lower Klaza River (Hegel 2015), receive very low levels of human activity during this period. However, there is evidence to suggest that some late-winter range areas used historically by the herd are now used relatively infrequently, or have been largely abandoned, in response to all-season human development and activity in the Mount Nansen area.

2. Future Situation

While it is not possible to predict exactly when or where future mineral development will occur, the mineral development scenario currently being contemplated for the Dawson Range (extension of the

[1] In the context of a woodland caribou range assessment, 'risk' is considered the degree to which one or more factors threatens the long-term viability and persistence of a caribou population and/or its habitats.

Freegold Road, development of the Casino mine, and potentially one or two other mines along the road corridor) would result in a large increase in the level of human disturbance on the winter range, a reduction in late-winter habitat effectiveness, and declining areas of undisturbed habitat. The major catalyst for increasing levels of all-season mineral development activity is anticipated to be construction of the Freegold Road extension, with the Hayes Creek – Selwyn River – Big Creek portion of the late-winter range being most at risk.

Based on our assessment, potentially large increases in the amount of all-season direct and indirect human disturbance is considered to be the greatest future management concern. The major anticipated risk facing the herd in the future is the conversion of current seasonal (summer only) quartz mineral exploration activities to all-season road infrastructure and mine sites. This will result in a large increase in the amount of direct and indirect human disturbance and access on the winter range during the late-winter period—a season that currently receives a very low level of human activity, and is a critical life period for woodland caribou.

RECOMMENDATIONS

1. Habitat

Maintaining the Klaza herd range in a condition that will support the current or an increasing caribou population size will depend on maintaining adequate amounts of areas with limited human disturbance, minimizing the effects of human land use where it does occur, and reclaiming disturbed habitats to functional caribou habitat. The following habitat-related recommendations are focused on mitigating or reducing potential impacts to the winter range, and during the winter season:

Objective	Strategies
Habitat Objective 1: Maintain a large, intact part of the Klaza herd winter range in a condition relatively undisturbed by human development and activities.	**Habitat Strategy 1.1:** The remaining intact late-winter range should be identified as a priority winter habitat area.
Habitat Objective 2: Maintain adequate undisturbed, high quality late-winter habitat in all areas of the Klaza herd annual range, and maintain connectivity among these areas.	**Habitat Strategy 2.1:** Human development footprint and land use activity should be avoided or minimized in areas of high quality late-winter habitat.
Habitat Objective 3: Minimize the level of indirect disturbance resulting from new or existing roads.	**Habitat Strategy 3.1:** Access roads should only be used seasonally, when caribou are not in the area.
	Habitat Strategy 3.2: Public use of any new access roads in the Klaza herd range should be discouraged.
Habitat Objective 4: Maintain the current amount of functional caribou habitat.	**Habitat Strategy 4.1:** Return areas disturbed by human activities to functional caribou habitat.

2. Population

To reduce additional direct human-caused caribou mortality, and potential impacts on the Klaza herd population, the following strategies are recommended:

Objective	Strategies
Population Objective 1: Maintain future harvest rates at a sustainable level (2 to 3% of total population).	**Population Strategy 1.1:** Continue the existing licensed harvest management strategy.
	Population Strategy 1.2: Continue to work with local First Nations and communities on harvest management plans and strategies.
	Population Strategy 1.3: Continue monitoring Klaza herd population trends and demography if conditions likely to negatively affect the population change from the current situation.

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Table of Contents

Glossary

1 Purpose 1
2 Background 2
2.1 The Klaza Caribou Herd 3
2.1.1 Management Concerns 3
3 Methods 5
3.1 Caribou Assessment Areas 5
3.2 Current Population Status and Habitat Utilization 7
3.2.1 Population Status and Trend 7
3.2.2 Seasonal Ranges and Important Habitats 7
3.3 Assessment of Risk Factors Affecting the Klaza Caribou Herd 8
3.3.1 Habitat Factors 9
3.3.2 Population Factors 13
3.4 Human Land Use, Ownership and Administration 13
4 Overview of the Klaza Herd Range 14
4.1 Biophysical Setting 14
4.2 Land Ownership and Land Use 15
4.2.1 Communities and First Nations 15
4.2.2 Transportation 15
4.2.3 Mineral Exploration and Development 16
4.2.4 Tourism and Recreation 17
4.2.5 Guide Outfitting 17
4.2.6 Forestry, and Oil and Gas 17
4.2.7 Land Use Planning and Protected Areas 17
5 Range Assessment 19
5.1 Population Status 19
5.2 Seasonal Ranges and Important Habitats 19
5.2.1 Summer Range 21
5.2.2 Winter Range 23
5.2.3 Migration 29
5.3 Risk Factors Affecting the Klaza Caribou Herd 29
5.3.1 Habitat Factors 29
5.3.2 Population Factors 51
5.3.3 Assessment of Risk Factors 57

5.4 Range Assessment Summary 69
5.4.1 Current Situation 69
5.4.2 Future Situation 71
6 Management Recommendations 73
6.1 Habitat-related Recommendations 73
6.1.1 Priority Winter Habitat Area 73
6.1.2 Late-Winter Range Habitat Management 74
6.1.3 Access Road Management 75
6.1.4 Habitat Reclamation 76
6.2 Population-related Recommendations 77
7 Implementation and Monitoring 79
7.1 Implementation 79
7.2 Monitoring 79
8 References 81

List of Figures

Figure 1. Annual range of the Klaza caribou herd in the Dawson Range of west-central Yukon. 2
Figure 2. Klaza herd range caribou assessment areas and current quartz and placer mineral interests. 6
Figure 3. First Nation Settlement Land and current land use interests within the Klaza herd annual range. 16
Figure 4. Recent Klaza herd summer range and the areas of highest utilization based on GPS radio collar locations from 2012 to 2014. 23
Figure 5. Historic Klaza herd late-winter range based on VHF radio collar locations from 1987 to 1998. The areas of highest utilization are shown in blue. 25
Figure 6. Recent Klaza herd late-winter range and the areas of highest utilization based on GPS radio collar locations from 2012 to 2014. 26
Figure 7. Klaza herd late-winter habitat suitability map. 28
Figure 8. Current direct and indirect human disturbance within the Klaza herd annual range – summer season. 31
Figure 9. Current direct and indirect human disturbance within the Klaza herd annual range – winter season. 32
Figure 10. Potential human disturbance resulting from Klaza herd range land use scenario at 25 years future - summer season. 35
Figure 11. Potential human disturbance resulting from Klaza herd range land use scenario at 25 years future - winter season. 37
Figure 12. Potential increase in future winter season human disturbance in CAA 1 (Freegold Road-Mount Nansen) and CAA 2 (Casino Trail-Coffee Creek) resulting from the Klaza herd range land use scenario. Human disturbance is reported as lower and higher ZOI as a percentage of each assessment area. 37
Figure 13. Recent wildfire disturbance in the Klaza herd annual range (1960 - 2013). 39
Figure 14. Potential future fire risk (probability of burning) in the Klaza herd annual range. The deeper red colours indicate a higher probability (25-50%) of burning in the next 25 years. 42

Figure 15. Current total disturbed area (human and recent wildfire) in the Klaza herd annual range - summer season. 43

Figure 16. Current total disturbed area (human and recent wildfire) in the Klaza herd annual range - winter season. 44

Figure 17. Potential future total disturbance (human and wildfire) in the Klaza herd annual range - summer season, 25-years future. Past fires that would remain in a non-regenerated state at the end of the 25 year scenario period are shown in tan. Areas with a moderate to high fire risk that could be expected to burn in the coming 25 years are shown in light red. 46

Figure 18. Potential future total disturbance (human and wildfire) in the Klaza herd annual range - winter season, 25-years future. Past fires that would remain in a non-regenerated state at the end of the 25 year scenario period are shown in tan. Areas with a moderate to high fire risk that could be expected to burn in the coming 25 years are shown in light red. 47

Figure 19. Current Klaza herd range late-winter habitat effectiveness map, showing low, moderate and high value habitat effectiveness classes. 48

Figure 20. Potential future Klaza herd range late-winter habitat effectiveness map, showing low, moderate and high value habitat effectiveness classes, and extent of potential human disturbance at 25-years future. 50

Figure 21. Calf recruitment (number of calves per 100 cows) in the Klaza caribou herd (1987 – 2013). Years with no data indicate years where composition surveys were not completed. Source: Figure 2 from Hegel (2014). 52

Figure 22. Annual licensed bull harvest (resident and non-resident) of the Klaza caribou herd (1995-2013). Source: Figure 5 from Hegel (2013). 54

Figure 23. Game management subzones (GMS) in the Klaza herd range. Most Klaza herd caribou harvest currently occurs in GMS 526 (Mount Nansen) and GMS 523 (Mount Langham-Apex Mountain). 55

List of Tables

Table 1. Klaza herd range caribou assessment areas (CAA). 7

Table 2. Linear land use features included in the Klaza herd range assessment and their associated lower and higher zones of influence (ZOI). 10

Table 3. Areal land use features included in the Klaza herd range assessment and their associated lower and higher zones of influence (ZOI). 11

Table 4. Overview of human land ownership and land use in the Klaza herd annual range, summarized by caribou assessment area (CAA). 18

Table 5. Overview of Klaza herd seasonal ranges and habitats. 20

Table 6. Amount of summer and winter range areas within each caribou assessment area. 21

Table 7. Proportion of late-winter habitat suitability classes reported by caribou assessment area. 28

Table 8. Level of current direct and indirect human disturbance in the Klaza herd range reported by season and caribou assessment area. 33

Table 9. Recent wildfire disturbance (1960 – 2013) in the Klaza herd range reported by caribou assessment area. 40

Table 10. Current total disturbed area (human and recent wildfire) in the Klaza herd range reported by caribou assessment area. 45

Table 11. Percentages of current late-winter habitat suitability classes reported by caribou assessment area while considering potential direct and indirect human disturbance effects during the winter season. 49

Table 12. Comparison of percentages of habitat suitability classes under no human influence, current level of human winter activity, and potential future level of human winter activity at 25-years future (assuming high human ZOI), reported by caribou assessment area. 50

Table 13. Summary of risks associated with factors affecting the Klaza caribou herd and its range. Both current and future potential risks are described. 58

Table 14. Suggested indicators for ongoing monitoring in the Klaza herd range. 80

Appendix A
Human Zone of Influence References

Appendix B
Future Land Use Scenario and Potential Levels of Human Disturbance

Glossary

Annual Range: The total area used or occupied by a woodland caribou herd. The Klaza herd annual range boundary was defined by the extent of all GPS radio collar locations for the period 2012 to 2014. The Klaza herd annual range is 10,819 km^2.

Caribou Assessment Area: A part of the annual range used for more detailed assessment of disturbance, habitat, land use, land ownership or other factors affecting caribou. Three assessment areas within Klaza herd annual range have been identified.

Fragmentation (habitat): The process by which habitats are increasingly divided into smaller units. Habitat fragmentation results in increased isolation of habitat patches, reduced habitat areas, and smaller habitat patches with reduced interior area.

Habitat Disturbance: Habitat that has been either directly or indirectly affected by human or natural disturbances. Human activities such as forest harvesting or agriculture, or natural disturbances such as wildfire, either temporarily or permanently remove or alter habitat, resulting in a direct habitat disturbance. Indirect, or functional, habitat disturbance results when animals use habitats differently or they alter their behaviour adjacent to the direct disturbance. These indirect effects are measured by a zone of influence (ZOI) around the direct disturbance.

Habitat Effectiveness: The degree to which a patch of habitat is able to support an animal or group of animals (i.e., the value of a habitat). Habitat effectiveness incorporates the concepts of habitat suitability (the physical or vegetation characteristics of the habitat), accessibility (the ability of an animal to gain access to and utilize the habitat), and disturbance (the amount of human-caused sensory or other disturbance affecting the habitat). A habitat with high effectiveness is of high suitability, is accessible, and is not influenced by human or other disturbance.

Habitat Suitability: The ability of a patch of habitat to provide necessary life functions for a wildlife species, based on its physical or vegetation characteristics. For woodland caribou, high suitability winter habitats have a high abundance of ground lichens and occur in areas with relatively low snow depths.

Human Development Footprint: The area directly disturbed by human development and land use activities (e.g., roads, gravel pits, mine sites, etc.). The human development footprint results in the in the physical loss or alteration of wildlife habitat.

Human Zone of Influence (ZOI): The area around a human development footprint that is indirectly influenced by the human activities. Sensory disturbance, increased mortality risk or similar factors may influence the use of areas by wildlife adjacent to human developments. Wildlife may avoid or use areas less intensively within the ZOI, resulting in indirect habitat loss and reduced habitat effectiveness.

Late-Winter Range: The late-winter range is the part of the potential winter range used by woodland caribou during the late-winter season (February 1 to April 30). Based on recent GPS collar locations for the period 2012 to 2014, the Klaza herd late-winter range encompasses approximately 40% (4,318 km^2) of the annual range. The late-winter period is considered the most critical for northern mountain woodland caribou populations (Farnell 2009).

Linear Density: The total length of all human-created linear features, such as roads, trails, survey lines, utility corridors, and similar (measured in km), within a defined area. Linear density is expressed as km of features per unit of area (km/km^2). It provides a measure of landscape fragmentation and the potential level of human access within an area.

Potential Summer Range: The part of the annual range that could potentially be used by caribou during the summer season (late-April to late-October), in the absence of disturbance or other factors. In the Klaza herd range, the potential summer range is considered to include all areas above treeline (greater than 1,200 m in elevation). The Klaza herd potential summer range covers approximately 29% (3,143 km^2) of the annual range.

Potential Winter Range: The part of the annual range that could potentially be used by caribou during the winter season (December 1 to April 30), in the absence of disturbance or other factors. In the Klaza herd range, the potential winter range is considered to include all areas below treeline (less than 1,200 m in elevation). The Klaza herd potential winter range covers approximately 71% (7,676 km^2) of the annual range.

Priority Winter Habitat Areas: Areas that should be prioritized for their long term use by woodland caribou during the winter season. These areas are intended to be maintained relatively free of human influences, particularly during the winter season.

Range Assessment: A process that examines habitat conditions and population trends for a wildlife species and identifies potential risk factors affecting the current and future viability of the species within a defined geographic area.

Resilience (ecological): The capacity of an ecosystem or species to absorb disturbance and still retain essentially the same function and structure. For woodland caribou, a resilient population is able to recover from natural and human-caused disturbances, and be self-sustaining within a range of natural variation.

Sensory Disturbance: Any human activity that interrupts the regular behaviour or routines of animals (e.g., vehicle noise, aircraft noise, industrial activities, etc.). In response to sensory disturbance, animals may avoid areas, use areas less frequently, or increase their vigilance in proximity to the source of the disturbance, resulting in decreased foraging with lowered energy intake/increased energy expenditure.

Summer Range: The area utilized by woodland caribou during the summer season (late-April to late-October) for calving, post-calving and fall rut, as identified by GPS or VHF collar locations. Based on recent GPS collar locations for the period 2012 to 2014, the Klaza summer range encompasses 53% (5,739 km^2) of the annual range. There is some overlap between the summer and winter ranges. The methods used to calculate seasonal range boundaries result in some lower and higher elevation areas included in each. High elevation subalpine and alpine habitats above treeline receive the highest use during the summer season.

Winter Range: The area utilized by woodland caribou during the winter season (December 1 to April 30), as identified by GPS or VHF collar locations. Based on recent GPS collar locations for the period 2012 to 2014, the Klaza winter range encompasses 40% (4,318 km^2) of the annual range. There is some overlap between the winter and summer ranges. The methods used to calculate seasonal range boundaries result in some lower and higher elevation areas included in each. Forested habitats below treeline receive the highest use during the winter season.

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A Range Assessment for the
Klaza Caribou Herd in the Dawson Range of West-central Yukon

1 PURPOSE

This range assessment summarizes the current habitat and population status of the Klaza woodland caribou herd in the Dawson Range of west-central Yukon (**Figure 1**). Key risk factors[2] affecting the herd are described, and the factors representing the greatest risk to the herd's long-term viability are identified. Management objectives, recommendations and strategies for maintaining the integrity of the herd's seasonal habitats and reducing population-level impacts are also provided. This range assessment considers both human-caused (anthropogenic) and natural factors that affect current condition and longer-term sustainability of habitat and the population.

This range assessment was prepared by Environment Yukon in response to Klaza caribou herd management concerns resulting from high levels of mineral exploration and development activity in the Dawson Range area. Such concerns were identified in recent Yukon Environmental and Socio-economic Assessment Board (YESAB) project reviews and the Little Salmon Carmacks Community-based Fish and Wildlife Workplan (2012-2017). A companion range assessment for sheep has also been prepared for the Dawson Range area (Hayes et al. 2015).

This assessment builds on prior Environment Yukon technical studies and publications, and utilizes the best available information regarding Klaza caribou habitat and population conditions. It is not intended to replace regional land use planning or other potential future planning exercises (e.g., forest management or sector-specific plans) within the Klaza herd range. Rather, it is intended to complement and support these exercises by identifying management concerns in specific areas and providing recommendations that can then be considered during those other exercises. Other plans, specific project reviews, and other initiatives are intended to be the main implementation mechanism for the recommendations contained in this report.

The audience for this assessment is project-level assessors and other land and resource managers and decision-makers. It assists in evaluating and managing the effects of ongoing and proposed human land use activities within the Klaza herd range, with a focus on habitat management. This document also provides guidance for future data collection and monitoring programs.

[2] In the context of a woodland caribou range assessment, 'risk' is considered the degree to which one or more factors threatens the long-term viability and persistence of a caribou population and/or its habitats.

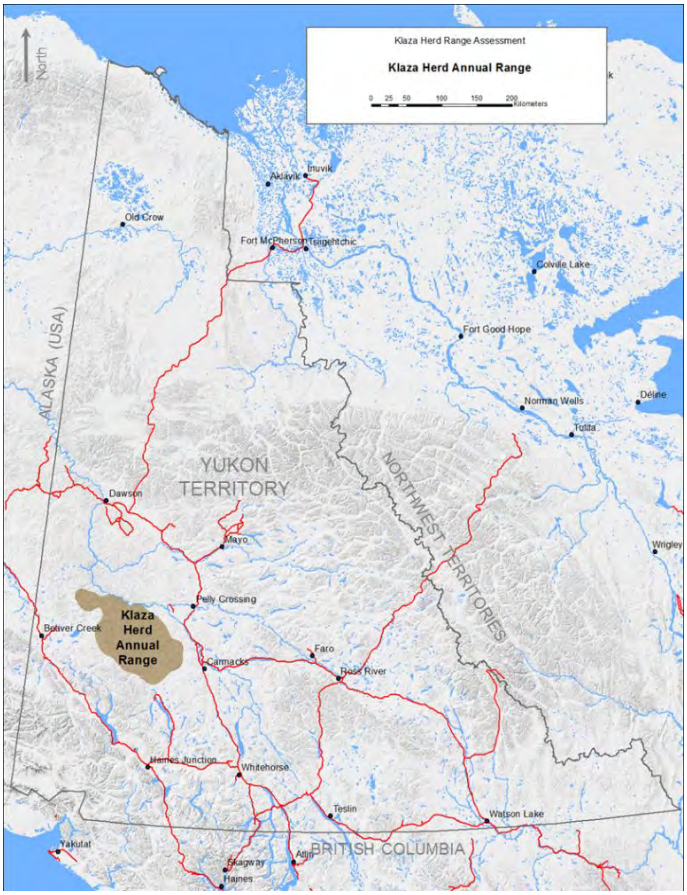

Figure 1. Annual range of the Klaza caribou herd in the Dawson Range of west-central Yukon.

2 BACKGROUND

The northern mountain ecotype of woodland caribou (*Rangifer tarandus caribou*) range through parts of northern British Columbia, Northwest Territories, Alaska and Yukon[3]. Nationally, northern mountain woodland caribou were assessed in 2002 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and subsequently listed as a species of Special Concern under the federal *Species at Risk Act* (SARA) in 2005[4]. Under SARA, a status of Special Concern means a "wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats".

In response to its conservation status of Special Concern, the "Management Plan for the Northern Mountain Population of Woodland Caribou *(Rangifer tarandus caribou)* in Canada" (Environment Canada 2012) was developed. Its goal is to prevent northern mountain caribou from becoming threatened or endangered, by having responsible agencies work together to carefully manage caribou

[3] Nationally, northern mountain caribou are considered a discrete population that has been labelled Designatable Unit 7 (DU7) (COSEWIC 2011).
[4] In 2014, COSEWIC reconfirmed the Special Concern conservation status of northern mountain woodland caribou (COSEWIC 2014).

and their habitat. While the management plan provides a general assessment and management strategies for all identified northern mountain herds in Canada, the development of range-specific goals and management recommendations is required, particularly for at-risk herds.

2.1 The Klaza Caribou Herd

The Klaza caribou herd (hereafter the Klaza herd) is a population of northern mountain woodland caribou that reside in the Dawson Range of west-central Yukon (**Figure 1**). It is one of 26 northern mountain herds recognized in the territory (Hegel and Russell 2013). The Klaza herd was formerly known as the Klotassin herd (Jingfors 1989).

The Klaza herd occurs within the historic range of the Fortymile caribou herd. In 1900 the Fortymile herd was estimated at approximately 260,000 caribou and ranged throughout central Alaska and Yukon. By 1975, as a result of severe over-harvesting, the Fortymile herd had declined to about 5,000 animals. The herd has now increased to approximately 52,000 caribou, and in the winter of 2013 the Fortymile herd utilized the western part of the Dawson Range for the first time in decades. This was a significant occurrence as prior to then the Fortymile herd had not been observed in the area since at least 1941 (McDonald and Cooley 2004).

Based on a 2012 population survey, the Klaza herd is currently estimated to be approximately 1,180 caribou and is considered stable (Hegel 2013). Similar to most Yukon northern mountain woodland caribou, the Klaza herd exhibits a seasonal migration between higher elevation alpine and sub-alpine areas in the summer and fall seasons, and lower elevation forested areas in the winter. This seasonal migration between different range areas is an important strategy of most northern mountain woodland herds and is thought to be critical to their long-term persistence (Environment Canada 2012). Seasonal range utilization provides the diversity of habitats required for predator avoidance, snow conditions, insect relief, and forage quality at different times of the year.

Some parts of the range are remote and receive limited human visitation and appear to have relatively low harvest pressure. However, historic and recent increases in mineral exploration interest and activity, combined with wildfire, currently affect large portions of some parts of the range. In the future, the amount of human and wildfire disturbance is expected to increase, presenting future management challenges.

2.1.1 Management Concerns

The Dawson Range has historically been an area of significant mineral exploration and development interest (Farnell et al. 1991), with a long history of both quartz and placer activities. The first mineral staking occurred around the time of the 1898 Klondike Gold Rush, on copper and gold showings in the Williams Creek and Merrice Creek canyons, near the site of the current Carmacks Copper property (**Figure 2**). Gold and copper were first discovered at Mount Nansen in 1943, with mines operating periodically between 1960 and 2000. In 1999, the Mount Nansen mine was abandoned and is currently being reclaimed. The Casino copper deposit has been trenched and drilled since the 1960s, and the Freegold property has been explored for decades. The Freegold and Mount Nansen roads were developed in the 1980s, providing access to the eastern part of the Klaza herd range. The original Freegold Road proposal was to provide access to the Casino property, but the western portion, past Big

Creek, was not completed. Concerns over the potential effect of the Freegold Road on wildlife populations led to the first Environment Yukon wildlife surveys in the area, including Klaza herd studies (Farnell et al. 1991).

While there has been a relatively high level of historic mineral-related activity, from 2009 to 2011 the central Dawson Range and other areas in Yukon experienced an unprecedented level of mineral staking and exploration. A combination of favourable economic conditions and promising mineral discoveries in the White Gold district resulted in thousands of new quartz mineral claims being registered over large areas of the northern part of the Klaza herd range. The 2009 to 2011 staking rush resulted in the establishment of several advanced exploration properties with multi-year mining land use permits, the potential for multiple projects to advance to producing mines, and a proposal to construct at least one new major all-season haul road through a portion of the Klaza herd range[5]. If these developments were to proceed, the area disturbed by year-round human activities within the Klaza herd range would increase substantially.

This rapid pace of change resulted in a number of management concerns being raised by communities, First Nations and Environment Yukon regarding the cumulative effect of this high level of quartz mineral activity on Klaza caribou, moose, sheep and other wildlife species, and potential future effects should a high level of activity continue. As described by Hegel (2014), in 2011 Environment Yukon biologists conducted a conservation assessment of all mountain caribou herds in Yukon. The Klaza herd ranked highest with respect to the level of conservation threats affecting the herd and its range. Obtaining additional information about the Klaza herd was also recognized as a top priority by the Little Salmon/Carmacks Community Based Fish and Wildlife Management Plan (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011).

The high level of conservation concern for the Klaza herd in the face of ongoing and anticipated mineral development resulted in the initiation of a large-scale GPS radio collaring program (Hegel 2012) and a late-winter habitat assessment (Hegel 2015). It was also recognized that the YESAB project-by-project review process was not well suited to assessing and managing the cumulative effects of multiple development projects and natural disturbances. This range assessment[6] for the Klaza herd was initiated to summarize the historical and recent information collected by Environment Yukon, and to examine the potential cumulative effects of land use activities, combined with other natural factors, that may be affecting the herd.

The Klaza herd range assessment is focused on the following management concerns:

- What has been the effect of recent and historic mineral exploration activity on the herd and its habitat?
- What might be the effect of future mineral exploration activity on the herd and its habitat?
- What level of risk might these situations represent to longer-term viability of the herd?
- How can potential future risks be mitigated, or reduced?

[5] The Casino Project, including the 120 km Freegold Road extension, is currently in the YESAA review process (YESAB Project #2014-0002).

[6] Conducting range assessments for focal wildlife species in areas with high levels of human land use activity was proposed as an approach for Environment Yukon to assess and manage potential cumulative disturbance effects on wildlife populations (Francis et al. 2013).

3 METHODS

Range assessment methodology generally follows Francis et al. (2013) and is consistent with the Canadian Boreal Forest Agreement Methodological Framework (Antoniuk et al. 2012), and the "Management Plan for the Northern Mountain Population of Woodland Caribou *(Rangifer tarandus caribou)* in Canada" (Environment Canada 2012). Disturbance-based risk assessment methodology generally follows that developed for boreal woodland caribou (Environment Canada 2011) but has been adapted to consider northern mountain caribou ecology.

This range assessment draws upon Environment Yukon technical reports and other studies including: Farnell et al. (1991), Hegel and Russell (2013), EDI (2013), Hegel (2012, 2013, 2014 and 2015), and Russell (2014b). It also considers and reflects the broad management goals, objectives and recovery measures that have been recommended in the "Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada" (Environment Canada 2012).

3.1 Caribou Assessment Areas

Three caribou assessment areas (CAAs) were created to better understand levels of disturbance and potential management issues in different parts of the Klaza herd annual range (**Figure 2**). The CAAs form a reporting and potential management framework for the Klaza herd range. The three assessment areas and the rationale for their selection are listed in **Table 1**.

The CAAs were delineated and manually digitized by considering human land use patterns (i.e., existing and future potential mineral tenure, proposed transportation corridors, etc.), and Klaza herd range use.

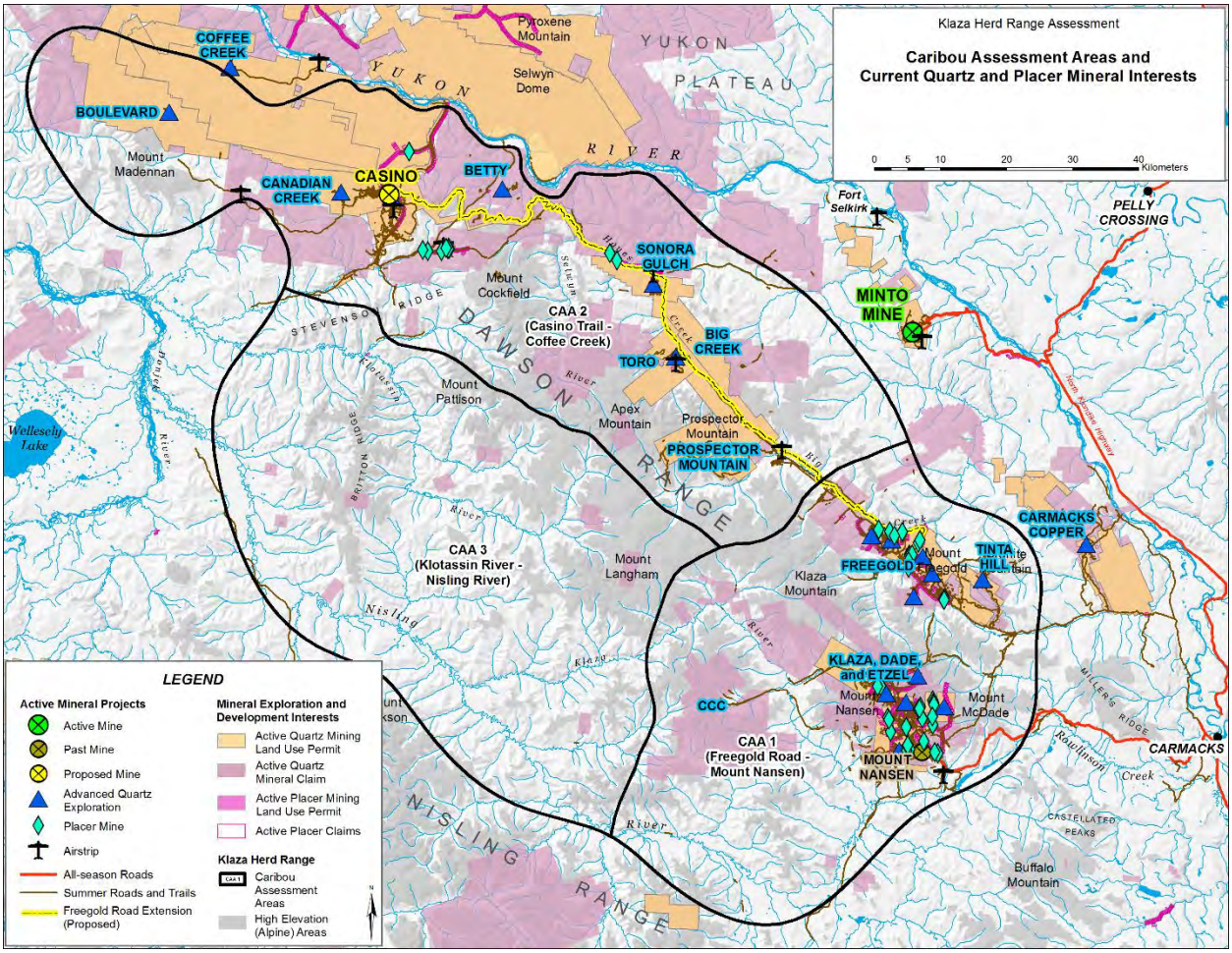

Figure 2. Klaza herd range caribou assessment areas and current quartz and placer mineral interests.

Table 1. Klaza herd range caribou assessment areas (CAA).

CAA Number	CAA Name	General Description and Rationale for Identification	Area (km^2)	Area (% annual range)
1	Freegold Road – Mount Nansen	This area has the highest level of existing human development and activity in the Klaza herd range. There are two existing roads, a number of advanced quartz exploration and placer properties, and a past producing gold mine in the area.	3,104	28.7
2	Casino Trail – Coffee Creek	While this area currently has relatively low footprint and human activity, an all-season haul road and a large open pit mine are proposed for this part of the Klaza herd range. In addition, several advanced quartz mineral exploration properties are located along the proposed road route, as well as existing placer operations. Development of the all-season road and potential future mines would result in a large increase in all-season human activity and habitat disturbance in this area.	4,181	38.6
3	Klotassin River – Nisling River	This area is remote and currently receives limited human access. This part of the Klaza herd range has the lowest level of human development footprint and activity, and future levels of activity are also anticipated to be lower than in CAA 1 and CAA 2.	3,535	32.7
	TOTAL RANGE		10,819	100.0

3.2 Current Population Status and Habitat Utilization

3.2.1 Population Status and Trend

In response to the management concerns surrounding the Klaza herd, Environment Yukon conducted a focused population survey and GPS radio collaring program from 2012 to 2014. In 2012 and 2013, 33 GPS radio-collars were deployed on adult female caribou, resulting in the collection of 16,369 GPS locations. Based on results of these field studies, Hegel (2013 and 2014) provides a detailed description of Klaza herd population and demographic parameters. Key findings from these studies are reported here.

3.2.2 Seasonal Ranges and Important Habitats

Two approaches were used to identify Klaza herd seasonal ranges and important habitats. Historic range use in the vicinity of the Casino Trail and central Dawson Range was examined using VHF radio-collar data from the period 1987 to 1998. Deployment of VHF radio-collars on Klaza caribou began in 1987 (Farnell et al. 1991), and from 1987 to 1998, 43 caribou were radio-tracked seasonally via aerial telemetry, including during the late-winter season. During this time period, the only year in which information was not collected was 1992. This historic VHF collar information represents a long-term,

multi-year dataset of Klaza caribou distribution in the Dawson Range consisting of 227 separate relocation points (Hegel 2015).

Recent range utilization and seasonal distribution was examined by using the recent GPS collar locations (n = 16,369). Hegel (2015) developed summer and late-winter range kernels based on the 95% utilization distributions of collar locations, and identified the areas of highest utilization within the seasonal ranges for the period 2012 to 2014. These collar locations, in addition to other data inputs, were also used to develop the resource selection probability function model required for development of a late-winter season habitat suitability map (Hegel 2015).

3.3 Assessment of Risk Factors Affecting the Klaza Caribou Herd

Although the "Management Plan for the Northern Mountain Population of Woodland Caribou *(Rangifer tarandus caribou)* in Canada" (Environment Canada 2012) provides general guidance, at this time there is no single accepted method to assess the overall or cumulative level of risk for northern mountain woodland caribou populations. An approach to assessing risk to long-term population viability for boreal woodland caribou[7] has been developed by Environment Canada (2011), as part of the national boreal woodland caribou recovery strategy. This approach calculates the total extent of all human (i.e., direct footprint and a potential zone of influence of 500 m around those features) and natural (i.e., recent fires less than 40 years old that are more than 200 ha in size) disturbances in a boreal caribou range. The total level of disturbance within the range, expressed as percent, is then related to the probability of a herd remaining stable, increasing, or declining over a 20-year period. The correlation between level of disturbance within a range and risk of population decline was determined empirically from 57 boreal caribou herds across Canada.

Reid et al. (2013) examined the potential application of the boreal caribou population viability equation (Environment Canada 2011) to a Yukon northern mountain woodland caribou herd (Carcross herd in the Southern Lakes region). They suggested that at this time, the equation should not be used directly to assess northern mountain woodland caribou herd population viability, as some of the assumptions behind the use of the boreal caribou equation may not be met. Most important among these is the migratory nature of the northern mountain herds and the spatial separation between high elevation, alpine summer ranges and low elevation, forested winter ranges. Further, most of the human development footprint is concentrated in the low elevation winter ranges, and late winter is generally recognized as the most critical period for woodland caribou (Farnell 2009).

While the Environment Canada (2011) population viability equation may not be directly applicable to an assessment of the Klaza herd, the examination of important human and natural disturbance factors remains a useful approach, particularly for understanding the differences in levels of habitat disturbance and human activity between the summer and winter ranges, versus a single, range-wide disturbance assessment. Therefore, the Environment Canada (2011) 'total zone of influence approach' has generally been adopted for this Klaza herd range assessment, but has been modified to consider both habitat and

[7] Boreal woodland caribou in Canada inhabit the boreal forests east of the Rocky Mountains. These caribou generally do not exhibit a migration pattern like northern mountain woodland caribou, so there is limited separation between summer and winter ranges. Consideration of the seasonal ranges of northern mountain caribou as part of the range assessment methodology is an important addition to the Environment Canada (2011) approach.

population-related risk factors relevant to the ecology of northern mountain woodland caribou, particularly the importance of winter range conditions. However, given the findings of Reid et al. (2013), direct relationships between levels of habitat disturbance and caribou population viability have not been suggested at this time.

3.3.1 Habitat Factors

3.3.1.1 Level of Disturbance

Current and future potential levels of human and wildfire disturbance were calculated using the following approaches.

3.3.1.1.1 Human Disturbance

Direct Human Disturbance

Direct human disturbance refers to the human development footprint resulting in direct habitat loss or degradation. Three human surface disturbance mapping data sources were available for representing direct human footprint in the Klaza herd range:

1. Drift Geomatics (2014) developed an integrated data set from visual interpretation of high and medium resolution satellite imagery for most of the Klaza herd range. The mapping was completed using imagery acquired during the summer months between 2010 and 2012.
2. EDI (2014) developed a data set of features missing from Drift Geomatics (2014) by digitizing or compiling mining recorder and industry files of very recent disturbances (2012 to 14) or that occurred outside of the Drift Geomatics data capture area.
3. The Dawson Range CE Project (2014) developed a generalized disturbance dataset based on publically available medium resolution SPOT imagery, National Road Network road and trail features, and industry publications.

The Drift Geomatics (2014) dataset was considered the most complete 'integrated' human footprint mapping dataset. However, it did not cover the entire Klaza herd annual range developed by Hegel (2015), nor did it incorporate the major National Road Network road features (e.g, Freegold and Mount Nansen roads) or winter roads or trails. Therefore, human surface disturbance features from EDI (2014) and the Dawson Range CE Project (2014) were added to the Drift Geomatics data set where found missing. Given that summer imagery was used as the major source of information, some winter roads or trails may be missing. In cases where a feature occurred in more than one dataset, the data source that appeared to best represent the feature and its spatial location was selected. The placement of features in 'logical' topographic locations assisted in the interpretation and selection of which data source best represented the feature.

Using this method, a single integrated human surface disturbance data set was created, and a feature classification scheme was developed. The types of linear and areal features classified were generally based on those used by Drift Geomatics (2014) but were modified or expanded as required, in order to identify different types of linear or areal features relevant to woodland caribou ecology (**Table 2** and **Table 3**). In particular, different types of mineral exploration or mining footprint types were identified, based on local knowledge and Government of Yukon databases.

Table 2. Linear land use features included in the Klaza herd range assessment and their associated lower and higher zones of influence (ZOI).

Linear Features

Feature Name	Feature Code	Description	Average Width (m) *	Lower ZOI (m)	Higher ZOI (m)
Powerline	PL	Cleared powerline right of way and associated above ground structures (power poles and power lines).	8	1,000	1,000
Rough Road	ROU	Other roads leading to areas of high mineral exploration activity.	10	1,000	4,000
Secondary Road	SEC	Wide maintained roads leading to areas of high mineral exploration activity (e.g., Freegold and Mount Nansen Roads).	10	1,000	4,000
Survey Cutline	SCL	Linear clearings; may be old winter roads or trails.	12	250	250
Trail	TRA	Exploration trails (access to drill pads, etc.).	6	250	250
Trench	TRE	Trenching conducted in support of mineral exploration.	10	250	250
Unknown	UNK	Other unclassified linear features (most appear to be trails and partially overgrown roads).	6	250	250

* Average width (m) represents the average of measured feature widths.

Table 3. Areal land use features included in the Klaza herd range assessment and their associated lower and higher zones of influence (ZOI).

Areal Features

Feature Name	Feature Code	Description	Lower ZOI (m)	Higher ZOI (m)
Airstrip	A	Active airstrips.	1,000	4,000
Fuel Cache	FC	Fuel caches associated with mineral exploration projects (only 2 reported).	250	1,000
Gravel Pit/Pullout	G	Active or inactive gravel pits and pullouts adjacent to roads.	250	1,000
Other	O	Unclassified clearings, pits, camp areas, etc.	250	1,000
"Mining" (M): Quartz or Placer mining activities. Mining was classified into the following categories:				
Early Exploration	E_EXPL	Early quartz exploration activities. Class 1 exploration sites or heli-supported drilling without multi-season mining camp.	1,000	4,000
Advanced Exploration	A_EXPL	Advanced quartz exploration activities. Well established property with semi-permanent mining camp and extensive ground-based activities such as trenching and new road and trail construction. Airstrips are often associated with these sites.	2,000	5,000
Active Mine	MINE	Active (producing) quartz (hard rock) mine.	4,000	10,000
Past Mine	PAST_MINE	Past quartz mine(s) under care and maintenance or abandoned.	1,000	4,000
Placer	PLACER	Active placer mining area.	1,000	4,000

Indirect Human Disturbance (Zone of Influence)

Indirect human disturbance refers to the area around human land use or human-caused surface disturbances that may be indirectly affected by the feature or human use of the feature. Indirect effects may be higher levels of sensory disturbance resulting in caribou avoiding or reducing their use of an area, or potentially increased mortality risk in proximity to a feature. Indirect effects are expressed as a zone of influence (ZOI) around different human feature types.

In the Klaza herd range, there are large seasonal differences in the level of human activity. Currently, almost all mineral exploration and placer mining activities take place in the summer (snow free) season. During this season, most roads are accessible to vehicle traffic and there may be high levels of activity around advanced quartz mineral exploration properties. Most mineral staking activities also take place in the summer. In contrast, during the winter (snow present) season there is a very low level of human activity in the Klaza herd range. While the direct human development footprint remains, the features receive very limited (or no) use by people during the winter season. Currently, the only feature readily accessible during both the summer and winter seasons is the Mount Nansen road, which is maintained for ongoing mine remediation activities. Given these seasonal differences in activity levels, a seasonal

ZOI approach was used to quantify the current and future potential level of indirect human disturbance in the Klaza herd range.

To assist in determining potential ZOI values for human disturbance features, a scientific literature review was conducted on the avoidance behavior of caribou to such features. Our objective was to provide a range of plausible ZOI values for footprint types that are relevant to the Klaza herd. We reviewed studies on a range of caribou populations, including northern mountain caribou in British Columbia, barren-ground caribou in Alaska and Canada, boreal woodland caribou in Canada, and semi-domestic and wild reindeer in Norway (see "Human ZOI References" in Section 8, References). Caribou ZOI summary tables developed by AEM (2004), and recent environmental assessments by EDI (2014) in Yukon and Areva Resources Canada Inc. (Russell 2014a) in Nunavut were also reviewed. Based on this review, lower and higher ZOI values were assigned to the human footprint types as shown in **Table 2** and **Table 3** (note that throughout this report "lower" ZOI means an estimated zone of influence of smaller size, not lower intensity and, likewise, a "higher" ZOI refers to an estimated zone of influence of larger size, not higher intensity). In order to calculate potential indirect effects of human disturbance features, ZOI values were only applied during the season when the land use feature was thought to be actively used by humans.

Future Direct and Indirect Human Disturbance

A major part of the Klaza herd range assessment was to evaluate potential risks arising from future human land use. To assist in the assessment of potential future conditions, a 25-year land use scenario was developed for the Dawson Range area, based on existing, proposed and potential future land uses. The scenario assumptions, methods and level of potential human seasonal disturbance resulting from future human activities are described in Appendix B, with major results reported in Section 5.3.1, below.

3.3.1.1.2 Wildfire Disturbance

Recent Wildfire Disturbance

The Yukon Fire History database (1946 to 2013) was used to identify recently burned areas, and to calculate burn rates within the Klaza herd range. Recently burned areas are not considered suitable woodland caribou habitat, as woodland caribou avoid or utilize recently burned areas less frequently than other areas (Russell 2014b, Nagy 2011, Thomas et al. 1996, and others). In this project, based on the results of Russell (2014b), recently burned areas were classified as those 50-years old or less, and were identified in the fire history database as fires occurring between 1960 and 2013.

Potential Future Wildfire Disturbance

While it is not possible to predict the location or timing of future wildfire events, the risk of future burning can be assessed. Based on an analysis of central Yukon fuel types, fire size and fire rates, Ember Research (2014) examined potential future fire risk in the Klaza herd annual range, where fire risk was expressed as the probability of burning in the coming 25 or 50 years. This analysis identified areas where future fires are more likely to occur in the coming decades.

3.3.1.2 Late-Winter Habitat Effectiveness

Current Situation

Hegel (2015) developed a late-winter habitat selection model using recent (2012 to 2014) caribou GPS radio collar locations, satellite-based landcover and lichen abundance mapping, fire history, and terrain data[8]. The model was used to identify areas predicted to be more frequently selected by caribou in late-winter, and to develop a map of late-winter habitat suitability with a range of lower and higher quality habitat types. The range of values was re-classified into three habitat suitability classes—low, moderate and high—based on the Jenks natural breaks classification method.

Potential Future Late-Winter Habitat Effectiveness

Based on the results of the future land use scenario, the future winter season human disturbance ZOI was overlaid on the late-winter habitat suitability map and habitat quality classes were reduced by 1 class where they intersected with the ZOI (e.g., a Class 3 (high value) habitat was reduced to Class 2 (moderate value) habitat). The reduced proportion of high suitability habitats within each of the three CAAs was then calculated to illustrate the potential magnitude in reduction of late-winter habitat effectiveness resulting from human activities.

3.3.2 Population Factors

Current and future potential factors affecting the Klaza herd population (e.g., recruitment, mortality, predators and other ungulate prey density, harvest rates, etc.) were summarized from existing information sources, including Farnell et al. (1991), EDI (2013) and Hegel (2012, 2013 and 2014).

3.4 Human Land Use, Ownership and Administration

First Nation Settlement Land, mineral claims and permits (quartz and placer), and other land ownership and land use management boundaries were obtained from the Geomatics Yukon geospatial data warehouse or were provided by Government of Yukon departments. All land ownership, land use, mineral tenure and administrative boundaries used in the analysis were current as of November 2014.

[8] Note: At this time, a detailed map of summer habitat suitability has not been developed.

4 OVERVIEW OF THE KLAZA HERD RANGE

4.1 Biophysical Setting

The Klaza herd resides in the Dawson Range of west-central Yukon, south of the Yukon River and north of the Nisling Range (**Figure 1** and **Figure 2**). The Klaza herd annual range is 10,819 km^2 in size. The Dawson Range is a series of gently-sloping, northwest-southeast trending mountains with broad sub-alpine and alpine plateaus. Most of the Klaza herd annual range is within the Klondike Plateau ecoregion, but a small portion also occurs in the Yukon Plateau-Central ecoregion (YEWG 2004). The area has remained unglaciated for at least 400,000 years (some areas potentially 2.9 million years), creating an ancient landscape with smooth rolling hills and low mountains with dissected stream channels and steep, V-shaped valleys. The absence of glacial scouring and morainal deposits has resulted in a landscape with very few lakes (YEWG 2004).

Elevations range from approximately 400 m near the Yukon River, to approximately 2,000 m at the summit of Apex Mountain (all elevations are above sea level). At 2,026 m, Apex Mountain is the highest point in the region, and the approximate geographic center of the herd's annual range. Most other mountains and ridges are between 1,200 m and 1,700 m in elevation. Treeline occurs at approximately 1,200 m. Discontinuous permafrost covers the area with 50% to 90% of soils containing ice lenses. Permafrost is most prevalent in fine-textured valley-bottom soils and on north-facing slopes (YEWG 2004).

The climate is continental, with very cold, long winters and brief, warm summers. Valley bottoms can experience extreme annual variations in temperature, ranging from -60^{o}C in winter to +35^{o}C in summer (YEWG 2004). Annual average precipitation is 300 to 500 mm, with most falling in summer (June to August monthly averages of 50 to 90 mm). Intense convective thunderstorms are common. Winter snow fall is typically light, with late-winter (February to April) being the driest period of the year (YEWG 2004). Snow typically covers lower elevations from mid-October through to late-April.

Approximately 60% of the Klaza herd annual range is forested. Permanent shrublands of willow (*Salix* spp.) and shrub birch (*Betula* spp.) are extensive in the subalpine and in lower elevation areas. At lower elevations, shrublands are associated with cold air drainage and poorly drained permafrost soils. Forests are dominated by white (*Picea glauca*) and black spruce (*Picea mariana*) stands, either unmixed or mixed with balsam poplar (*Populus balsamifera;* typical of riparian areas), paper birch (*Betula papyrifera*), or trembling aspen (*Populus tremuloides*) (YEWG 2004). Mature, open canopy white and black spruce forests generally have the highest abundance of ground lichens, an important source of winter forage for caribou. Unlike caribou winter habitat common over much of southern Yukon, open canopy lodgepole pine (*Pinus contorta*) stands are generally absent from the area, except in the eastern part of the range near the community of Carmacks; and on some elevated terraces along the Yukon River. Sub-alpine and alpine vegetation is typical of central Yukon with low stature shrubs and tundra vegetation, with grasses and forbs dominating wetter sites and dwarf shrubs and lichens occurring in drier areas. In steep topography, bare and sparsely vegetated rock and rubble are common.

The combination of summer weather conditions (intense lightning storms, warm temperatures, and long daylight hours), and the low elevation rolling topography with extensive coniferous forests results in a vigorous wildfire regime. The Klondike Plateau and Yukon Plateau-Central ecoregions are part of the 'fire belt' of Yukon, with fires occurring every 50 to 200 years in low to mid-elevation forests (Government of Yukon 2010). However, high elevation sub-alpine and alpine areas, such as the central Dawson Range,

are rarely affected by wildfire. The Klaza herd annual range is considered to have a natural fire regime; it is in the Wilderness Fire Management Zone where wildfires are recognized as a natural and important ecological process, and are not actioned.

4.2 Land Ownership and Land Use

Figure 3 shows the location of nearby Yukon communities, First Nation Settlement Land, human land use features, quartz and placer mineral tenure, and outfitting areas. Results are summarized by caribou assessment area in **Table 4**.

4.2.1 Communities and First Nations

There are no permanent settlements within the Klaza herd annual range; the closest communities are Carmacks and Pelly Crossing. Parts of five First Nation Traditional Territories occur within the area. Most of the range is within the Traditional Territories of the Selkirk and Little Salmon/Carmacks First Nations. The periphery of the range includes parts of the Champagne and Aishihik, Trond'ëk Hwech'ën and Kluane First Nations Traditional Territories. Approximately 10% (1,014 km^2) of the annual range is First Nation Settlement Land, with almost all of the land selections being Selkirk and Little Salmon/Carmacks Category 'A' R-blocks[9] in the eastern and central parts of the range. The remaining 90% of the area is Yukon public land. With the exception of First Nation Settlement Land, there are no private land parcels.

4.2.2 Transportation

Two major roads, Freegold and Mount Nansen, provide access to the eastern part of the herd's range. The Mount Nansen Road is an all-season road maintained during the winter season, providing access to the abandoned Mount Nansen mine for ongoing reclamation activities. The Freegold road is summer only and is not passable to most vehicles past Big Creek. An extensive network of summer roads and trails, and winter routes, traverse CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek). The highest road and trail densities are in the vicinity of Mount Nansen and Freegold Mountain, with both areas having long-standing mineral properties. There is very limited surface access in CAA 3 (Klotassin River – Nisling River). The proposed Freegold Road extension, generally following the old Casino Trail, would facilitate all-season access to the far northwestern part of the Klaza herd annual range.

[9] Category A Settlement Land refers to First Nation Settlement Land with both surface and sub-surface ownership. R-blocks refer to 'rural' Settlement Lands, versus C-blocks which are 'community' Settlement Lands.

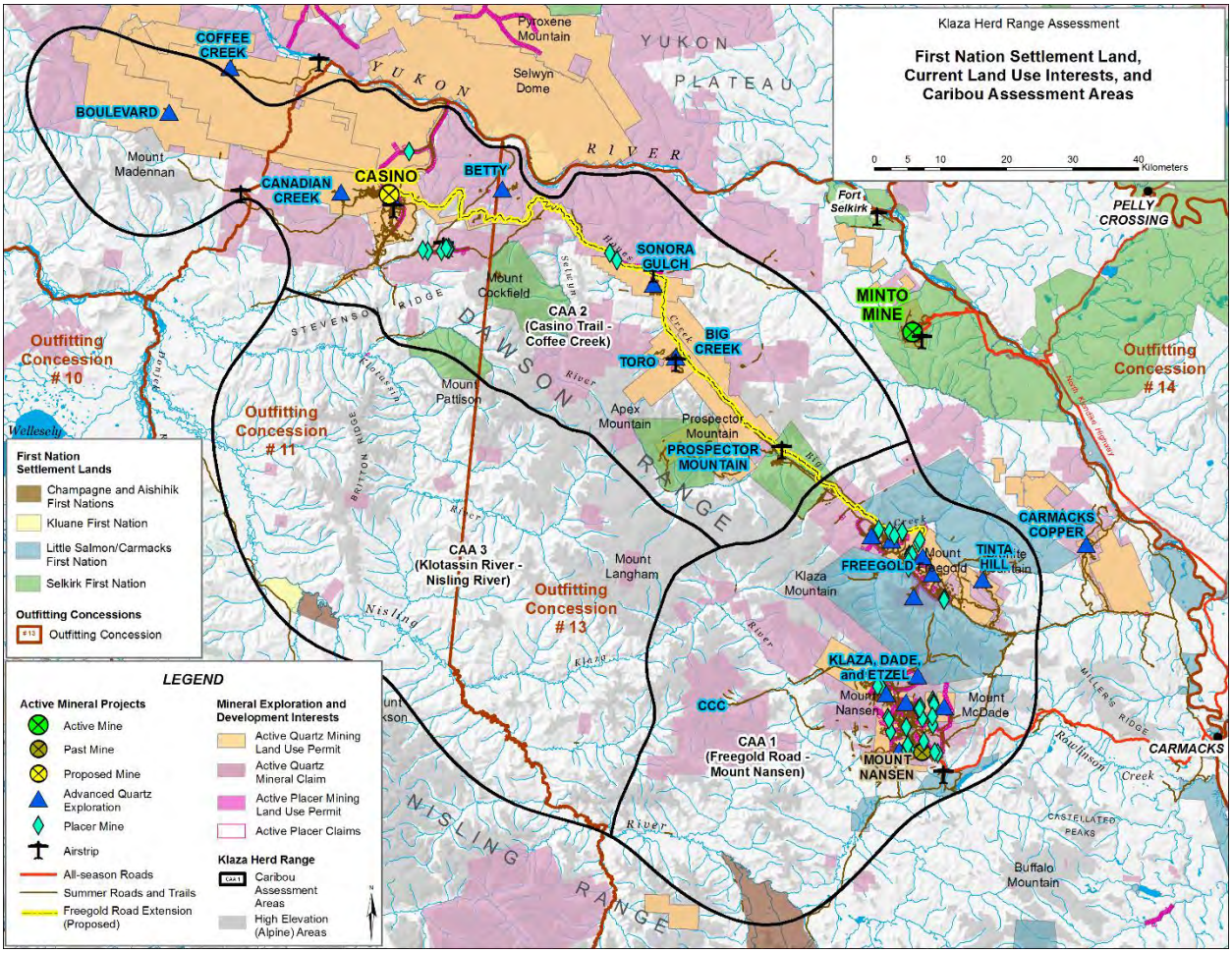

Figure 3. First Nation Settlement Land and current land use interests within the Klaza herd annual range.

4.2.3 Mineral Exploration and Development

As described in Section 2, the Dawson Range has long been an area of high mineral exploration and development interest. Quartz and placer mining activities are the major land use activity in the Klaza herd annual range. As of November 2014, active quartz mineral claims or mining land use permits covered over 40% (4,451 km^2) of the range. Most mineral interests are in the northern and eastern parts of the range; 80% of CAA2 (Casino Trail – Coffee Creek) and 33% (1,035 km^2) of CAA 1 (Freegold Road – Mount Nansen) have active quartz mineral tenure. The Minto Mine, to the northeast of the annual range, is currently the only producing quartz mine in the area. The Mount Nansen mine, which last operated between 1996 and 1999, is now abandoned and is being reclaimed, resulting in a low-level of year-round activity. The proposed Casino mine project entered the YESAB assessment process in January 2015. Less than 2% of CAA 3 (Klotassin River – Nisling River) is covered by active mineral claims.

Placer activity is restricted to riparian areas in the Mount Nansen, Freegold, Casino and Coffee Creek areas. While placer mining can be locally intensive, placer mineral tenure (active placer claims or mining land use permits) covers less than 2% (184 km^2) of the annual range.

4.2.4 Tourism and Recreation

The Dawson Range is not a major tourism or recreation destination. The Yukon River corridor (the northern boundary of the annual range) has high heritage and cultural values, and is a popular canoe and boat travel route for many residents and international travelers. The Fort Selkirk Historic Site is located at the confluence of the Yukon and Pelly Rivers. Recreational hunting of caribou occurs around the Mount Nansen and Freegold roads. Some people hunt moose in the more remote areas in the northwest portion of the range, accessing the area by boat from the Yukon River, traveling from Minto or Dawson. Most hunting activities are supported by off-road vehicles.

4.2.5 Guide Outfitting

Two Outfitting Concessions (11 and 13) cover most of the Klaza herd annual range. Caribou, grizzly bear and sheep are important species for the outfitters in the area, with Klaza caribou being the most frequently harvested. Guided hunts access the central part of the range by fixed-wing aircraft and by horse-back.

4.2.6 Forestry, and Oil and Gas

There are no commercial forest harvesting activities in the Klaza herd annual range, and the area has very limited commercial forest harvesting potential. Large trees can be found along streams and major rivers but are not commercially harvested due to restrictions in riparian habitat, and cultural and recreational values. There are no oil and gas activities or interests in the annual range, and oil and gas potential is considered to be very low.

4.2.7 Land Use Planning and Protected Areas

No land use plans are in place and no protected or conservation areas have been established within the Klaza herd annual range. Neither are anticipated in the coming years.

Table 4. Overview of human land ownership and land use in the Klaza herd annual range, summarized by caribou assessment area (CAA).

	CAA 1 (Freegold Road-Mount Nansen)	**CAA 2 (Casino Trail-Coffee Creek)**	**CAA 3 (Klotassin River-Nisling River)**
Area of CAA	3,104.0 km^2 (28.7% annual range)	4,180.7 km^2 (38.6% annual range)	3,534.6 km^2 (32.7% annual range)
First Nation Settlement Land (area in CAA, in km^2)			
Champagne and Aishihik	52.7	0.0	18.1
Kluane	0.0	0.0	17.5
Little Salmon/Carmacks	541.0	0.0	0.0
Selkirk	14.7	346.9	22.8
Trond'ëk Hwech'ën	0.0	0.0	0.0
Totals	608.4 (19.6%)	346.9 (8.3%)	58.4 (1.7%)
Transportation			
Main Access Roads (connected to Yukon public road system)	Freegold Road, Mount Nansen Road	none	none
Exploration Roads and Trails	Extensive network of summer roads and trails over much of area.	Locally-extensive network of summer roads and trails around advanced exploration properties. Casino Trail is also used occasionally during winter.	Very limited access; few roads and trails.
Quartz Mining Activity (area in CAA, in km^2)			
Active Quartz Mineral Claims	903.8	2,228.2	66.1
Active Quartz Mining Land Use Permits	131.2	1,121.7	0.0
Totals	1,035.0 (33.3%)	3,349.8 (80.1%)	66.1 (1.9%)
Placer Mining Activity (area in CAA, in km^2)			
Active Placer Mining Claims	87.0	30.9	0.1
Active Placer Mining Land Use Permits	46.3	19.2	0.0
Totals	133.3 (4.3%)	50.1 (1.2%)	0.1 (<1.0%)
Guide Outfitting			
Outfitting Concessions	#13	#11 and #13	#11 and #13

5 RANGE ASSESSMENT

5.1 Population Status

Since the 1980s, the Klaza herd has received two formal population surveys, and other population estimates based on fall composition surveys. In 1989, the population was estimated at 441 caribou (Farnell et al. 1991). However the survey did not include the southern portion of the Klaza herd's range, and is therefore not directly comparable with more recent population estimates (the Farnell et al. (1991) study was focused on the proposed Casino Trail road corridor). Based on a fall composition survey in 2000, a minimum population of 700 animals was estimated after 651 individual animals were observed (Hegel 2013). The most recent population survey was conducted in 2012 and resulted in an estimate of 1,180 caribou (SE = 129) (Hegel 2014).

While population estimates resulting from the 1989 and 2012 surveys suggest the Klaza herd population has increased in size, the actual amount of change between the two periods is not possible to determine as survey methods and boundaries differed among the study years (Hegel 2013). Therefore, at this time a trend assessment cannot be provided but the Klaza herd population is considered stable with a population of approximately 1,180 animals.

5.2 Seasonal Ranges and Important Habitats

The general ecology of northern mountain woodland caribou is described in Environment Canada (2012). Farnell et al. (1991) provides a detailed description of the ecology, distribution and habitats of the Klaza herd. Using the recent (2012-2014) GPS radio collar locations, Hegel (2015) developed updated annual and seasonal range boundaries and a late-winter habitat suitability map. Similar to most northern mountain herds, the Klaza herd exists as a number of sub-groups that utilize different seasonal ranges during the summer and winter seasons and move between them in the spring and late-fall. **Table 5** provides an overview of the herd's seasonal ranges and cycles.

Table 5. Overview of Klaza herd seasonal ranges and habitats.

Seasonal Range	Seasonal Activity	Dates	Description
	Migration to Summer Range	Late April – early-May	
Summer Range (high elevation mountain plateaus) Utilized Summer Range ** *(95% Utilization Distribution):* 53% (5,739 km^2) of annual range. Potential Summer Range *(>1,200 m elevation):* 29% (3,143 km^2) of annual range.	Calving and Post-Calving	May 1 – June 14	• Areas higher than 1,200 m elevation (above treeline) are potential summer range. • Broad subalpine and alpine plateaus with late-lying snow patches for insect relief are particularly important. • Important summer range areas include all major mountain blocks in the Dawson Range but Britton Ridge, Mount Langham – Prospector Mountain, and Mount Cockfield – Mount Pattison receive consistent use. • Grasses, lichen, moist sedges, and low shrubs provide high quality forage. • The summer range may provide increased security from predators during the calving and post-calving period.
	Summer	June 15 – September 10	
	Fall Rut	September 11 – October 31	
	Migration to Winter Range	Mid-October – late-November	
Winter Range (lower elevation forested slopes and valleys) Utilized Late-Winter Range ** *(95% Utilization Distribution):* 40% (4,318 km^2) of annual range) Potential Winter Range *(<1,200 elevation):* 71% (7,676 km^2) of annual range.	Early-winter	November 1 – January 31	• Forested valleys and mountain slopes less than 1,200m elevation (below treeline) are potential winter range. • Since the late 1980s, the most consistently used areas during the winter season have been: ○ Hayes Creek – Selwyn River – Big Creek; ○ Upper Klotassin River – Lower Klaza River; and ○ Upper Nisling River - Lonely Creek • The winter strategy for predator avoidance is for small groups of caribou to disperse across the landscape.
	Late-winter	February 1 – April 30	

**Note: There is some overlap between the utilized summer and winter ranges as identified by GPS collar locations. The methods used to calculate seasonal range boundaries result in some lower and higher elevation areas included in each.

The Klaza herd tends to use lower elevation forested habitats in winter because of easier access to terrestrial lichen and potentially better snow conditions. During the summer season, Klaza caribou utilize higher elevation sub-alpine and alpine areas to avoid predators, provide insect relief, and to access herbaceous and low shrub vegetation. All three CAAs contain potential summer and winter habitat but in varying amounts. The amount of potential summer and winter range and the range areas utilized based on locations of recent GPS radio collars is summarized in **Table 6**.

Table 6. Amount of summer and winter range areas within each caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		SEASONAL RANGE							
		SUMMER RANGE				WINTER RANGE			
		Potential Summer Range (>1200m)		Summer Range (95% UD)		Potential Winter Range (<1200m)		Late-Winter Range (95% UD)	
CAA	Area (km^2)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)
Freegold Road – Mount Nansen	3,104	1,153.7	37.2	1,116.8	36.0	1,950.3	62.8	656.9	21.2
Casino Trail – Coffee Creek	4,181	1,192.3	28.5	2,404.6	57.5	2,988.4	71.5	1,531.2	36.6
Klotassin River – Nisling River	3,535	796.9	22.5	2,217.4	62.7	2,737.7	77.5	2,130.4	60.3
TOTAL	10,819	3,142.9	29.0	5,738.7	53.0	7,676.3	71.0	4,318.5	39.9

5.2.1 Summer Range

The Klaza herd summer range is comprised primarily of high elevation (greater than 1,200 m elevation) non-forested subalpine and alpine plateaus in the central Dawson Range[10] (**Figure 4**). While on the summer range, cow caribou disperse to high alpine habitats to calve individually, and then re-aggregate in the post-calving period, when they feed on grasses, sedges and dwarf shrubs. During the summer season, areas with late-lying snow patches are particularly important to caribou for insect relief. The fall rut also occurs in these same high elevation areas where smaller groups join together to form mixed-sex breeding groups.

[10] In the Dawson Range, treeline occurs at approximately 1,200 m elevation.

Approximately 29% (3,143 km^2) of the Klaza herd annual range is above 1,200 m in elevation, representing potential summer habitat. However, the summer range, as identified by the 95% utilization distribution of recent GPS collar locations, covers 53% (5,739 km^2) of the annual range. The methods used to calculate seasonal range boundaries result in some lower elevation areas being included in the summer range.

As reported in **Table 6**, at 37% (1,154 km^2), CAA 1 (Freegold Road – Mount Nansen) has the highest proportion of high elevation potential summer habitat of the three assessment areas, followed by CAA 2 (Casino Trail – Coffee Creek) and CAA 3 (Klotassin River – Nisling River). However, utilization of CAA 2 and CAA 3 during the summer season is much higher than that observed in CAA 1. As determined by recent (2012 to 2014) GPS radio collar locations (Hegel 2015), 63% of CAA 3 is utilized by caribou during the summer season, compared to only 36% in CAA 1 (approximately 60% of CAA 2 is utilized by caribou during the summer). CAA 3, with the lowest amount of potential summer range, receives the highest summer utilization by Klaza caribou—this is also the portion of the annual range with the lowest level of human activity during the summer season.

Based on the 50% utilization distribution of GPS radio collar locations, the areas receiving highest recent summer use by Klaza caribou are:

- Mount Langham – Prospector Mountain;
- Mount Cockfield – Mount Pattison; and
- Britton Ridge.

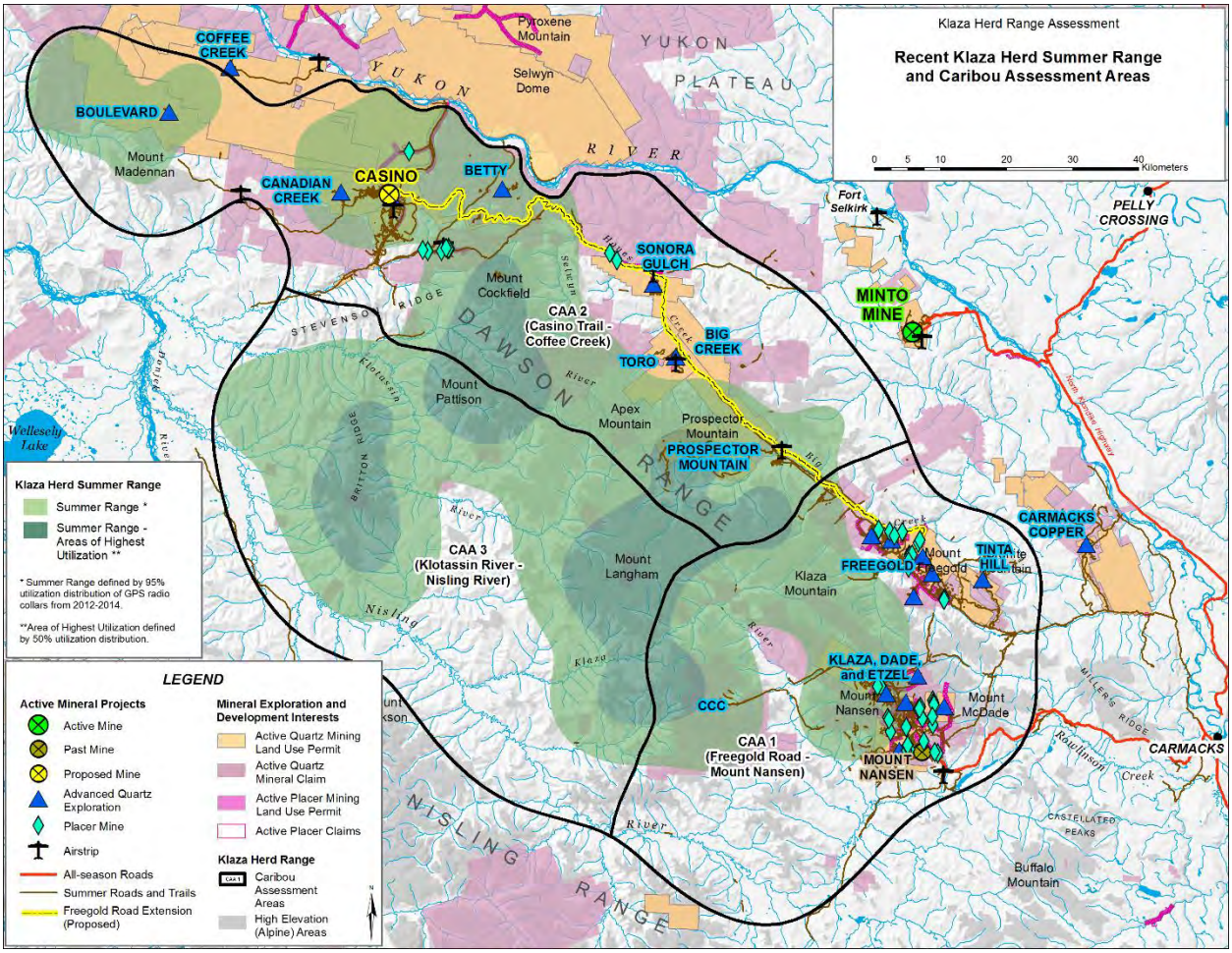

Figure 4. Recent Klaza herd summer range and the areas of highest utilization based on GPS radio collar locations from 2012 to 2014.

5.2.2 Winter Range

The Klaza herd winter range is generally comprised of the lower elevation (less than 1,200 m) forested valleys and mountain slopes of the Dawson Range[11] (Kuzyk et al. 1999) (**Figure 6**). While on the winter range, Klaza caribou disperse in small groups as a predator avoidance strategy, and forage primarily for terrestrial lichens. During the winter season, snow conditions may play a large role in determining the distribution of caribou on the landscape, as well as fine-scale habitat selection. The selection of winter range, on an annual basis, is likely due to variability in snow depth between different areas. Typically, in the Dawson Range snow depth is less at lower elevations. However, in some years this pattern may be reversed where higher elevation areas are more windswept and low elevations have higher snow accumulation. In those years the herd may use these high elevation habitats as it is less demanding to acquire forage.

[11] Some northern mountain woodland caribou may remain at high elevations all year, with the Aishihik caribou herd being an example. The alpine areas in the western portion of their range are often windswept, allowing Aishihik caribou to remain at high elevations during the winter season.

Approximately three quarters (71%, 7,676 km^2) of the annual range occurs at elevations less than 1,200 m; these areas area considered potential winter range for the Klaza herd. Our assessment focuses on the late-winter range, as this period (February 1 to April 30) is considered the most critical for northern mountain caribou populations (Farnell 2009).

5.2.2.1 Historic Late-Winter Utilization

The historic late-winter distribution of the Klaza herd was examined by calculating the density of late-winter VHF relocation points across all years using a moving window analysis with a 5 km diameter circle (Hegel 2015). Point densities are represented as a raster layer with 5 km pixels. Results are shown in **Figure 5**, with higher density areas (representing greater long-term historic use by caribou) identified in blue. The historic late-winter VHF collar locations show greater relative use of the following areas:

- Hayes Creek – Selwyn River – Big Creek;
- Somme Creek – Klotassin River; and
- Klaza River – Lonely Creek (near Mount Nansen).

Given the long-term nature of the VHF collar data set (11 years), the historic late-winter caribou distribution indicates relatively consistent use of these areas for the period 1987 to 1998.

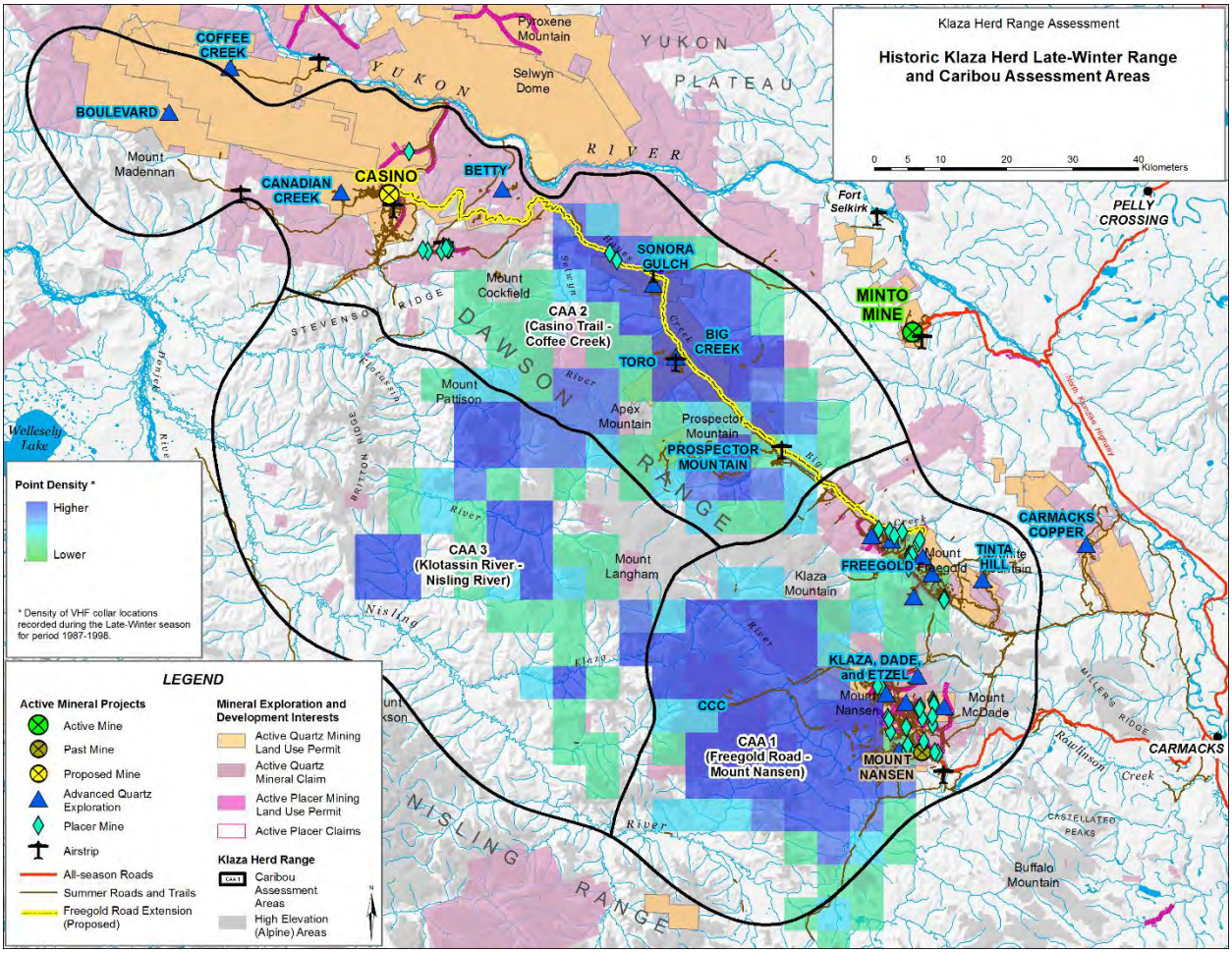

Figure 5. Historic Klaza herd late-winter range based on VHF radio collar locations from 1987 to 1998. The areas of highest utilization are shown in blue.

5.2.2.2 Recent Late-Winter Utilization

Recent late-winter range use, as identified by the 95% utilization distribution of GPS radio collar locations for the period 2012 to 2014, is shown in **Figure 6**. Recently-used late-winter range represents approximately 40% (4,318 km^2) of the annual range. Based on the 50% utilization distribution of GPS collar locations, the two areas with the highest levels of recent use by Klaza caribou during the late-winter period are:

- Hayes Creek – Selwyn River – Big Creek; and
- Upper Klotassin River – Lower Klaza River.

The Klaza River – Lonely Creek area, near Mount Nansen, was also utilized by Klaza caribou, but not as intensively as the Hayes Creek and Upper Klottassin River areas. As reported in **Table 6**, all caribou assessment areas have a relatively high proportion of potential winter habitat (63 to 78%), but the Hayes Creek – Selwyn River – Big Creek in CAA 2 and Upper Klotassin River – Lower Klaza River in CAA 3 received the highest levels of recent late-winter use by Klaza caribou.

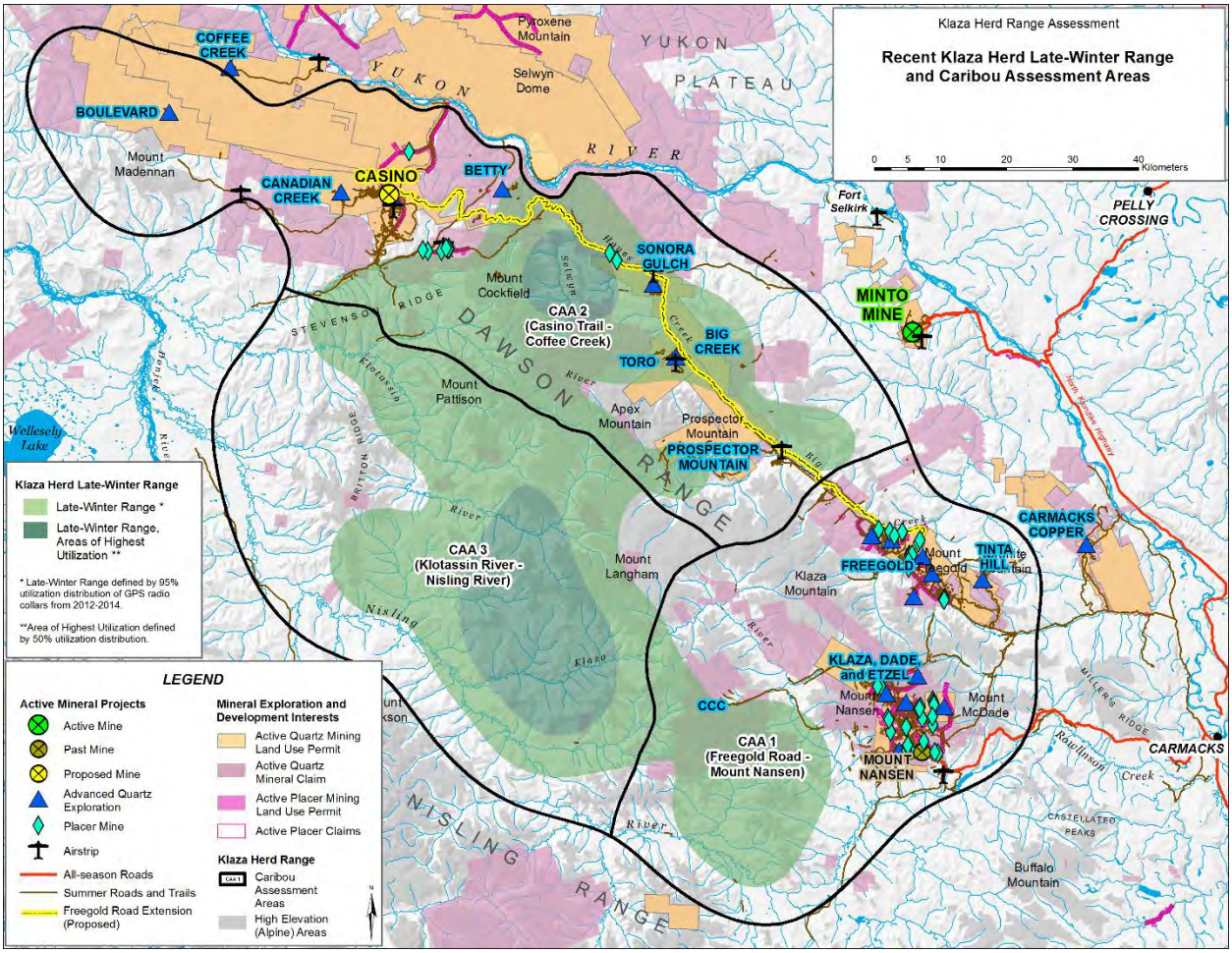

Figure 6. Recent Klaza herd late-winter range and the areas of highest utilization based on GPS radio collar locations from 2012 to 2014.

In recent times, similar late-winter range areas were used as those identified by the historic VHF radio collar data (**Figure 5**). The Klaza herd winter surveys completed in the late 1980s (Farnell et al. 1991), combined with our analysis of the historic VHF telemetry dataset and recent GPS collar locations, suggest relatively long-term and consistent use of these areas during the late-winter period. The historic VHF telemetry dataset represents a long-term perspective of late-winter caribou distribution by the Klaza herd which may not have been adequately represented by focusing only on the three years of recent GPS radio-collar data (Hegel 2015).

5.2.2.3 Late-Winter Habitat Suitability

The Klaza herd range late-winter (February 1 to April 30) habitat suitability map is shown in **Figure 7**. This map identifies low, moderate and high quality caribou habitats in the Klaza herd range, not factoring in the potential influence of human activities. The proportion of habitat suitability classes within each CAA is summarized in **Table 7**.

In the winter season, northern mountain woodland caribou typically select mature coniferous forest stands with the most abundant lichen resources and shallow snow depths. Recently burned (i.e., within the past 50 years) and high elevation areas have lower late-winter habitat suitability, as well as some lower-elevation habitat types with limited terrestrial lichen abundance. CAA 1 (Freegold Road – Mount Nansen) has the largest proportion of high suitability late-winter habitat in the Klaza herd annual range, yet it has the lowest amount of recent late-winter range utilization (see **Figure 6**). This is especially evident in the vicinity of the Klaza River. In contrast, CAA 3 (Klotassin River – Nisling River) has the smallest proportion of high suitability late-winter habitat but experiences the highest level of use by Klaza caribou during the late-winter season. As noted by Hegel (2015), the Klaza River area northwest of Mount Nansen was known to have been used historically by Klaza caribou (Farnell et al. 1991) but there has been almost no observed use of this area in recent years. This suggests that while high value late-winter habitat conditions exist, caribou may be avoiding this area due to high levels of human activity or other factors.

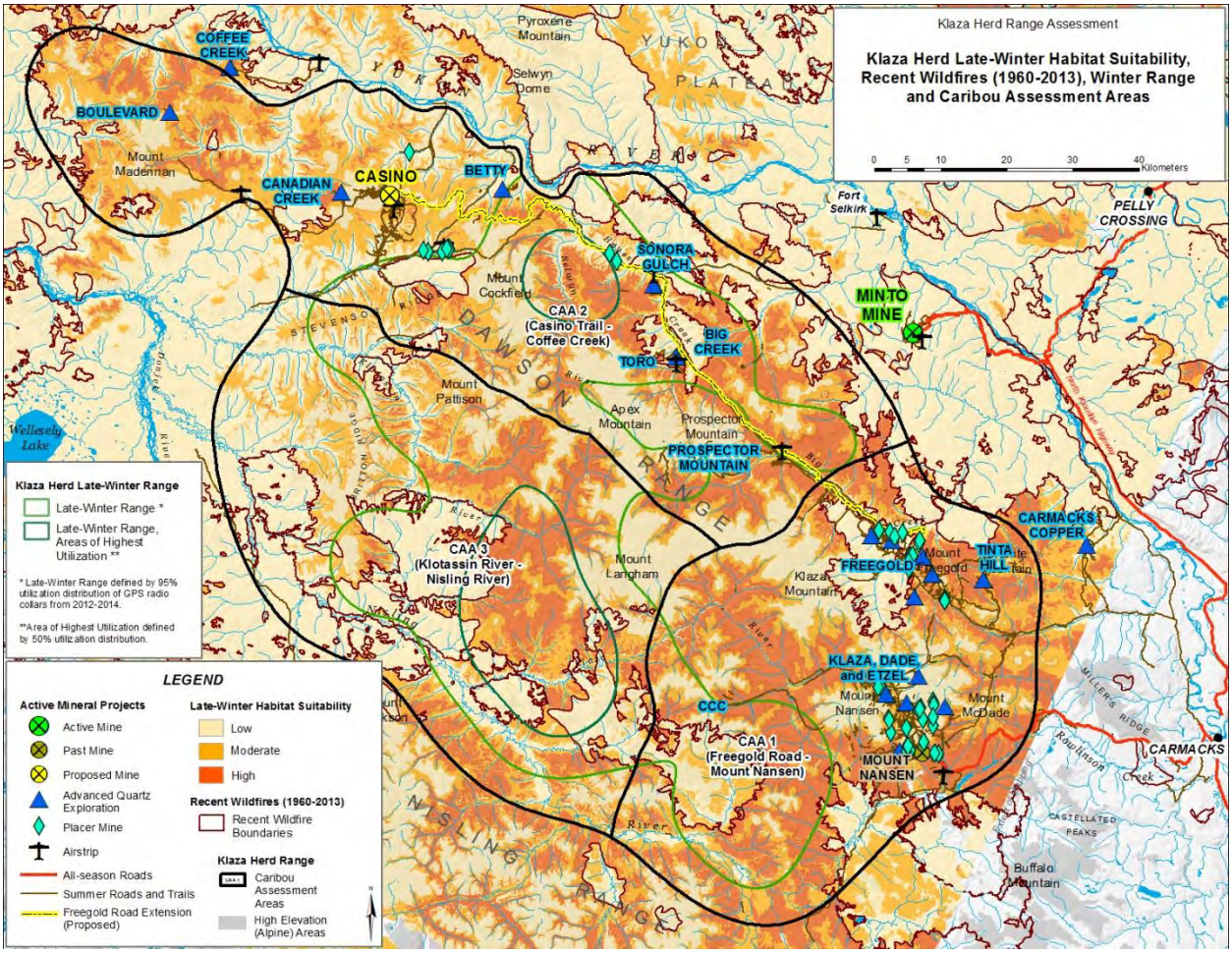

Figure 7. Klaza herd late-winter habitat suitability map.

Table 7. Proportion of late-winter habitat suitability classes reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		LATE-WINTER HABITAT SUITABILITY CLASS			
CAA	Area (km^2)	Low (% CAA)	Moderate (% CAA)	High (% CAA)	Sum of Suitability Classes (% CAA) *
Freegold Road – Mount Nansen	3,104	32.7	29.8	37.2	99.7
Casino Trail – Coffee Creek	4,181	48.4	31.7	19.9	100.0
Klotassin River – Nisling River	3,535	57.2	25.1	17.7	100.0
TOTAL	10,819	46.8	29.0	24.1	99.9

* NOTE: Due to a small area of missing satellite image coverage, habitat mapping in the Freegold Road – Mount Nansen CAA does not sum to 100%.

5.2.3 Migration

The ability of all populations of northern mountain woodland caribou to move between seasonal ranges is vitally important, and is considered a requirement for their long-term persistence (Environment Canada 2012). Seasonal movements provide increased forage availability and quality, insect relief, and enhanced security through reduced predation risk.

At this time, well defined migration corridors between lower elevation winter, and higher elevation summer, habitats have not been observed. Given the relatively gently sloping topography of the Dawson Range landscape and the relatively low number of all-season human land-use features across much of the range, it is unlikely that major barriers to seasonal migrations currently affect herd movement.

5.3 Risk Factors Affecting the Klaza Caribou Herd

The habitat- and population-related risk factors affecting the Klaza herd are discussed in the following sections, and summarized in **Table 13**. Where appropriate, areas of management concern are identified.

5.3.1 Habitat Factors

5.3.1.1 Direct and Indirect Human Disturbance

5.3.1.1.1 Current Situation

Figure 8 and **Figure 9** show the location of existing human development and potential zones of influence for the summer and winter seasons, respectively. Both the direct development footprint and its estimated lower and higher zones of influence (ZOI) are shown. Results are summarized in **Table 8**.

Direct Human Development Footprint

Based on available mapping, approximately 0.3% (28 km^2, or 2,780 ha) of the Klaza herd annual range is affected directly by the human development footprint. CAA 1 (Freegold Road – Mount Nansen) accounts for 63% of the total development footprint, with the remaining 37% occurring in CAA 2 (Casino Trail – Coffee Creek). CAA 3 (Klaza River-Nisling River) contains less than 1% of the total direct human development footprint in the Klaza herd annual range. The average density of linear disturbance features across the annual herd range is 0.16 km/km^2, ranging from 0.32 km/km^2 in CAA 1 to 0.01 km/km^2 in CAA 3.

Indirect Human Disturbance

Currently, there are large seasonal differences in the level of human activity on the herd range and thus the corresponding area potentially affected indirectly by those activities. In recent years, the majority of human activity occurred during the summer season. Almost all mineral staking activities and early mineral exploration occur during summer, and more advanced quartz exploration projects and placer operations are generally only active during the snow free months. During the winter season, most areas of the Klaza herd annual range receive very limited human activity. The Mount Nansen Road is the only maintained route during the winter, providing access to the Mount Nansen mine site for on-going remediation activities (this also provides some public access to the area). Most other roads and trails, including the Freegold Road, are not accessible to wheeled vehicles during the winter season. The Casino Trail, along with some other routes, receive limited use during the winter for transporting fuel and materials to placer mines and mineral exploration camps; however, to date, these have occurred

infrequently and are usually of short duration (7 to 10 days in March). The only other major all-season activity near the Klaza herd range is the Minto Mine, where operations occur year-round.

During the summer season, when most mineral exploration activities occur, 13 to 32% of the Klaza herd annual range may be affected by human ZOI (**Figure 8**). However, similar to the pattern of direct footprint, there are large differences among the three assessment areas. In CAA 1 (Freegold Road – Mount Nansen) between 23 to 50% of the area may be affected by human activities, while in CAA 2 (Casino Trail – Coffee Creek), this value decreases to 15 to 45%. In CAA 3 (Klotassin River – Nisling River), the level of total human ZOI is very low, affecting less than 2% of the area.

Given the relative inaccessibility of the Klaza herd range and the lower levels of human activity during the winter season, the total area potentially affected during the winter season is much lower than that in the summer (**Figure 9**). The total area affected by human ZOI in the winter is estimated to be less than 3%[12]. Only in CAA 1 (Freegold Road – Mount Nansen) is there a notable human ZOI during the winter season, with the potential area affected by human activity ranging from 2 to 7%. In CAA 2 (Casino Trail – Coffee Creek) and CAA 3 (Klotassin River – Nisling River), the total area affected by human ZOI in the winter is currently estimated to be very low (less than 1%).

[12] Assuming a ZOI of 1,000 m, when the Casino Trail winter trail is in use, total winter ZOI within the Klaza herd annual range may temporarily increase to 5%. In CAA 2 (Casino Trail-Coffee Creek), the winter ZOI may increase to 10% while the winter trail is active.

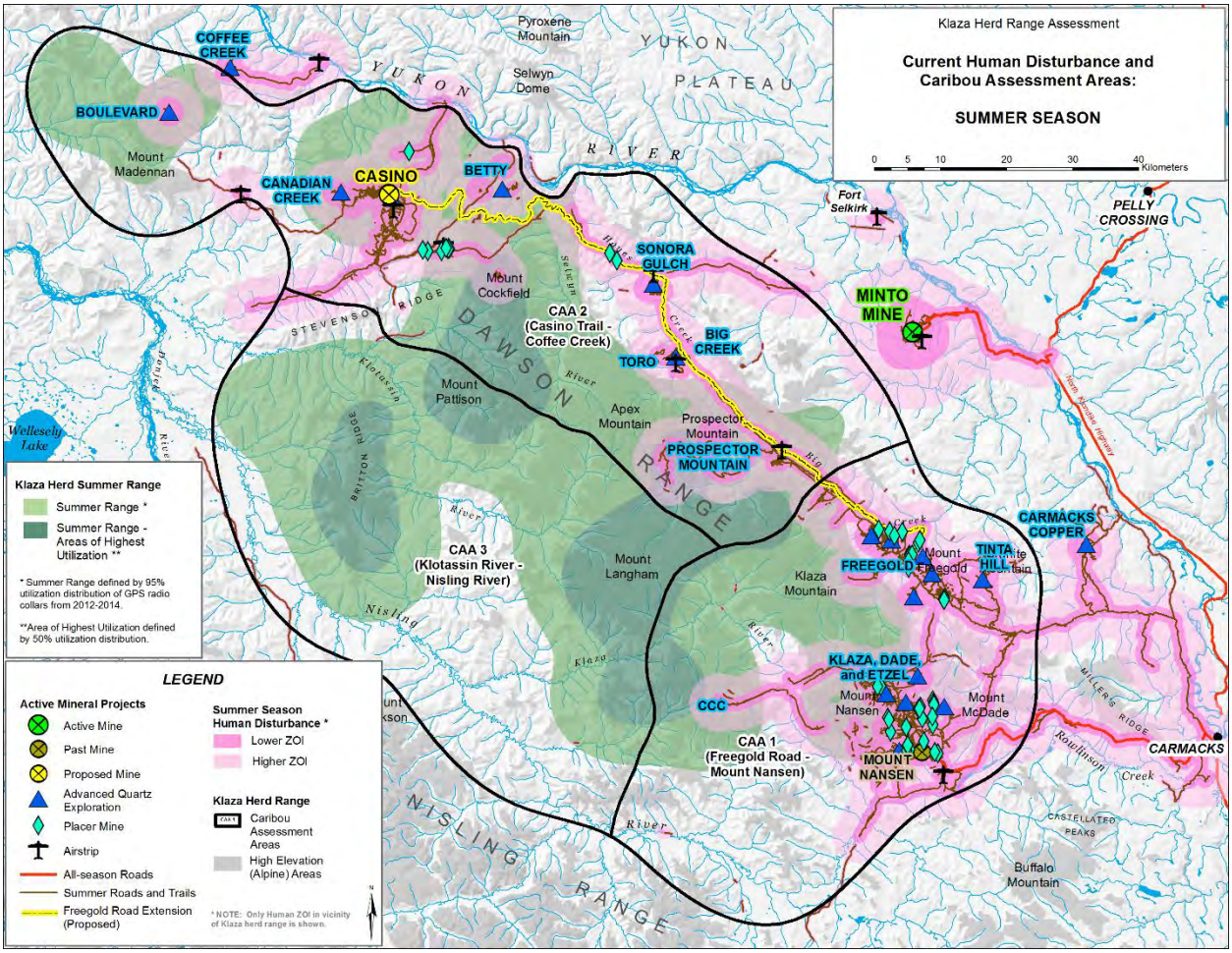

Figure 8. Current direct and indirect human disturbance within the Klaza herd annual range—summer season.

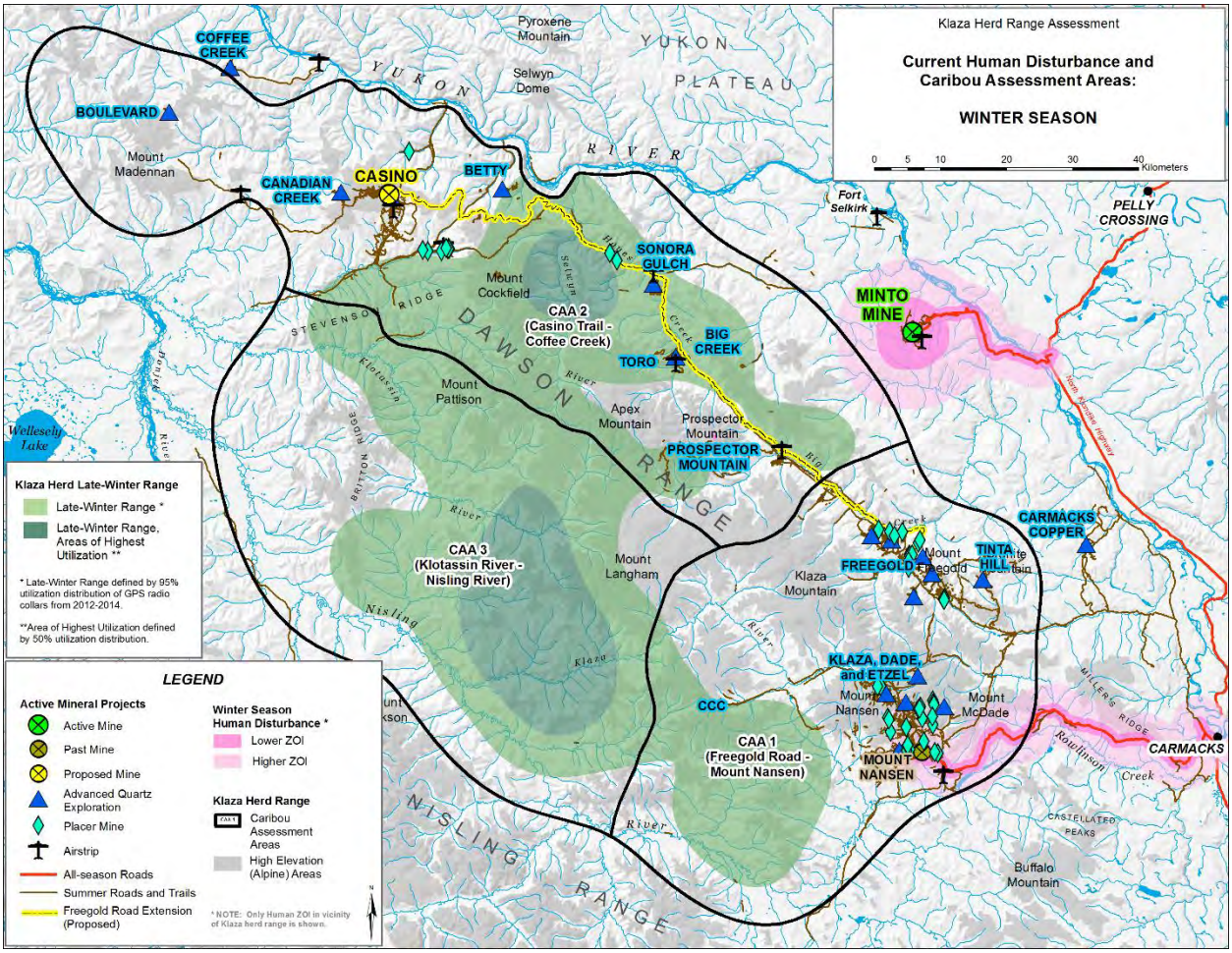

Figure 9. Current direct and indirect human disturbance within the Klaza herd annual range—winter season.

Table 8. Level of current direct and indirect human disturbance in the Klaza herd range reported by season and caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		HUMAN DISTURBANCE - LINEAR FEATURES		CURRENT HUMAN DISTURBANCE									
				Total Direct Human Development Footprint		Total Human Development ZOI (Direct Footprint + Indirect Effects)							
						SUMMER				WINTER			
						Lower ZOI		Higher ZOI		Lower ZOI		Higher ZOI	
CAA	Area (km^2)	Total Linear Features (km)	Avrg. Linear Density (km/ km^2)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)
Freegold Road – Mount Nansen	3,104	1,002.3	0.32	17.4	0.56	740.6	23.9	1,584.0	51.0	67.0	2.2	209.0	6.7
Casino Trail – Coffee Creek	4,181	650.7	0.16	10.3	0.25	626.0	15.0	1,867.9	44.7	10.3	0.2	46.4	1.1
Klotassin River – Nisling River	3,535	28.7	0.01	0.2	0.01	20.9	0.6	56.3	1.6	0.2	0.0	0.2	0.0
TOTAL	10,819	1,681.6	0.16	27.8	0.26	1,387.5	12.8	3,508.3	32.4	77.5	0.7	255.6	2.4

5.3.1.1.1 Future Situation

A detailed description of the potential levels of future human disturbance that may occur in the Klaza herd range in the coming 25 years is provided in Appendix B. The mapping results for the summer and winter 25-year future scenario are shown **Figure 10** and **Figure 11**, respectively. In 25 years, four active mines are assumed to be operating in the Klaza herd range: Casino, Coffee Creek, Freegold, and Sonora Gulch (or a similar project along the Casino Trail corridor). The Freegold Road is assumed to be an all-season haul road, connecting these four active mines to Carmacks and the North Klondike Highway. It is uncertain whether all four mines would be operating during this period or if different mines or patterns of development will occur[13]. The scenario also assumes that the current Minto Mine has closed and that the Carmacks Copper mine has been developed but has run the course of its mine life, and is also closed. The Minto, Carmacks Copper and Mount Nansen mine sites are assumed to remain active year-round for the purposes of remediation and water treatment, but with a reduced human ZOI.

Direct Human Development Footprint

While the direct habitat disturbance was not calculated separately as part of the future land use scenario (see Appendix B), the direct human development footprint is estimated to have increased to three or four times the current level. Given the large scale of the proposed Casino mine site and the Freegold Road extension, these developments are anticipated to account for much of the increase in future direct footprint (e.g., the current direct human footprint in the Klaza herd annual range is estimated at approximately 2,800 ha, and future levels may reach 10,000-12,000 ha). Future mine site and road footprints would result in long-term direct habitat loss, but may only cover 1-2% of the total annual range area, compared to the potentially large, indirect effects of the human ZOI. Future direct habitat impacts are expected to be greatest in CAA 2, with potentially 1-2% of the assessment area being affected (increasing from 1,000 ha today to 6,000-7,000 ha 25 years in the future).

The Klaza herd range future land use scenario does not directly address additional roads and trails that may be developed from the Freegold Road to adjacent areas, or the proliferation of new roads and trails that often occurs around advanced mineral exploration sites. In addition to the growth of mine site-related direct footprint, there is the potential for new linear features to be built, resulting in higher levels of human access and ZOI within the herd's range than may be projected by the scenario.

[13] The future land use scenario developed for this project was modeled after that created for an internal Government of Yukon project examining potential future mining activity in the Dawson Range (Francis and McNeil 2014). The main difference between the two future land use scenarios is that in the Klaza assessment, the Casino Project is assumed to proceed according to the proponents stated timelines, with the Freegold Road extension and Casino mine operating in approximately seven years (Casino Mining Corporation 2014).

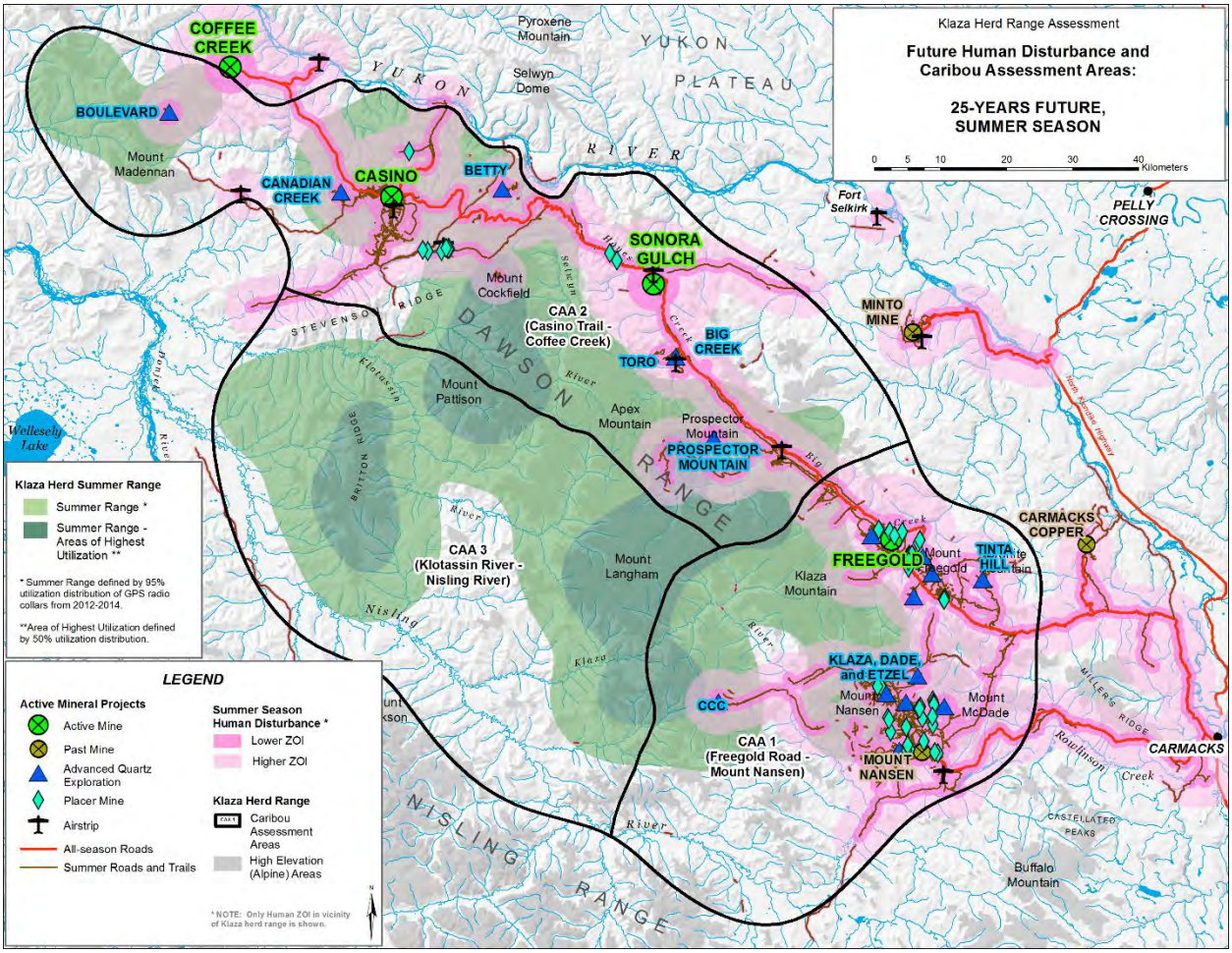

Figure 10. Potential human disturbance resulting from Klaza herd range land use scenario at 25 years future - summer season.

Indirect Human Disturbance

Given the current high level of human activity during the summer in the Klaza herd range, in the future, the spatial extent of total human disturbance may increase only marginally during the summer season[14], even if the Freegold Road extension, Casino Mine and other potential developments in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek) proceed. Given the assumptions of the land use scenario (see Appendix B), anticipated levels of total human summer ZOI may reach approximately 50% in both assessment areas—only slightly higher than the current values (CAA 2 is expected to increase from its current level of 42% to 50%, assuming higher ZOI values). In the future, if the major developments proceed as proposed, it is likely that much of CAA 2 will reach similar levels of disturbance as are currently observed in parts of CAA 1—an area that Klaza caribou appear to have largely abandoned.

[14] While the spatial extent of future human ZOI during the summer season may not increase substantially, the intensity of human use would increase significantly. The Casino mine and upgraded Freegold Road would result in more than 100 transport trucks traveling the corridor daily, as well as traffic from other mining operations. Such increases would result in either a larger ZOI or a more intense disturbance/avoidance effect on caribou.

While the amount of human ZOI may increase only slightly during the summer, a large increase during the winter is expected if the proposed, and reasonably foreseeable, developments occur as assumed in the future land use scenario (**Figure 12**). As summer-only advanced exploration properties convert to all-season mine sites, and their connecting roads become all-season transportation routes, human activities will affect larger areas of the Klaza herd range during the winter season. Further, many of the proposed or anticipated developments would fall within the lower elevation winter habitats[15] (e.g., the Freegold Road extension would pass through Hayes Creek – Selwyn River – Big Creek winter area which is observed to have long-term, consistent use by Klaza caribou). In 25 years, human activities may affect 6-22% of CAA 1 (Freegold Road – Mount Nansen) and 8 to 32% of CAA 2 (Casino Trail – Coffee Creek) during the winter season. Current levels of human disturbance are estimated to be less than 7% for CAA 1 and less than 2% in CAA 2 (**Table 8**). In contrast, relatively few future developments are anticipated for CAA 3 (Klotassin River – Nisling River). Should the projected developments occur, in the future, CAA 3 may be the only remaining part of the Klaza herd annual range that remains relatively unaffected by human activities. Most significantly, it may be the only remaining portion of unaffected winter range.

[15] In addition to a large increase in the amount of human ZOI on parts of the winter range, the intensity of vehicle traffic on the Freegold Road extension may also result in a barrier effect, preventing caribou from accessing the high quality winter range to the north and east of the road, around Big Creek. Proposed vehicle traffic from the Casino mine is expected to be more than 100 transport trucks daily, and traffic from other mining operations could also be expected.

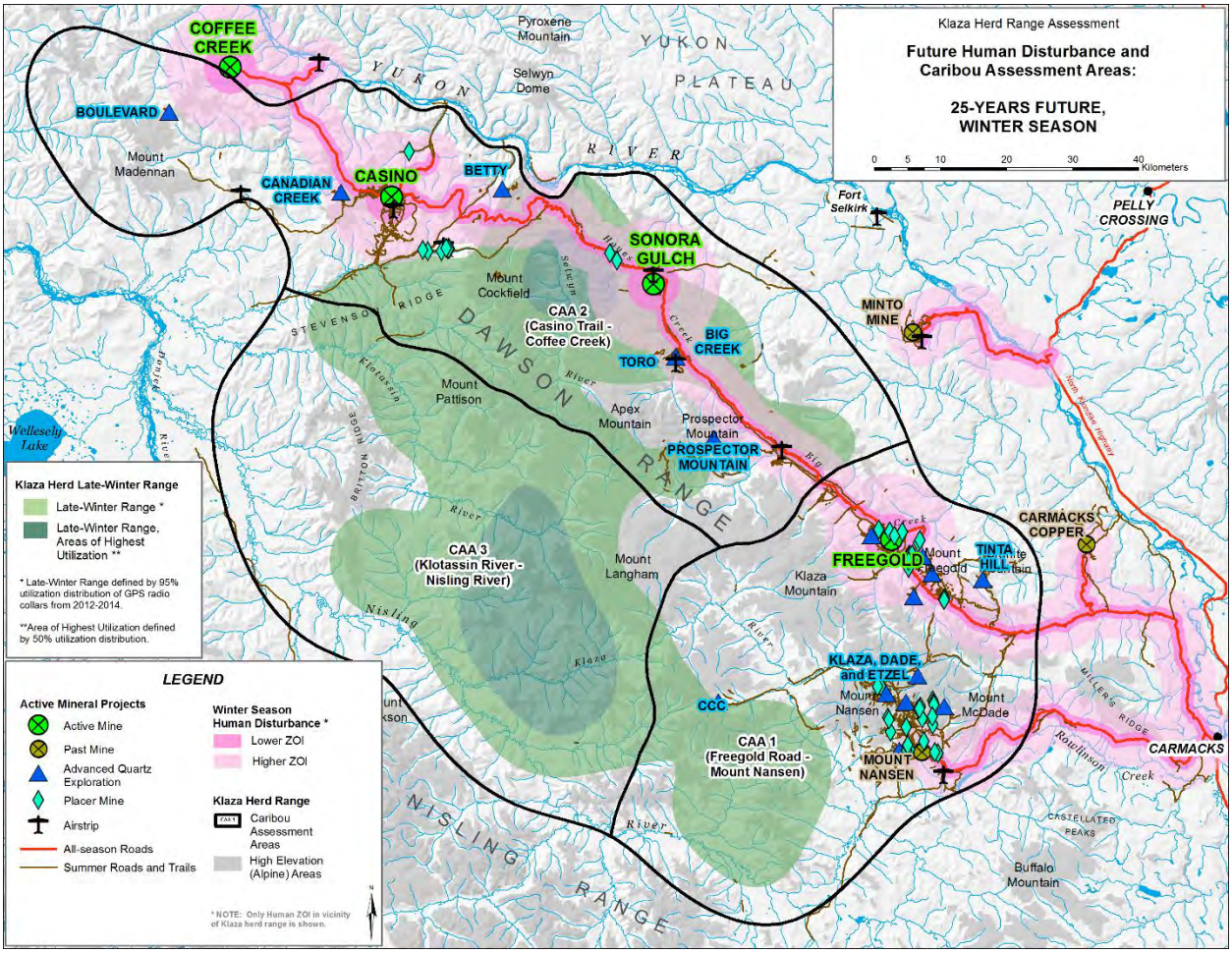

Figure 11. Potential human disturbance resulting from Klaza herd range land use scenario at 25 years future—winter season.

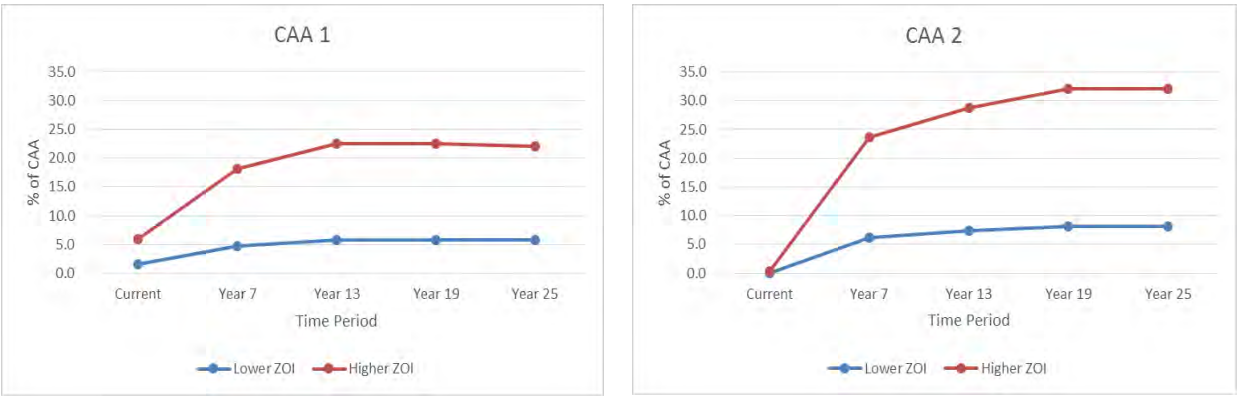

Figure 12. Potential increase in future winter season human disturbance in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek) resulting from the Klaza herd range land use scenario. Human disturbance is reported as lower and higher ZOI as a percentage of each assessment area.

5.3.1.2 Wildfire Disturbance

5.3.1.2.1 Current Situation

Recently burned areas are considered lower quality caribou habitat, as forest structure and lichen biomass has not recovered to a suitable condition. Caribou may therefore avoid recent burns or use these areas less frequently than unburned areas. Stand recovery rates may differ across Yukon, being influenced by habitat type and fire intensity. Russell (2014b), investigated the use of recent burns by Klaza caribou in the Dawson Range and considered burned areas 50-years and younger to be avoided or used less frequently by caribou. Low use of burns less than 50 years old is also reported by other authors (e.g., Nagy 2011, Thomas et al. 1996, Thomas and Gray 2002). The Klaza herd range late-winter habitat model (Hegel 2015) classified wildfires occurring since 1960 as recent burns.

The Yukon Plateau-Central and Klondike Plateau ecoregions of central Yukon have some of the most active fire regimes in Yukon, with calculated fire cycles of approximately 90 to 110 years[16]. However, given the large amount of high elevation, non-forested area in the Dawson Range the fire cycle in the Klaza herd annual range appears to be longer. **Figure 13** shows the location of recent burns in the Klaza herd annual range. The area affected by recent wildfires is summarized by assessment area in **Table 9**.

Since 1960, approximately 20% (2,084 km^2) of the herd's annual range has been affected by wildfire. Based on this rate of burning, a 260-year fire cycle is calculated for the Klaza herd annual range. Expressed as an annual average rate of wildfire, approximately 0.3% (42 km^2) of the range could be expected to be affected by fire annually. Nineteen percent (584 km^2) of CAA 1 (Freegold Road – Mount Nansen), 14% (576 km^2) of CAA 2 (Casino Trail – Coffee Creek), and 26% (924 km^2) of CAA 3 have been burned since 1960.

Wildfire does not affect all areas of the landscape equally. Due to the lack of flammable fuel types and the wetter, cooler climates, non-forested, high-elevation subalpine and alpine areas are generally not affected by wildfire, or only very infrequently. The differences in area burned between the assessment areas generally reflect the amount of lower-elevation forested fuel types available in each. For example, 44% of the total area burned since 1960 has occurred in CAA 3, and 80% of CAA 3 is covered by lower-elevation forested areas. In comparison, 60% of CAA 1 is covered by lower-elevation forests.

In **Table 9**, the final column reports the amount of recent wildfire activity as the proportion of potentially flammable forested fuel types in each assessment area (fuel type mapping was developed by Ember Research (2014) as part of the Klaza herd range fire risk assessment). In CAA 1 and CAA 2, 30% and 19% of the lower elevation forested areas have burned since 1960, respectively. In CAA 3, the lower elevation forested area affected by wildfire increases to 34%.

As described in Section 5.2.2 above, these same lower-elevation forested areas also comprise a large part of the Klaza herd winter range. Expressed as an annual fire rate, approximately 0.55% (42 km^2) of the potential winter range (forested areas less than 1,200 m elevation) may be affected by wildfire annually, resulting in a calculated winter range fire cycle of 190 years. Wildfire disturbance affects the winter range at a higher rate than the summer range and is additive to human disturbance.

[16] Yukon Fire Management, unpublished data. These values are supported by the area burned in the Klaza herd annual range, based on wildfire mapping for the period 1946 to 2013, and the Klaza range burn probabilities calculated by Ember Research (2014).

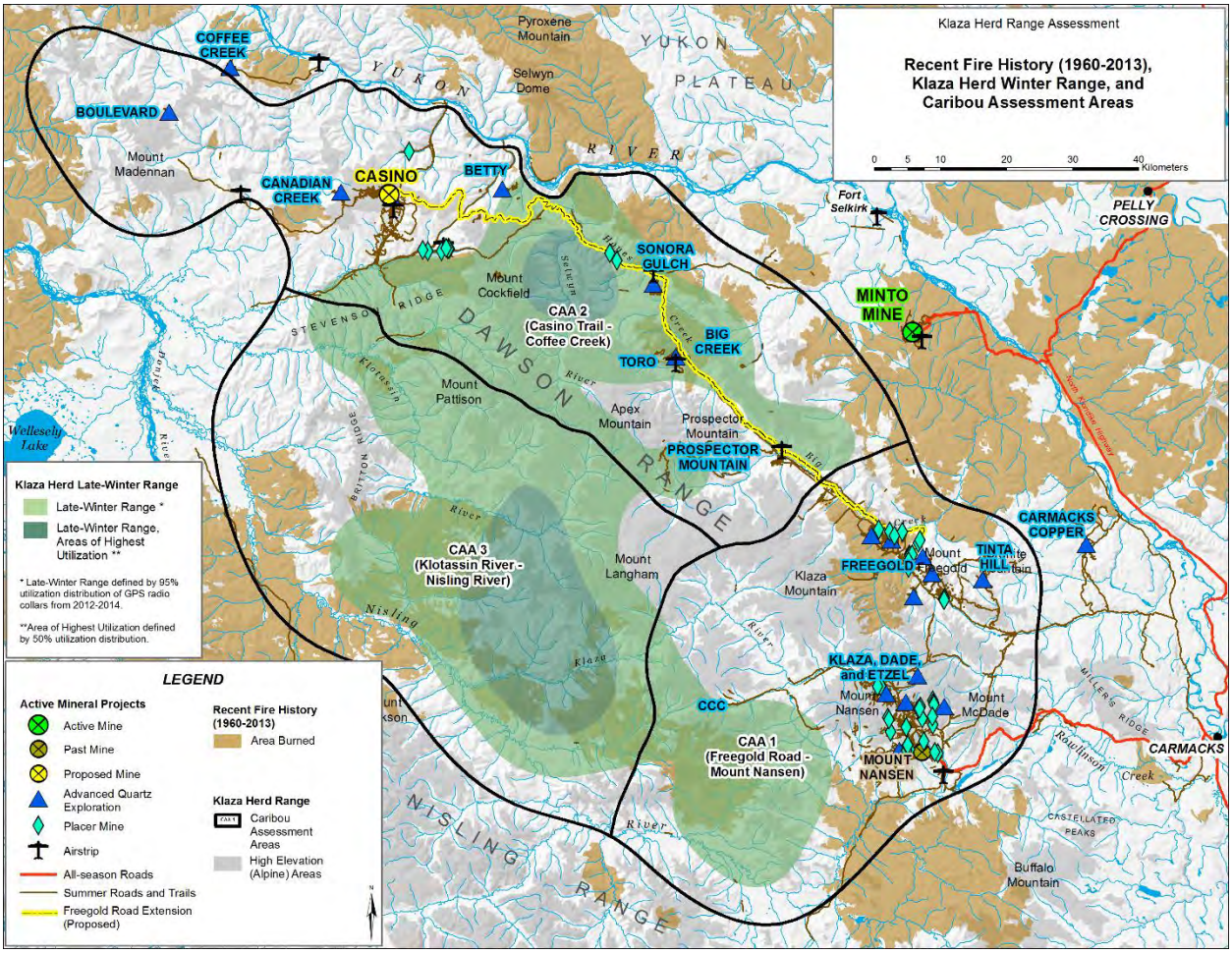

Figure 13. Recent wildfire disturbance in the Klaza herd annual range (1960 - 2013).

Table 9. Recent wildfire disturbance (1960 – 2013) in the Klaza herd range reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		RECENT WILDFIRE DISTURBANCE – AREA BURNED (1960 – 2013)			
CAA	Area (km^2)	Recent Area Burned (km^2)	Recent Area Burned (% Total Area Burned)	Recent Area Burned (% CAA)	Recent Area Burned (% Vegetated Fuel Type in CAA) *
Freegold Road – Mount Nansen	3,104	584.4	28.0	18.8	30.2
Casino Trail – Coffee Creek	4,181	576.3	27.6	13.8	18.8
Klotassin River – Nisling River	3,535	923.5	44.3	26.1	33.9
TOTAL	10,819	2,084.2	100.0	19.3	26.9

* The area of non-fuel types (non-forested subalpine and alpine areas) in each assessment area are as follows: CAA 1 = 38% (1,167 km^2), CAA 2 = 27% (1,109 km^2), and CAA 3 = 23% (809 km^2). These values very closely approximate the areas greater than 1,200 m elevation, as reported in **Table 6**.

5.3.1.2.2 Future Situation

Based on an analysis of central Yukon fuel types, and wildfire size and rates, Ember Research (2014) examined potential future wildfire risk in the Klaza herd annual range. **Figure 14** shows areas with the projected highest risk of fire in the coming 25 years, expressed as a probability of burning. On **Figure 14**, the deep red colours indicate a 25 to 50% probability of burning in the next 25 years (i.e., there is a 25 to 50% chance that the area will experience a wildfire in the next 25 years). Wildfire boundaries from 1960 to 2013 are also displayed.

Assuming wildfire rates similar to the recent past (average annual fire rate of 0.30 to 0.55%, or 40 to 45 km^2/year), approximately 10 to 15% (1,100 km^2) of the annual range is expected to burn in the coming 25 years, with the potential winter range being most affected. Wildfires that occurred between 1960 and 1980 will begin to regenerate back to caribou habitat in the coming decades, but new wildfires should also be expected to occur. If future fire rates remain relatively constant, the amount of area disturbed by wildfire in the future may remain similar to the present, but the location of young forest will shift across the landscape.

Overall, as a result of large areas of high elevation, non-flammable fuel types along with the pattern of historic fires in lower elevation forested areas, much of the Klaza herd annual range has either a low or moderate risk of wildfire over the next 25 years (0 to 25% probability of burning in the 25 year future time period). Areas with the highest fire risk are generally the areas of low-elevation forests that have not been affected by fire in the past 50 to 60 years. The majority of these areas are in either the potential or recently utilized Klaza herd winter range.

In CAA 1 (Freegold Road – Mount Nansen), much of the forested area has been affected by recent wildfire. Only the areas closest to Carmacks[17] with mature conifer fuel types are identified as having a higher probability of burning in the coming 25 years. In CAA 2 (Casino Trail – Coffee Creek), based on fuel type and forest age class, much of the remaining low elevation forested area has been ranked as low or moderate risk. In CAA 3 (Klotassin River – Nisling River) much of the area is also low or moderate risk. Areas with the highest risk of burning in CAA 3 are the lower Klotassin River, the middle reaches of the Nisling River, and the lower Klaza River.

The two areas with the highest recent amount of winter use by Klaza caribou, Hayes Creek - Selwyn River and Upper Klotassin River – Lower Klaza River, occur in areas of moderate to high future fire risk. Over time, the probability of these forested areas burning will increase and other areas recently affected by fire will recover to functional habitat. The shifting forest mosaic created by historic and future wildfire means that caribou will require adequate undisturbed habitat to move between the different areas of the winter range to access their required resources.

Climate Change

The Ember Research (2014) fire risk analysis did not examine potential changes in fire regimes resulting from climate change. In the coming decades, average summer temperatures in central Yukon are projected to increase by 1.5 ^{o}C to 2.5 ^{o}C above current average temperatures (Werner et al. 2009). Changes in precipitation are uncertain, but precipitation events are expected to be more variable. Several climate and fire studies predict increasing wildfire rates for the northern boreal forests of Canada (e.g., Weber and Flannigan 1997, Flannigan et al. 2005, Kochtubajada et al. 2006) with central Yukon forests potentially experiencing some of the highest risk of extreme summer fire weather, increasing area burned and fire severity (e.g., McVoy and Burn 2007). Under such future climate scenarios, the annual area burned in the Klaza herd range should be expected to increase above current levels, adding to the level of future winter range habitat disturbance. Thus, predictions illustrated in **Figure 14** may be conservative.

[17] The area around the community of Carmacks and the North Klondike Highway is part of the Full and/or Strategic Yukon Wildlife Fire Management Zones, meaning that any wildfire in this area would be actioned.

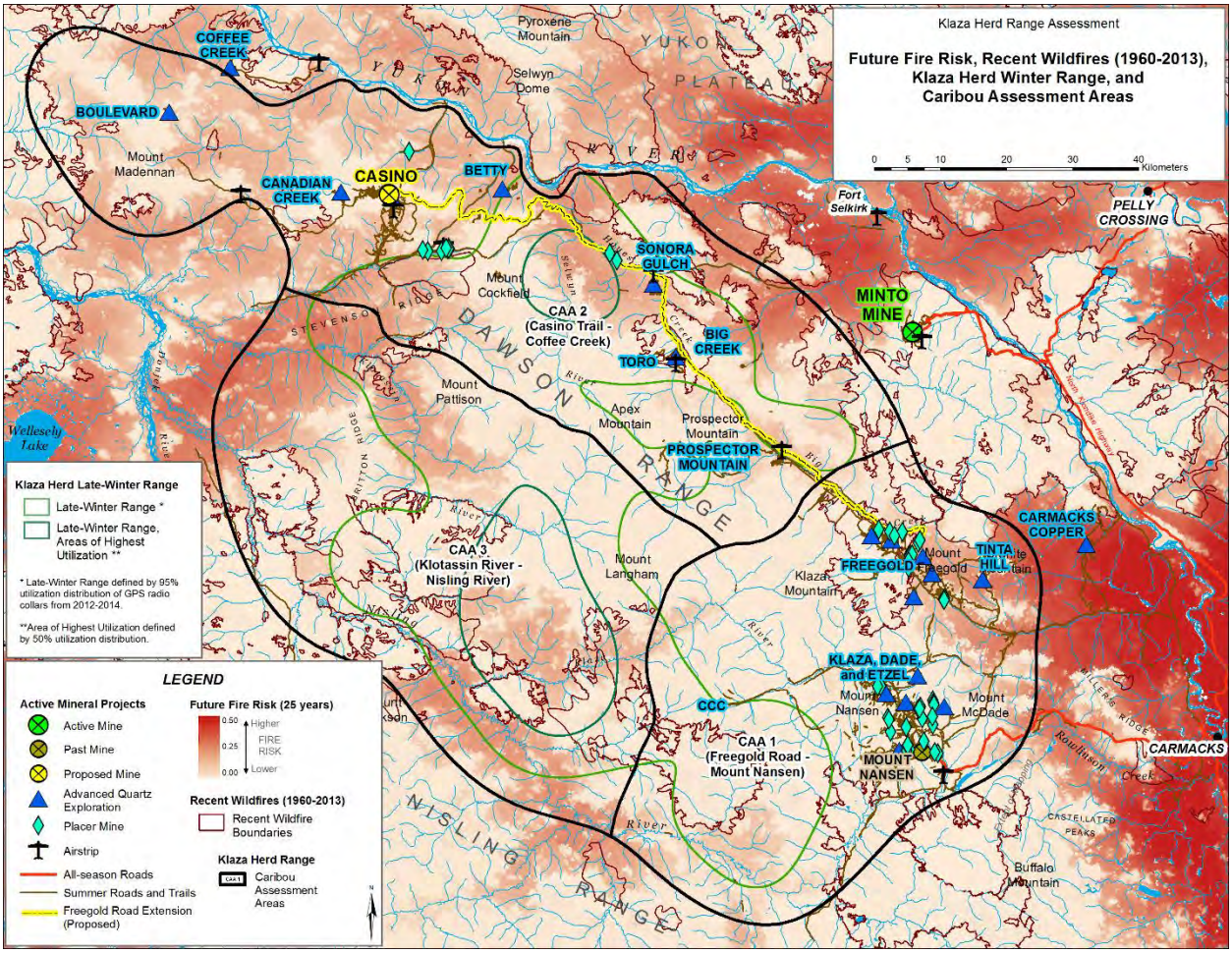

Figure 14. Potential future fire risk (probability of burning) in the Klaza herd annual range. The deeper red colours indicate a higher probability (25 to 50%) of burning in the next 25 years.

5.3.1.3 Total Disturbed Area

5.3.1.3.1 Current Situation

Human and wildfire disturbances both contribute to the total level of disturbance on the Klaza herd annual range. **Figure 15** and **Figure 16** show the current extent of total disturbance during the summer and winter seasons, respectively. Results are summarized in **Table 10**. During the summer season, the combined direct and indirect effects of human footprint and recent wildfires affect between 31 to 47% (3,298 to 5,061 km^2) of the annual range. As a result of the currently low level of human winter activity, total disturbance during the winter season is reduced to 20 to 21% (2,158 to 2,305 km^2), and almost all is due to recent wildfire disturbances.

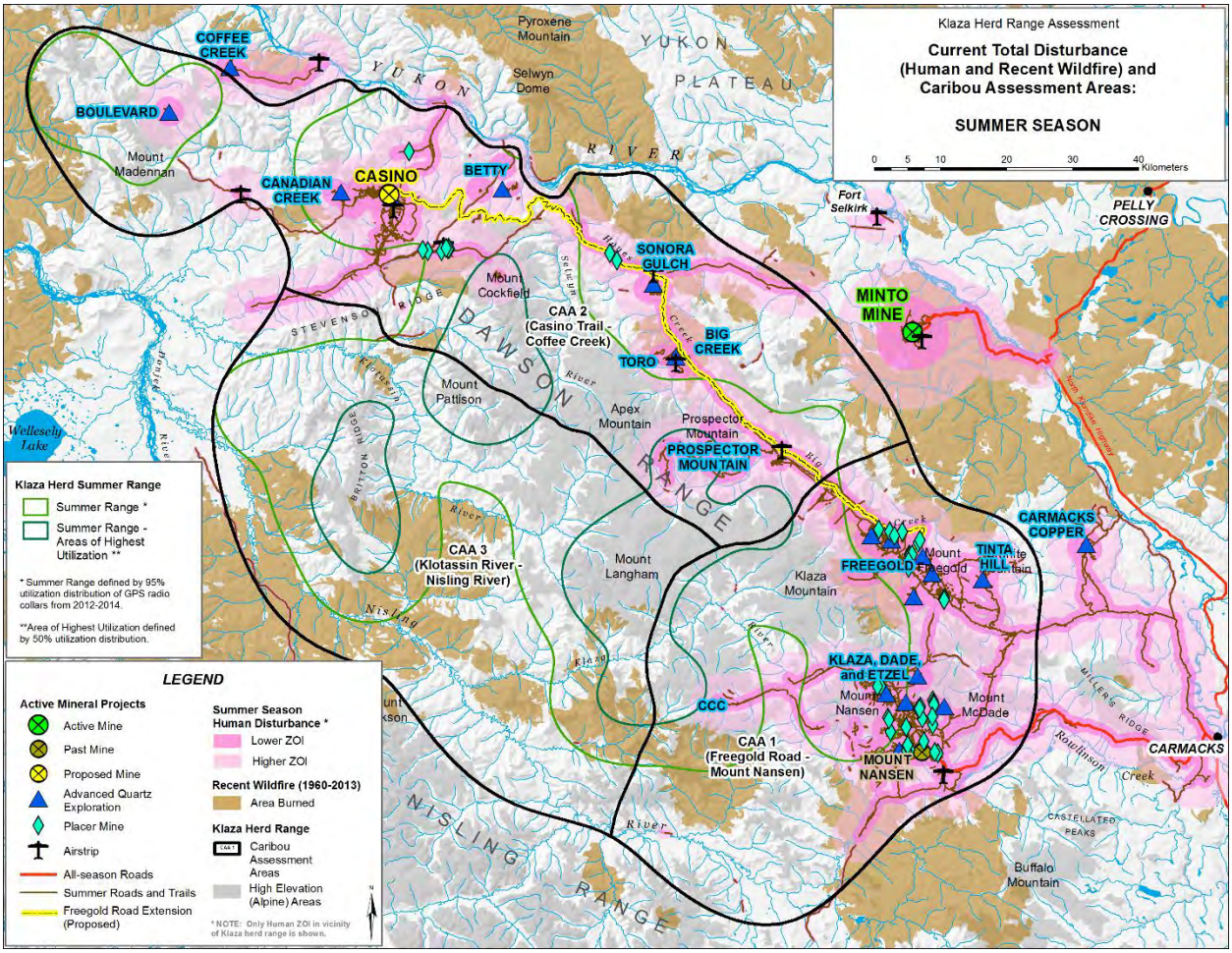

Figure 15. Current total disturbed area (human and recent wildfire) in the Klaza herd annual range—summer season.

The total level of summer disturbance is currently highest in CAA 1 (Freegold Road – Mount Nansen), ranging from 40 to 61% (1,217 to 1,892 km^2), followed by CAA 2 (Casino Trail – Coffee Creek) at 27 to 53% (1,147 to 2,198 km^2). Approximately 40% of the summer range in CAA 2 is affected by the combined effects of human activity and wildfire. The total level of summer disturbance in CAA 3 (Klotassin River – Nisling River) is 26 to 27% (935 to 970 km^2) of the assessment area, with almost all resulting from recent wildfire. In the winter season, the total level of disturbance is quite similar among the three assessment areas, ranging from 14 to 26%. CAA 3 currently has the highest level of total disturbed area during the winter season as a result of having the highest amount of recent wildfire activity.

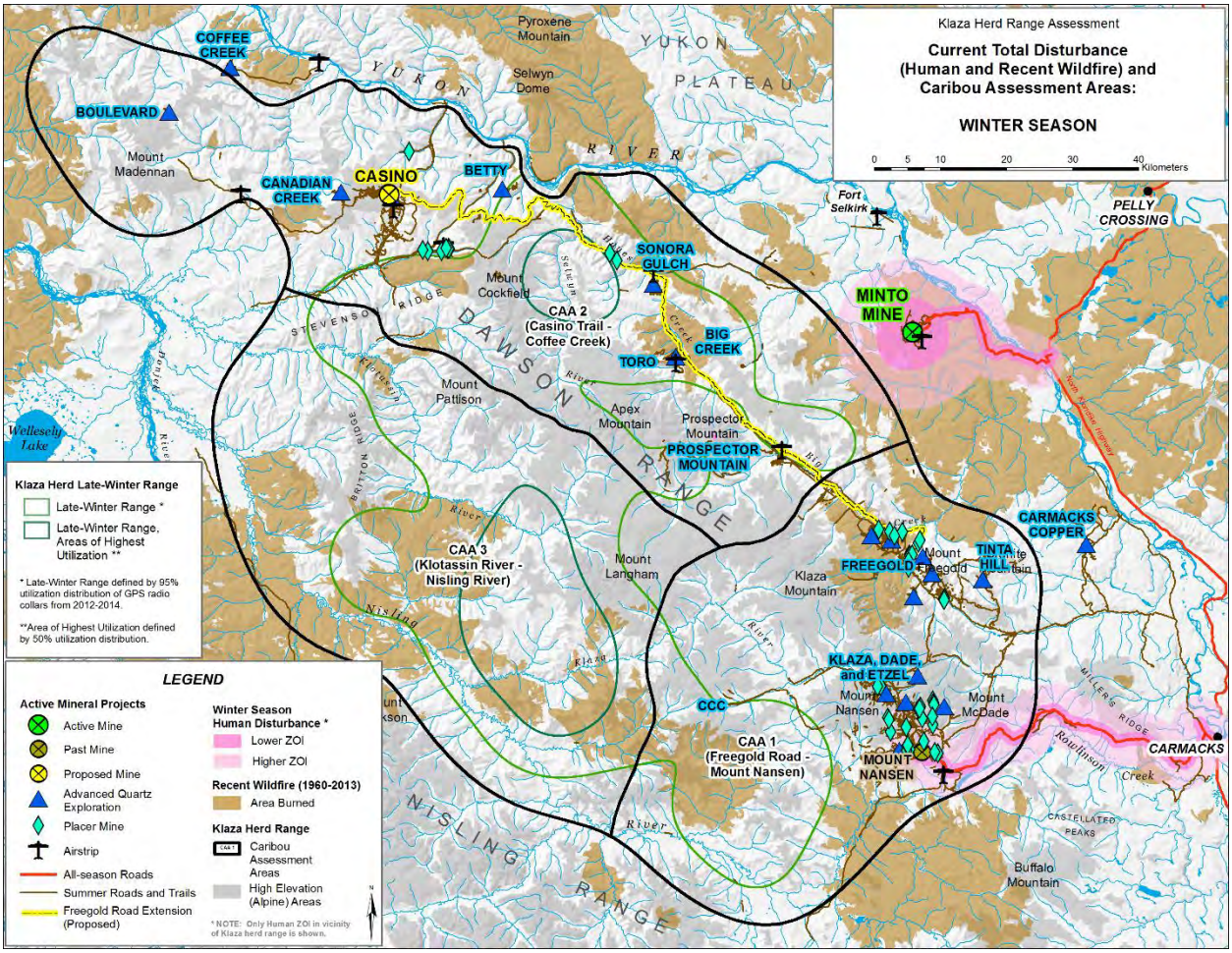

Figure 16. Current total disturbed area (human and recent wildfire) in the Klaza herd annual range—winter season.

Table 10. Current total disturbed area (human and recent wildfire) in the Klaza herd range reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		CURRENT TOTAL DISTURBANCE (Human and Recent Wildfire)							
		SUMMER				WINTER			
		Lower ZOI		Higher ZOI		Lower ZOI		Higher ZOI	
CAA	Area (km^2)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)	Area (km^2)	Area (% CAA)
Freegold Road – Mount Nansen	3,104	1,216.7	39.2	1,892.2	61.0	648.5	20.9	790.1	25.5
Casino Trail – Coffee Creek	4,181	1,146.5	27.4	2,198.1	52.6	586.2	14.0	591.3	14.1
Klotassin River – Nisling River	3,535	934.6	26.4	970.1	27.4	923.6	26.1	923.6	26.1
TOTAL	10,819	3,297.9	30.5	5,060.5	46.8	2,158.3	19.9	2,305.0	21.3

5.3.1.3.2 Future Situation

As described above, the amount of human disturbance in the Klaza herd range is expected to increase in the next 25 years. While wildfires that occurred from the 1960s to the 1980s will begin to regenerate back to caribou habitat in the coming decades, new wildfires are also likely to occur. **Figure 17** and **Figure 18** show potential future levels of total disturbance (human and wildfire) for the summer and winter seasons, respectively. On these figures, past fires that would remain in a non-regenerated state at the end of the 25 year scenario period are shown in tan (i.e., burns that occurred since 1989 and would be less than 50 years old in 25 years), and areas with a moderate to high fire risk that could be expected to burn in the coming 25 years are shown in light red (i.e., areas with greater than 25% probability of burning).

Assuming similar fire rates as in the recent past (average annual fire rate of 0.30 to 0.55%, or 40 to 45 km^2/year), approximately 10 to 15% (1,100 km^2) of the annual range could be expected to burn in the coming 25 years, with the potential winter range being most affected. If fire rates increase as projected due to climate change, the amount of area burned is expected to increase, resulting in higher levels of potential winter range being in an unsuitable condition for use by caribou.

If mineral exploration and development activity proceeds in the manner anticipated in the Klaza future land use scenario (Appendix B), a large increase in human disturbance during the winter season is expected to occur in CAA 2 (Casino Trail – Coffee Creek), and a moderate increase in CAA 1 (Freegold Road – Mount Nansen) (see **Figure 12**). The combined effects of past and future wildfire, along with the development of an all-season road and multiple mine sites, may result in 20 to 50% of CAA 2 being

affected by human disturbance during the winter season, compared with the current level of 14%. The total winter disturbance in CAA 1 may increase to 30 to 34%, compared with the current level of 21 to 25%. In CAA 3 (Klotassin River – Nisling River), if current trends in human land use continue, the total level of future winter season disturbance may remain similar to current levels (26%), with wildfire continuing to be the major source of habitat disturbance. Given the relatively high level of existing summer season human activity, in the future the total amount of disturbance during the summer may not increase much above the current level. However, the amount of direct footprint may expand considerably as roads and mine sites are developed. During the summer season, 40 to 65% of CAA 1 and 30 to 60% of CAA 2 may be affected by the combined effects of human activities and wildfire. If CAA 3 remains relatively unaffected by human activities, the future level of disturbance may remain similar to current (27%).

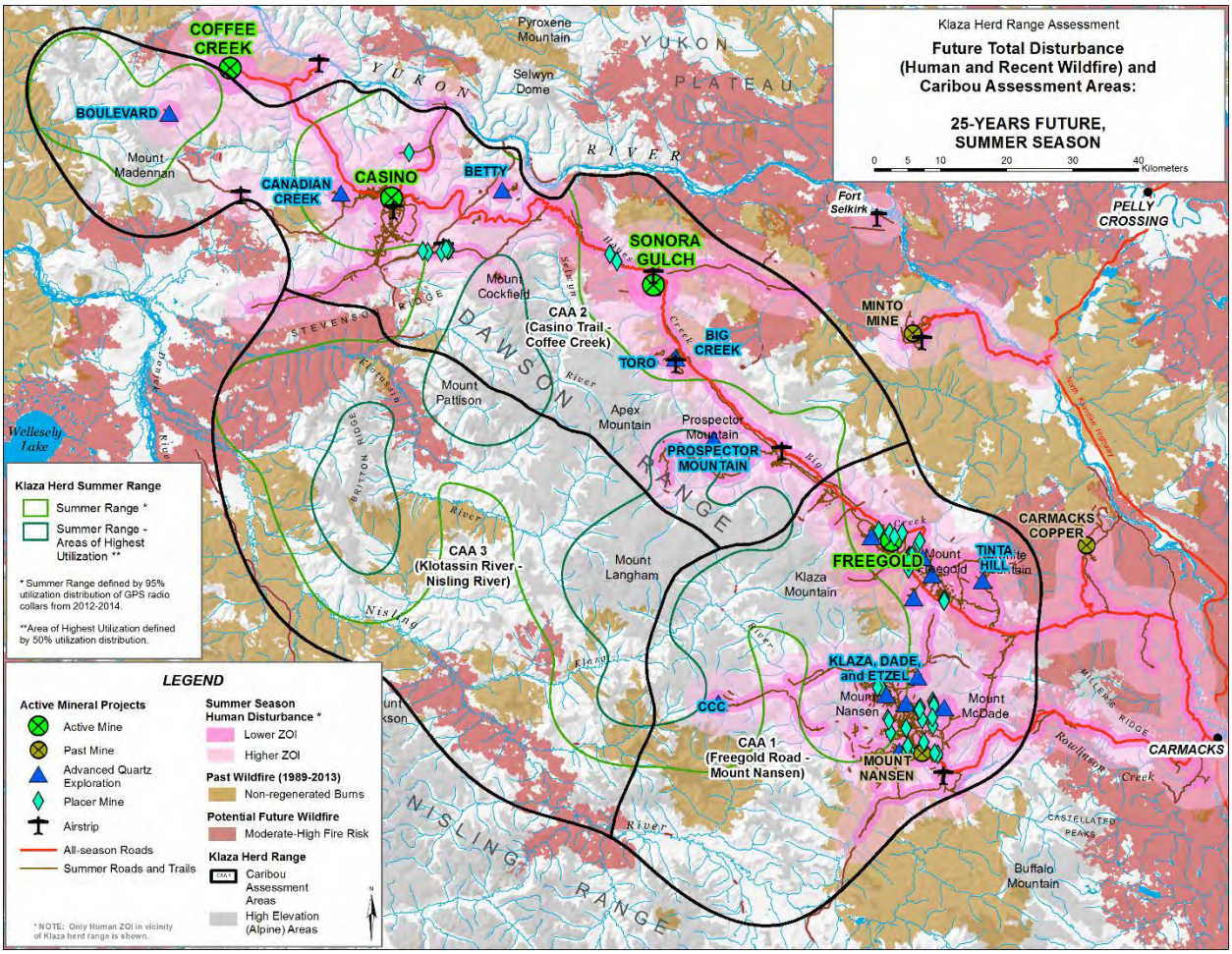

Figure 17. Potential future total disturbance (human and wildfire) in the Klaza herd annual range—summer season, 25-years future. Past fires that would remain in a non-regenerated state at the end of the 25 year scenario period are shown in tan. Areas with a moderate to high fire risk that could be expected to burn in the coming 25 years are shown in light red.

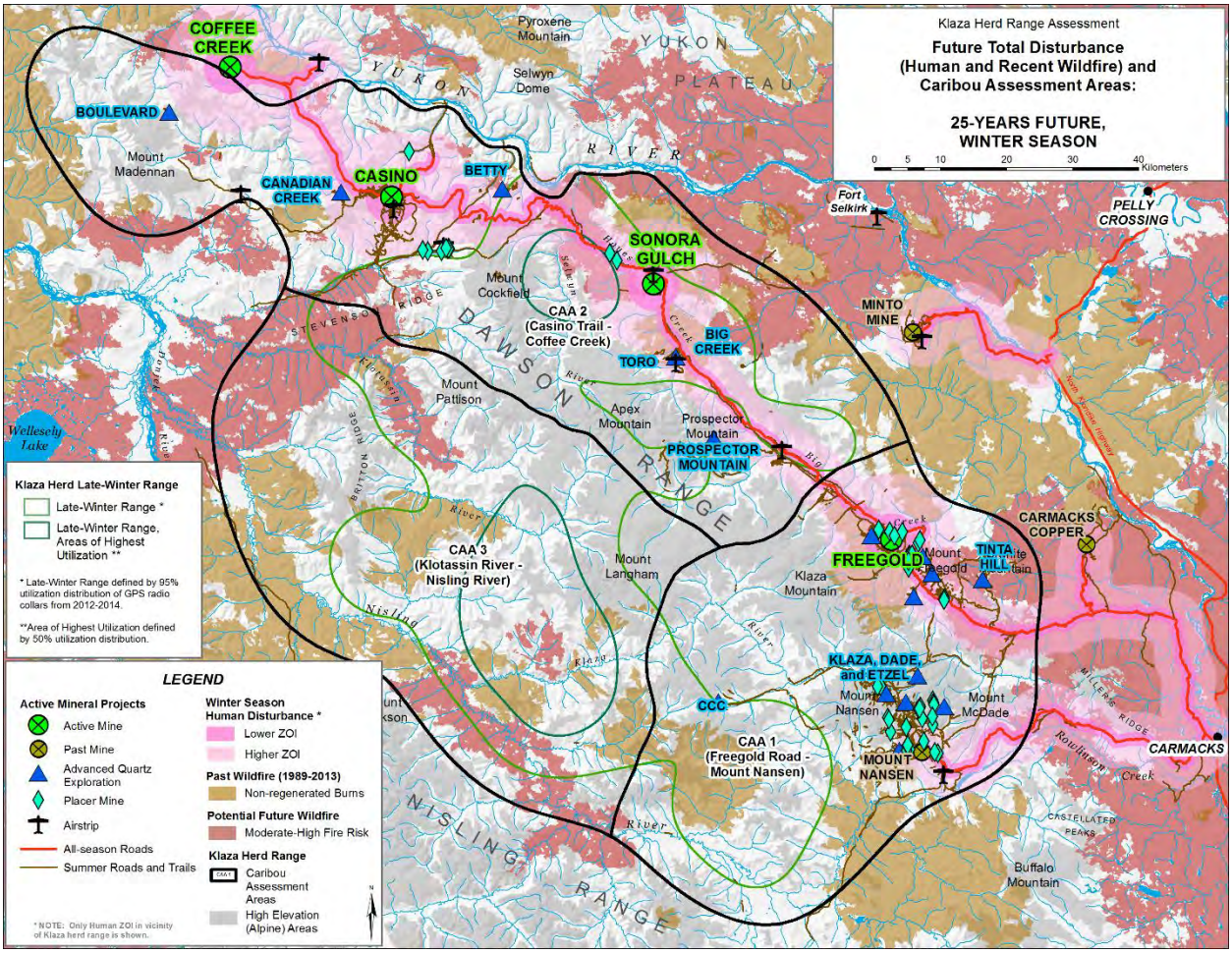

Figure 18. Potential future total disturbance (human and wildfire) in the Klaza herd annual range—winter season, 25-years future. Past fires that would remain in a non-regenerated state at the end of the 25 year scenario period are shown in tan. Areas with a moderate to high fire risk that could be expected to burn in the coming 25 years are shown in light red.

5.3.1.4 Late-Winter Habitat Effectiveness

5.3.1.4.1 Current Situation

Habitat suitability represents relative habitat quality without considering the potential influence of direct and indirect human effects. In contrast, habitat effectiveness represents the change in habitat quality resulting from the combined effects of direct and indirect human disturbance. A reduction in caribou habitat effectiveness may be caused by the avoidance or reduced use of habitats by animals, increased mortality risk in proximity to human features, or changes in vegetation quality due to dust or chemical residue.

The current late-winter (February 1 to April 30) habitat effectiveness map showing the reduction of habitat quality resulting from higher human ZOI is displayed in **Figure 19**. The late-winter habitat suitability map was shown previously in **Figure 7**. **Table 11** summarizes the percentages of late-winter

habitat classes in each caribou assessment area, accounting for potential reduction of winter season habitat quality by direct or indirect human disturbance.

Currently, CAA 1 (Freegold Road – Mount Nansen) is the only area to receive a moderate amount of human use during the winter season. The Mount Nansen Road is maintained between Carmacks and the Mount Nansen mine site, allowing vehicle travel, and providing access to adjacent areas with off-road vehicles. In CAA 2 (Casino Trail – Coffee Creek) the Casino Trail winter route receives occasional use. Given this situation, there has likely been only a relatively small reduction in late-winter habitat effectiveness over most of the range. As shown in **Figure 19**, CAA 1 has the only notable human influence. In this CAA, without potential human influences, high value late-winter habitat comprises 37% of the assessment area (see **Table 7**). When current winter human ZOI is overlaid on the habitat suitability map, the amount of high value habitat is reduced by 5 to 14% from its current level to 33 to 35% of the assessment area. As the amount of high value habitat has been reduced, the area of moderate and low value habitat has increased correspondingly, resulting in a small reduction in overall habitat effectiveness.

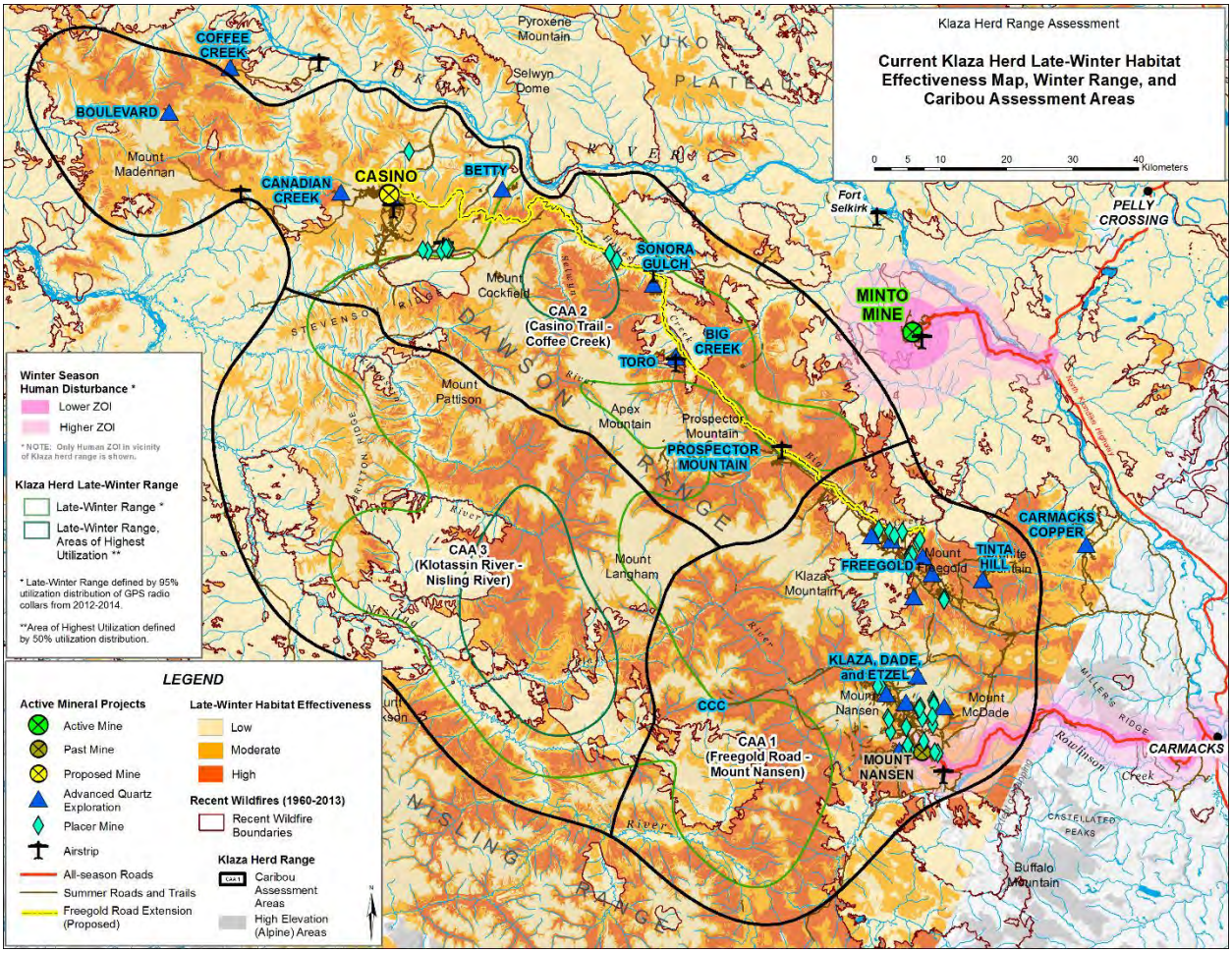

Figure 19. Current Klaza herd range late-winter habitat effectiveness map, showing low, moderate and high value habitat effectiveness classes.

Table 11. Percentages of current late-winter habitat suitability classes reported by caribou assessment area while considering potential direct and indirect human disturbance effects during the winter season.

CARIBOU ASSESSMENT AREA (CAA)		CURRENT HABITAT SUITABILITY (HS) CLASSES					
		Low Human ZOI			High Human ZOI		
		Low HS	Mod HS	High HS	Low HS	Mod HS	High HS
CAA	Area (km^2)	Area (% CAA)			Area (% CAA)		
Freegold Road – Mount Nansen	3,104	33.2	30.8	35.7	34.6	31.9	33.1
Casino Trail – Coffee Creek	4,181	48.5	31.6	19.9	48.6	31.6	19.9
Klotassin River – Nisling River	3,535	57.2	25.1	17.7	57.2	25.1	17.7
TOTAL	10,819	47.0	29.2	23.7	47.4	29.6	23.0

5.3.1.4.2 Future Situation

If the current level of all-season human land use activity increases substantially, as assumed in the Klaza future land use scenario (Appendix B), an incremental reduction of late-winter caribou habitat effectiveness is likely to result. **Figure 20** shows the potential future Klaza herd range late-winter habitat effectiveness map, overlaid with lower and higher zones of human influence that may be realized during the winter season in 25-years future. **Table 12** provides a comparison between habitat suitability classes without human influence, the current situation, and the potential situation, 25 years in the future.

Assuming the higher human ZOIs are observed, in 25 years a 12% reduction in the area of high value (high suitability) habitat may occur in CAA 1 (Freegold Road – Mount Nansen). This assessment area has already experienced a 10% reduction in the area of high value habitat due to human activity; future conditions may therefore represent a 22% reduction from before any human-caused habitat disturbance was present. In CAA 2 (Casino Trail-Freegold Road), at the end of the 25-year scenario period, the area of high value late-winter habitat may be reduced by 40% as a result of increasing all-season human activity in the winter range. If wildfire rates remain similar to the current situation, CAA 3 (Klotassin River – Nisling River) is not expected to experience a major decline in the amount of high value winter habitat, but this assumption is contingent on the area remaining relatively free of human activity.

The areas affected by wildfire between 1960 and 1990 will begin to regenerate back to potential caribou winter habitat over the next 25 years, but it should be recognized that new fires will also occur on the winter range during this period. This will likely result in a balance between recently burned and mature forest habitat, unless the rate of wildfire increases. Given this situation, in the future, increasing levels of all-season human activity are anticipated to be the primary disturbance factor resulting in reduced late-winter habitat effectiveness, with both direct and indirect habitat impacts being most pronounced in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail-Freegold Road).

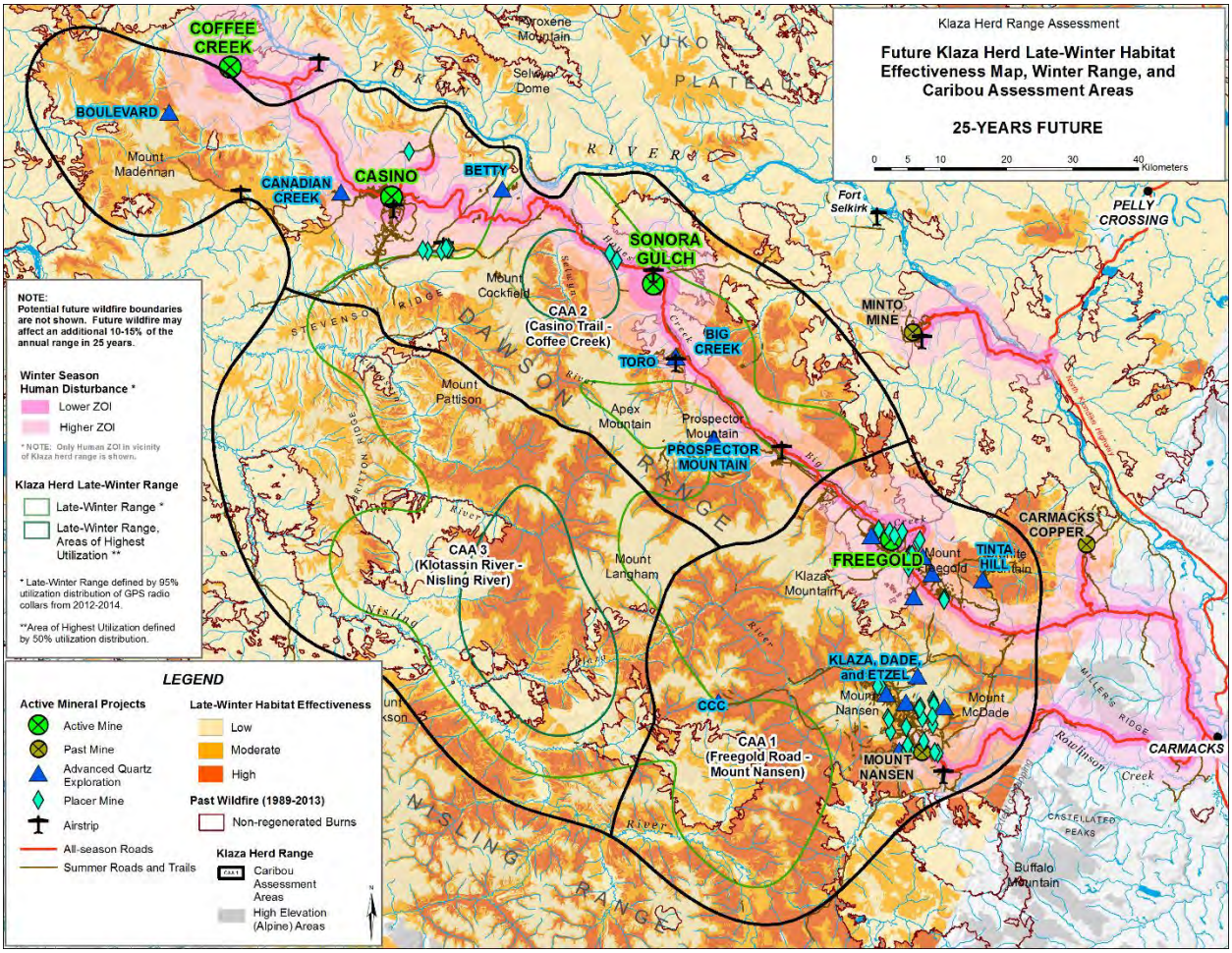

Figure 20. Potential future Klaza herd range late-winter habitat effectiveness map, showing low, moderate and high value habitat effectiveness classes, and extent of potential human disturbance at 25-years future.

Table 12. Comparison of percentages of habitat suitability classes under no human influence, current level of human winter activity, and potential future level of human winter activity at 25-years future (assuming high human ZOI), reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)		HABITAT SUITABILITY (HS) CLASSES								
		No Human Influence			Current Situation, High Human ZOI			25-Year Future Situation, High Human ZOI		
		Low HS	Mod HS	High HS	Low HS	Mod HS	High HS	Low HS	Mod HS	High HS
CAA	Area (km^2)	Area (% CAA)			Area (% CAA)			Area (% CAA)		
Freegold Road – Mount Nansen	3,104	32.7	29.8	37.2	34.6	31.9	33.1	38.5	32.0	29.2
Casino Trail – Coffee Creek	4,181	48.4	31.7	19.9	48.6	31.6	19.9	59.8	27.8	12.4
Klotassin River – Nisling River	3,535	57.2	25.1	17.7	57.2	25.1	17.7	57.2	25.1	17.7
TOTAL	10,819	46.8	29.0	24.1	47.4	29.6	23.0	52.8	28.1	19.0

5.3.2 Population Factors

Hegel (2013 and 2014) provides a detailed description of the current Klaza herd population demography and survivorship-related information based on field studies conducted during 2012 and 2013. Farnell et al. (1991) provide a historic perspective. Key factors that may affect the Klaza herd population are summarized below.

5.3.2.1 Recruitment and Survivorship

Klaza herd population recruitment and natural mortality rates appear similar to other Yukon northern mountain woodland caribou herds. Based on the results of 14 composition surveys between 1989 and 2013, the Klaza herd has an average recruitment rate of 25 calves per 100 cows (range 17 to 47 per 100 cows) (Hegel 2013) (**Figure 21**). This average recruitment rate is similar to other Yukon populations of northern mountain woodland caribou, and is considered adequate to maintain a stable population trend without additional sources of mortality.

Caribou calf survival is considered to be a key factor in determining caribou herd population size and trend. The natural annual adult mortality rate is estimated to be approximately 5 to 10% (Farnell et al. 1991; Environment Yukon unpublished data).

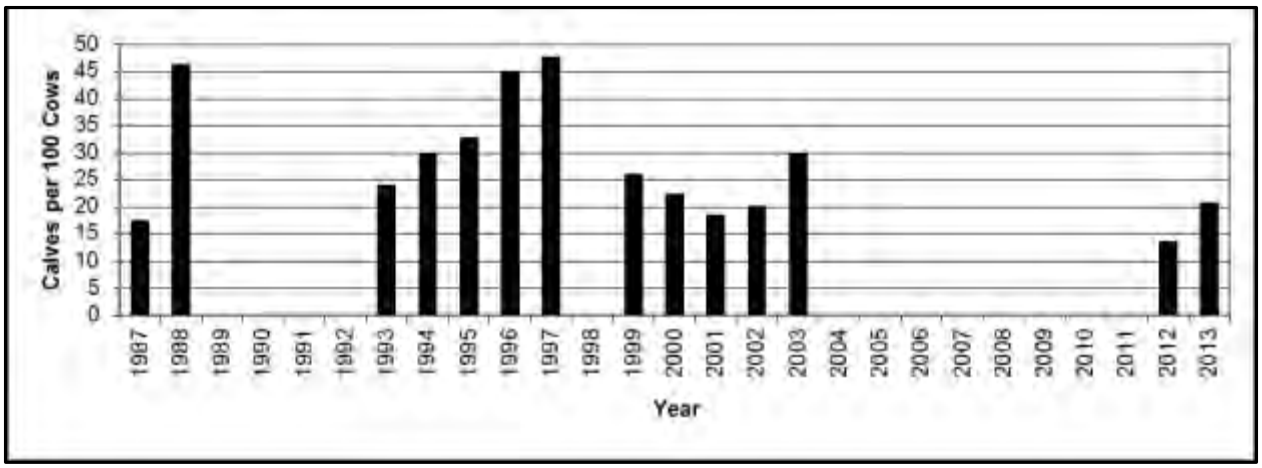

Figure 21. Calf recruitment (number of calves per 100 cows) in the Klaza caribou herd (1987 – 2013). Years with no data indicate years where composition surveys were not completed. Source: Figure 2 from Hegel (2014).

5.3.2.2 Natural Sources of Mortality

5.3.2.2.1 Predators and Other Ungulate Prey Species

The density of predators and other ungulate prey species is an important factor affecting woodland caribou populations. Large populations of other ungulate species (e.g., moose and deer) can support higher predator populations, potentially leading to increased woodland caribou mortality rates.

Predators

Wolves

Predation by wolves is considered to be the primary factor limiting growth of the Klaza herd population (Hayes et al. 2003). However, grizzly bear, black bear and wolverine can also be important predators of caribou calves in their first months of life (Gustine et al. 2006; Environment Canada 2012). While wolves are the main predator of caribou during the fall and winter (Larsen et al. 1989), moose are generally the main prey species for wolves. Caribou utilize habitats where other ungulate prey such as moose are less abundant—a strategy used to reduce predation risk. In the summer, this means using high elevation sub-alpine and alpine areas, while in winter caribou space out, across the landscape.

A limited wolf control program was conducted in the Aishihik caribou herd range (south of the Klaza herd range) from 1993 to 1997, but it likely had a limited effect on the wolf population within the Klaza herd range. Wolf density in the Dawson Range area was historically low (3.2 wolves per 1,000 km^2, Baer and Hayes 1987) but may be increasing in response to an increase in moose and caribou populations. Relatively large numbers of wolves (24 to 36 during late winter surveys) with large pack sizes (13 to 16 wolves per group) were recently observed during field work in support of the Casino Project wildlife baseline studies (EDI 2013). Based on current moose and caribou populations, Hayes et al. (2015) predict that wolf density in the Dawson Range area may have increased to a level where wolf predation could become a limiting factor to caribou population size (Thomas 1995).

Grizzly Bear and Wolverine

Grizzly bear density in the Klaza herd range is uncertain. Yukon expert opinion-based grizzly bear density estimates for the Klondike Plateau ecoregion suggest 11 bears per 1,000 km^2 (Smith and Osmond-Jones 1990). In the spring, grizzly bears utilize high elevation sub-alpine areas, where newborn caribou calves become vulnerable to predation by grizzly bears (Government of Yukon 2000). Wolverine density within the Klaza herd range is also unknown.

Other Ungulate Prey Species

Moose

Moose numbers in the Dawson Range were historically very low (40 moose per 1,000 km^2, Markel and Larsen 1988) but appear to have increased substantially to 100 to 200 moose per 1,000 km^2 (O'Donoghue et al. 2008). While much higher than in the late-1980s, the current moose density remains somewhat lower than the Yukon average of 150 to 250 moose per 1,000 km^2 (Yukon Fish and Wildlife Management Board 1996). The increasing moose population is thought to be largely responsible for the possible increase in wolf density.

Sheep

The Klaza herd summer range overlaps with Dall's sheep habitat. Low numbers (approximately 70) of Dall's sheep have been observed on most large alpine areas of the Klaza herd range, including Mount Langham, Apex Mountain, Prospector Mountain and Klaza Mountain. Hayes et al. (2015) provide a detailed analysis of the sheep population and habitat characteristics within the Dawson Range.

Wood Bison

Wood bison are present in very low numbers and only at the southern edge of the Klaza herd range; they are not a major prey species for wolves or grizzly bears.

Mule Deer

Mule deer are present in the Klaza herd range but likely only in very low numbers, and are thought to be limited to specific areas or habitats (e.g., south facing slopes along the Yukon River) (EDI 2013).

5.3.2.2.2 Disease and Parasites

Farnell et al. (1999) examined disease and parasite conditions for Yukon northern mountain woodland caribou herds from 1988 to 1997. At that time, no major incidents of disease or parasites were identified for the Klaza herd. Disease testing on caribou captured as part of the 2012 to 2014 collaring program also revealed no major disease concerns. Therefore, at this time, diseases and parasites are not considered to be a major risk factor affecting the Klaza caribou.

In the future, climate change may increase the prevalence or severity of diseases or parasites in northern ungulate populations (Kutz et al. 2005), which may contribute to declining fitness in individual caribou, potentially leading to population-level effects.

5.3.2.3 Human-caused Mortality

5.3.2.3.1 Harvest

Environment Yukon generally considers a sustainable woodland caribou harvest rate to be 2 to 3% of the total herd population. Based on the current population estimate of 1,180 caribou, a sustainable harvest rate for the Klaza herd would be 24 to 35 male caribou per year. From 1995 to 2012, licensed harvesting resulted in an average of 7 (range: 2-13) bull caribou being harvested per year (**Figure 22**). Harvest by Little Salmon/Carmacks and Selkirk First Nation hunters is recorded by the First Nations, and the current total harvest rate is well within sustainable limits.

Over the past ten years, most Yukon resident harvesting has occurred in the vicinity of the Mount Nansen Road, within Game Management Subzone (GMS) 526, and has made use of the available all-season access (**Figure 23**). Most non-resident harvesting has occurred in GMS 523 (Mount Langham-Apex Mountain), presumably as a result of guided hunters accessing remote areas with aircraft (EDI 2013). GMS 509 and GMS 510 are currently closed to harvest. As suggested by the higher resident harvest rates along the Mount Nansen road, future harvest will likely depend on the amount of new road access in the area, and the management of public access on those new roads.

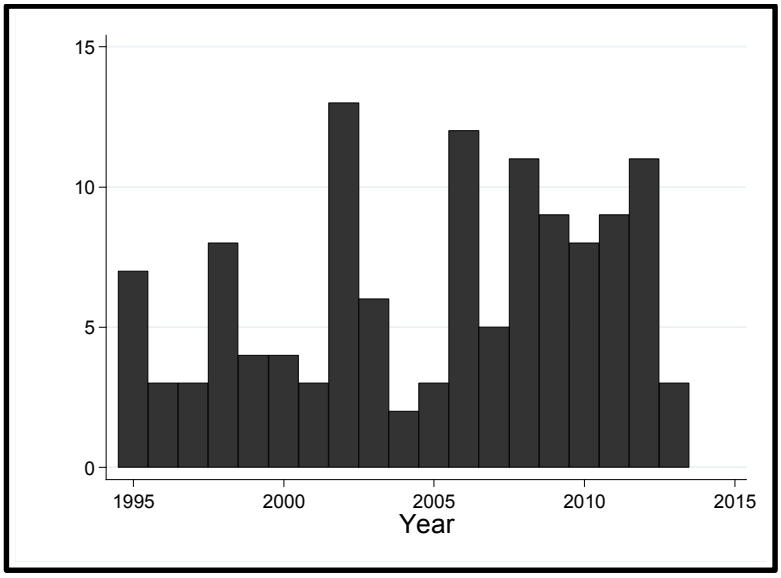

Figure 22. Annual licensed bull harvest (resident and non-resident) of the Klaza caribou herd (1995 to 2013). Source: Figure 5 from Hegel (2013).

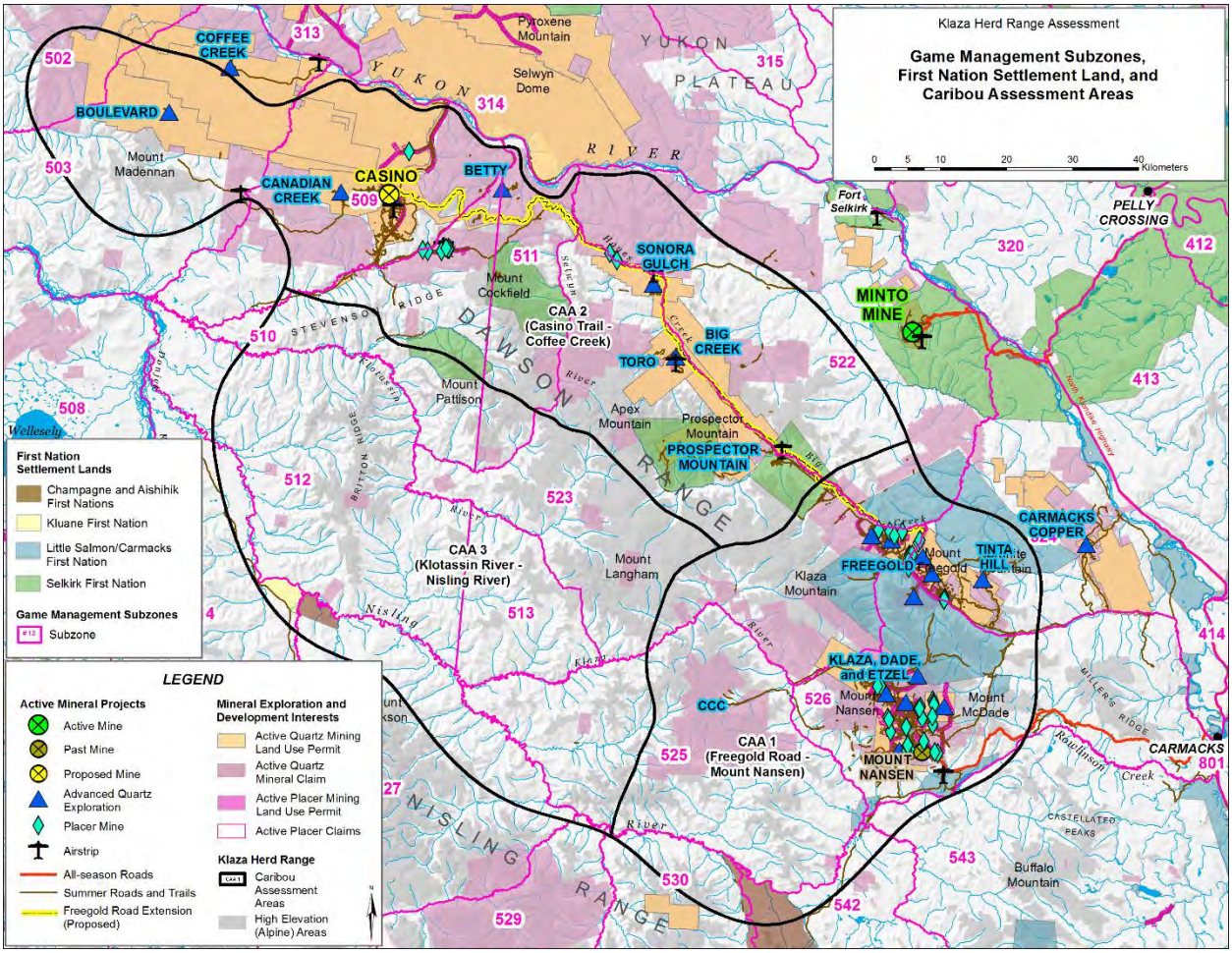

Figure 23. Game management subzones (GMS) in the Klaza herd range. Most Klaza herd caribou harvest currently occurs in GMS 526 (Mount Nansen) and GMS 523 (Mount Langham-Apex Mountain).

5.3.2.3.2 Vehicle Collisions

Vehicle collisions resulting in caribou mortalities can be an important source of mortality for some Yukon woodland caribou herds whose ranges are bisected by busy roads (e.g., Carcross and Little Rancheria caribou herds experience 5 to 10 caribou mortalities per year along the Alaska Highway). As the Klaza herd range is not currently intersected by any major roads, there have been no reported Klaza caribou mortalities resulting from vehicle collisions.

In the future, if all-season roads are developed in the Klaza range, industrial traffic volumes and speeds are anticipated to be lower than highway traffic, ideally resulting in relatively few vehicle-caused caribou mortalities. Operational best practices used on major industrial roads may further limit the risk of vehicle collisions.

5.3.2.4 Climate

In the coming decades, the average summer temperature in central Yukon is projected to increase by 1.5 to 2.5°C above current temperatures (Werner et al. 2009). Changes in precipitation are uncertain, but rain and snowfall events are expected to become more variable. Climatic change may affect caribou populations by increasing fire disturbance rates, changing habitat types and quality, and by changing snow conditions or increasing the frequency of anomalous weather events.

5.3.2.4.1 Wildfire Disturbance

The current annual average rate of wildfire disturbance within the Klaza herd annual range is 0.30% per year, with 0.55% per year being calculated for the potential winter range (see Section 5.3.1.2, above). Under a warming climate scenario, several studies predict increasing fire rates for the northern boreal forests of Canada (e.g., Weber and Flannigan 1997, Flannigan et al. 2005, Kochtubajada et al. 2006). Fire rates are generally predicted to increase 1.5 to 2 times the current rate, with central Yukon forests potentially experiencing some of the highest risk of extreme summer fire weather, with an increase in area burned and fire severity (e.g., McVoy and Burn 2007). Under such future climate scenarios, the annual area burned in the Klaza herd range is expected to increase above current levels, adding to the amount of future habitat disturbance in the winter range and reduction of high quality winter habitat.

5.3.2.4.2 Habitat Change

Changes in habitat conditions across the Klaza herd range may also result from a changing climate (temperature and precipitation). Changes may include potential shifts in forest composition (Johnstone et al. 2010), an increasing elevation of treeline (Danby and Hik 2007), and changes in vegetation structure in sub-alpine and alpine areas (i.e., increasing vegetation stature and density) (Sturm et al. 2001; Johnstone 2005; Macias-Fauria and Johnson 2013).

In the Klaza herd winter range, changes in species re-colonizing burned areas following wildfire may play an important role in the type and rate of forest change, and ultimately, the abundance of terrestrial lichens. High elevation areas in the herd's summer range may experience some of the most visible early effects of climate-induced vegetation change, as treeline advances to higher elevations and shrubby vegetation increases in stature and density. The long-term effects of potential climate-induced habitat change on Klaza caribou habitat utilization and population fitness are uncertain, however they are considered to be less of a risk than those due to increasing fire rate.

5.3.2.4.3 Snow Conditions and Anomalous Weather Events

Late-winter snow conditions can be an important factor affecting caribou distribution and individual fitness. The most heavily utilized areas of a woodland caribou winter range generally include locations with high forage quality/availability and favourable snow conditions. Snow depths greater than 74 cm are considered adverse to caribou for digging craters to access forage (Farnell et al. 1991). Access to forage can be further reduced by high snow density and hardness. Currently, snow conditions do not appear to be a major factor affecting the Klaza herd, as snow depth in the Klaza range rarely exceeds depths that are considered limiting to caribou (Farnell et al. 1991). Future snow conditions are uncertain but an increasing frequency of heavy snow falls and/or ice crusting events due to freezing rain or freeze-

thaw cycles may result in more adverse snow conditions for caribou, contributing to a decline in individual fitness and a decrease in available late-winter habitat.

Anomalous weather events may affect the distribution of caribou, as illustrated in the atypical distribution of caribou observed during the winter of 2012, where unseasonably warm winter weather and shallow snow depths resulted in caribou utilizing many alpine and sub-alpine habitats. The effect of such weather events on caribou may result in reduced individual fitness, higher rates of predation, or other effects (Hegel et al. 2010). Changing snow conditions associated with anomalous weather events may be one of the most significant weather-related climate change impacts on Klaza caribou.

5.3.3 Assessment of Risk Factors

Table 13 provides an assessment of current and potential future risk factors affecting the Klaza herd and its habitats, and the relative level of management concern regarding each factor.

Table 13. Summary of risks associated with factors affecting the Klaza caribou herd and its range. Both current and future potential risks are described.

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
HUMAN POPULATION AND ACCESS			
Resident human population in range	None.	None.	• No permanent settlements are expected in the future. • If future mine sites are developed, a large number of workers will be required and on-site camps would be created. However, staff access off camp is generally not permitted and the effects of an increasing number of mine site workers in the range are expected to be contained within the mine site ZOI. RISK ASSESSMENT: LOW CONCERN
Level of human activity in range	Currently there is a strong seasonal component to the level of human land use in the Klaza herd range: • During the summer (snow free) season, there is a high level of human activity. Placer mines, advanced quartz exploration properties, and the Freegold Road are only active in summer. • During the winter season, there is a very low level of human activity. The Casino Trail receives occasional use as a winter route, and only the Mount Nansen Road is accessible to vehicle traffic. Placer mines and advanced exploration sites are not active during with winter months.	Given the proposed Casino mine - Freegold Road extension, the number of advanced quartz exploration projects, and the generally high level of mineral exploration interest in the area, there is a high likelihood that the level of human activity in the herd range may increase substantially: • While the level of quartz mineral staking that occurred from 2009 to 2011 may not be realized again soon, the potential development of multiple mine sites and roads will mean a conversion from summer-only to all-season activities. This could greatly increase the amount of human activity during the winter season and within the winter range.	• If the Casino mine, the Freegold Road extension, and other mine development projects proceed, the future level of all-season human activity in the Klaza herd range will increase substantially. • Increases in the amount of human activity will be greatest during the winter season, and will have the largest effect on the winter range. RISK ASSESSMENT: HIGH CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Average linear density (amount of road and trail access)	**Annual Range:** 0.16 km/km^2 **CAA 1:** 0.32 km/km^2 **CAA 2:** 0.16 km/km^2 **CAA 3:** 0.01 km/km^2 • There is an existing network of seasonal roads and trails in CAA 1 and CAA 2. The highest density of linear features is concentrated around advanced exploration sites. • There are very few roads or trails in CAA 3. • Most roads and trails are currently accessible during the summer season only.	• Linear density is expected to increase in the herd range, although potentially only marginally in areas with high levels of existing mineral exploration (parts of CAA 1 and CAA 2). • If mineral exploration continues to be focused in CAA 1 and CAA 2, a very low linear density in CAA 3 is expected to be maintained.	• Given the extent of existing seasonal roads and trails in the vicinity of long-standing mineral exploration properties in CAA 1 and CAA 2, a major expansion of linear features in these areas is not anticipated. • While the number of new roads may only increase marginally in areas with existing high linear density, some new roads will likely be built off the Freegold Road into currently inaccessible areas, and others may be upgraded to all-season features, facilitating year-round access. This expansion of the road and trail network, and the change in seasonal use and associated increase in human activity during the winter season, is considered to be the largest concern associated with future linear features. • In the near term, the Freegold Road extension would be the largest change in linear features. RISK ASSESSMENT: HIGH CONCERN
LAND MANAGEMENT			
Land ownership	Most of the Klaza herd annual range is Yukon public land: • Approximately 10% (1,013 km^2) of the annual range is First Nation Category A or B Settlement Land. • The remainder of the range, 90% (9,806 km^2), is Yukon public land. • There are no other private titled land parcels.	• No changes in land ownership are expected.	• There are no major concerns regarding land ownership. RISK ASSESSMENT: LOW CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Land and resource tenure	A large portion of the Klaza herd annual range is covered by active quartz mineral tenure (mineral claims or mining land use permits): **Annual Range:** 41.1% (4,450.9 km^2) **CAA 1:** 33.3% (1,035.0 km^2) **CAA 2:** 80.1% (3,349.8 km^2) **CAA 3:** 1.9% (66.2 km^2) • Active placer claims or land use permits cover an additional 1.7% (183.5 km^2), but are localized to stream valleys in CAA 1 and CAA 2 • Two Outfitting Concessions (#11 and #13) cover most of the area	• It is unlikely that future mineral staking would affect an area greater than that experienced during the 2009-2011 mineral exploration boom. • Therefore, future mineral tenure is expected to be similar or potentially lower than current levels. • No other changes in land and resource tenure are expected.	• Once mineral tenure is established, it becomes challenging to implement landscape-level mitigation strategies for wildlife. • The large areas of quartz mineral claims and quartz mining land use permits are held by several different companies—this results in a high level of exploration activity, including air traffic, which is generally not coordinated between companies. • CAA 3 is the only part of the herd range without substantial mineral tenure. RISK ASSESSMENT: HIGH CONCERN
Land use planning	• No land use or land and resource management plans have been completed, or are currently under development, for the Klaza herd annual range.	• While processes exist to conduct land use or resource management plans within the Klaza herd range, completion of such plans in the near future appears unlikely. • There is potential for mineral resource and infrastructure planning to be completed, but this is uncertain.	• In the absence of land use planning, specific land management direction as established by resource management planning, or designated conservation areas, the long-term integrity of the range is reliant on the assessment, approval and management of land uses on a project-by-project basis. RISK ASSESSMENT: MODERATE CONCERN
Protected or conservation areas (Territorial Park, Habitat Protection Area, or similar)	• There are no designated protected or conservation areas within the herd range.	• There are no plans for the creation of conservation areas within the herd range, and the identification of such areas in the future appears unlikely.	• All areas of the Klaza herd range are potentially available for mineral exploration and development and other land uses—this situation is expected to continue in the future. • Long-term integrity of the range is therefore reliant on the assessment, approval and management of land uses on a project-by-project basis. RISK ASSESSMENT: MODERATE CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
HUMAN AND NATURAL DISTURBANCE			
Total direct human development footprint	**Annual Range:** 0.26% (27.8 km^2) **CAA 1:** 0.56% (17.4 km^2) **CAA 2:** 0.25% (10.3 km^2) **CAA 3:** 0.01 (0.2 km^2) • The total direct human development footprint is currently low, with the exception of localized, long-standing, mineral exploration properties and roads.	• The amount of direct human development footprint may increase to approximately 1-2% of the annual range, with the largest increases occurring in CAA 1 and CAA 2, areas already affected by human activities. • Large-scale, direct habitat conversion and loss due to forestry, agriculture or other land uses is unlikely.	• The direct human development footprint may increase 3 to 4 times above the current level but is anticipated to continue to be localized around existing advanced exploration sites, as well as future mine sites and roads. • Large-scale future habitat loss or conversion due to human activities is unlikely. • The indirect effects of human activity are considered to be of higher management concern than the level of direct habitat loss. RISK ASSESSMENT: LOW CONCERN
Total human development ZOI (direct footprint + indirect effects)	Given the large difference in levels of human activity between the summer and winter, the current total human ZOI also varies greatly between the summer (snow free) and winter seasons: <u>SUMMER</u> **Annual Range:** 13-32% **CAA 1:** 24-51% **CAA 2:** 15-47% **CAA 3:** 1-2% <u>WINTER</u> **Annual Range:** 1-2% **CAA 1:** 2-7% **CAA 2:** 0-1% **CAA 3:** 0%	If the Freegold Road extension and other proposed or potential mine sites proceed as anticipated, a large increase in the extent of human ZOI during the winter season is expected. Based on the assumptions of the Klaza herd range future scenario, the area affected by direct and indirect human activities may be as follows: <u>SUMMER</u> **Annual Range:** 14-35% **CAA 1:** 24-52% **CAA 2:** 17-50% **CAA 3:** 1-2% <u>WINTER</u> **Annual Range:** 5-19% **CAA 1:** 6-22% **CAA 2:** 8-32% **CAA 3:** 0%	• As a result of summer-only activities changing to all-season activities, the extent of total human ZOI during the winter season is expected to increase substantially. • The amount of area affected is expected to be greatest in CAA 1 and CAA 2, due to the Freegold Road extension and any associated mine site development along the road corridor. • Most of the increase in human direct and indirect disturbance in CAA 1 and CAA 2 will impact the winter range within these assessment areas. • If development proceeds as projected in the future land use scenario, in 25 years CAA 3 may be the only part of the Klaza herd annual range largely unaffected by human activities. RISK ASSESSMENT: HIGH CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Total area burned by recent wildfire	Between 1960 and 2013, the following areas were burned by wildfire: **Annual Range:** 19% (27% potential winter range) **CAA 1:** 19% (30% potential winter range) **CAA 2:** 14% (19% potential winter range) **CAA 3:** 26% (34% potential winter range) • Approximately 30% of the forested area (potential winter range) has burned in the past 50 years, suggesting a fire cycle of 150-200 years. This fire rate is lower than surrounding areas of the Yukon Plateau. • The Klaza herd range is situated within the Wilderness Fire Management Zone, where fires are not actively suppressed, and the fire regime is potentially unmodified (by human actions).	• The future rate of wildfire is uncertain but it will likely be similar or higher than rates experienced in the recent past (the area burned under future climate change scenarios is predicted to be 1.5 to 2 times greater than recent fire activity). • In the future, the majority of wildfires will continue to occur in the winter range, and will be additive to the effects of the increasing amount of human-caused disturbance. • Some of the areas with the highest probability of burning in the future are utilized by the Klaza herd during winter. • The same fire management zonation is likely to continue.	• Northern mountain woodland caribou have evolved with, and are adapted to, Boreal Cordillera wildfire regimes. • The Klaza herd range is in the Yukon Wildland Fire Management Zone and appears to still have a relatively unmodified wildfire regime. • In the future, 20 to 40% of the potential winter range is expected to be maintained in a recently-burned state. • Given the mountainous topography and historical burn patterns, it is unlikely that a single wildfire event would affect a significant portion of the range. RISK ASSESSMENT: LOW CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Total area disturbed (total human development ZOI + recent wildfire)	Currently, the total combined area affected by human direct and indirect disturbance and wildfire ranges from 27-61% during the summer and 14 to 26% during the winter. • There is limited human activity in most of the range during the winter season. Recently-burned areas from summer wildfires are the largest source of habitat disturbance during the winter season. • Levels of total combined disturbance for different areas of the Klaza herd range are as follows: <u>SUMMER</u> **Annual Range:** 31-47% **CAA 1:** 39-61% **CAA 2:** 27-53% **CAA 3:** 26-27% <u>WINTER</u> **Annual Range:** 20-21% **CAA 1:** 21-26% **CAA 2:** 14% **CAA 3:** 26%	The total area disturbed from the combined effects of increasing human disturbance and wildfire is expected to increase, with the greatest increase occurring within the potential winter range. • Future levels of total combined disturbance for different areas of the Klaza herd range may be as follows: <u>SUMMER</u> **Annual Range:** 33-54% **CAA 1:** 40-65% **CAA 2:** 30-60% **CAA 3:** 26-27% <u>WINTER</u> **Annual Range:** 24-38% **CAA 1:** 30-34% **CAA 2:** 20-50% **CAA 3:** 26%	• The total level of disturbance within the Klaza herd range is anticipated to increase, mainly as a result of increasing human disturbance in CAA 1 and CAA 2. • If mineral development proceeds as anticipated, construction of all-season roads and new mine sites will create new disturbance during the winter season. This will lead to a decline in winter habitat effectiveness. • The increase in combined disturbance will be greatest during the winter season and will primarily affect the utilized or potential winter range. • If wildfire rates increase above current levels, additional winter range area will be maintained in an unsuitable condition for Klaza caribou. RISK ASSESSMENT: HIGH CONCERN
Late-winter habitat effectiveness	• Given the currently low levels of human activity during the late-winter period, there has likely been only a relatively small reduction in late-winter habitat effectiveness over most of the range. • The only area with a notable reduction (12%) is CAA 1, as a result of the all-season Mount Nansen road and associated activities.	• If the level of mining development increases to that assumed by the Klaza herd range land use scenario, CAA 1 and CAA 2 may experience a 10 to 40% reduction in the amount of high quality late-winter habitats. • The largest reduction is anticipated to be in CAA 2, as a result of the Freegold Road extension and associated all-season activities. • On average, the area disturbed by future wildfire is anticipated to be similar to the current area.	• Increasing levels of all-season human activity are anticipated to be the primary disturbance factor resulting in reduced late-winter habitat effectiveness. RISK ASSESSMENT: HIGH CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
KLAZA HERD POPULATION			
Population size	• The Klaza herd population is currently estimated at 1,180 caribou (SE = +/- 129) based on results of a 2012 population survey (Hegel 2013).	• Changes to population size are uncertain but it is unlikely to increase substantially.	• The Klaza herd is currently estimated at approximately 1,180 animals and is considered stable. • The population is likely large enough to provide resilience against anticipated stressors, provided that mortality rates do not increase and that adequate habitat availability and quality is maintained. RISK ASSESSMENT: LOW CONCERN
Population trend	• Based on general observations and other information, it appears the Klaza caribou herd population has increased since the late 1980s. • The population trend is currently assumed stable, but is not able to be formally assessed due to different methods and survey areas between past studies (Farnell et al. 1991) and the most recent population survey from 2012 (Hegel 2013).	• Future population trends are uncertain but the herd is unlikely to increase substantially. • Increasing predator (wolf) and other ungulate prey (moose) populations, combined with increasing human winter season activity and declines in habitat effectiveness, may limit future population growth, or potentially cause population declines.	• While it appears the Klaza herd population has increased since the late 1980s, at this time a population trend is not able to be formally assessed due to the lack of comparable historical surveys. • Future population surveys will be required to assess population trend. RISK ASSESSMENT: LOW CONCERN
Recruitment	• On average, recruitment is 25 calves per 100 cows (range 17 to 47). This is based on the results of 14 composition surveys between 1989 and 2013 (Hegel 2013).	• Future recruitment rates are uncertain and susceptible to multiple factors; however, the long-term average is unlikely to increase.	• The current recruitment rate is considered average for Yukon populations of northern mountain woodland caribou, and is adequate to maintain a stable population trend. • If multiple consecutive years have low recruitment, a population decline will result. • Future recruitment rates will depend on many factors including caribou fitness, predation rates, climate, and range disturbance. RISK ASSESSMENT: LOW CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Harvest	• Between 1995 and 2012, an average of 7 to 8 (range 2 to 13) bull caribou were harvested annually from licensed harvesters (Hegel 2013). • Total harvest including First Nation harvest is within sustainable limits. • Game Management Subzones (GMS) 509 and 510 are currently closed to harvest. • Most Yukon resident harvesting occurs in the vicinity of the Mount Nansen Road (GMS 526), due to the ease of all-season access. • Most non-resident harvesting occurs in GMS 523, presumably as a result of guided hunters accessing remote areas with aircraft (EDI 2013).	• If all-season road access within the Klaza herd range improves, harvest levels may increase. • An increase in harvest to 20 to 30 bull caribou per year is within the 2 to 3% sustainable harvest rate for the herd (based on current population estimates).	• Environment Yukon considers a sustainable woodland caribou harvest rate to be 2 to 3% of the total population estimate. • Based on the current population estimate, a sustainable harvest rate for the Klaza herd is 24 to 35 caribou per year. • Current harvest rates are well-within the sustainable harvest rate. • If new all-season roads are built in the Klaza herd range, future harvest rates may approach the sustainable harvest rate—realized harvest effort and rates will likely depend on the amount of hunter access on any new road. RISK ASSESSMENT: MODERATE CONCERN
Other human-caused mortality	• No other sources of non-harvest, direct human-caused mortality are currently known. • There have been no recorded caribou mortalities resulting from existing road traffic in the Klaza herd range.	• If the Freegold Road extension is constructed and becomes an all-season road, the number of caribou mortalities resulting from vehicle collisions along this corridor is anticipated to be very low.	• If future all-season roads are developed, industrial traffic volumes and speeds are anticipated to be lower than highway traffic, resulting in fewer caribou mortalities due to vehicle collisions (unlike the situation with the Carcross and Rancheria herds along the Alaska Highway in Southern Yukon). RISK ASSESSMENT: LOW CONCERN
Predators and other ungulate prey density	PREDATORS **Wolves** Wolves are the main predator of caribou during the fall and winter seasons (Larsen et al. 1989). In the mid-1980s, wolf density in the Dawson Range was low (3.2 wolves per 1,000 km^2, Baer and Hayes 1987), but it may be increasing in response to increasing moose and caribou populations: • Relatively large numbers of wolves (24 to 36) with large pack sizes (13 to 16 wolves per group) were recently observed during late-winter surveys (EDI 2013). • Based on current moose and caribou population estimates, Hayes et al. (2015)	• Future predator and other ungulate prey density in the Klaza herd range is uncertain but is anticipated to be similar, or slightly higher, than current levels. • Moose population size will depend on the amount of harvesting pressure and abundance of young, seral forests resulting from wildfire activity or human-caused habitat disturbance. • Wolf populations will be closely linked with future prey density, including both moose and caribou.	• Predator (primarily wolf) and other ungulate prey species (primarily moose) population sizes appear to have increased substantially since the mid-1980s. • The increase in wolf and moose populations is thought to have resulted from the closure of moose harvesting. • Increasing moose populations have supported increasing wolf populations, which may now be approaching a density where the caribou population size could be limited by wolf predation (6.4 wolves per 1,000 km^2) (Thomas 1995). However, based on recruitment data, it is unlikely that predation has caused a negative population trend of Klaza caribou to date. • If the level of habitat disturbance increases in the future as a result of increasing human activity or an increase in

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
	predict that wolf density in the Dawson Range area may be increasing. **Grizzly Bear and Wolverine** • Grizzly bears and wolverines can be important predators of caribou calves while caribou are in the high elevation summer range. • Grizzly bear density is uncertain but across the Klondike Plateau ecoregion is estimated to be 11 bears per 1,000 km^2 (Smith and Osmond-Jones 1990). • Wolverine density is unknown. <u>OTHER UNGULATE PREY</u> **Moose** • In the mid-1980s, moose numbers in the Dawson Range were very low (40 moose per 1,000 km^2, Markel and Larsen 1988); however, they appear to have increased substantially to 100 to 200 moose per 1,000 km^2 (O'Donoghue et al. 2008). • While much higher than in the late-1980s, current moose densities remain lower than the Yukon average of 150 to 250 moose per 1,000 km^2 (Yukon Fish and Wildlife Management Board 1996). **Sheep** • The Klaza herd summer range overlaps with Dall's sheep habitat. • Low numbers of Dall's sheep have been observed in many alpine areas of the Klaza herd range, including Mount Langham, Apex Mountain, Prospector Mountain and Klaza Mountain. • Hayes et al. (2015) provide a detailed analysis of sheep population and habitat characteristics within the Dawson Range.		wildfires, greater amounts of young, seral forest and/or increased linear features may lead to increased prey abundance and/or higher rates of caribou mortality; a similar dynamic as has been observed in boreal caribou populations (Environment Canada 2011). RISK ASSESSMENT: LOW CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
	Wood Bison and Mule Deer • Wood bison are only present in very low numbers at the southern edge of the Klaza herd range and are not a major prey species of wolves or grizzly bears. • Mule deer are present in the area but only in very low numbers, with their distribution likely limited to specific areas (e.g., south facing slopes along the Yukon River) (EDI 2013).		
Sensory disturbance	There are currently large seasonal differences in the level of human activity in the Klaza herd range: • In the summer (snow free) season, there is a high level of human activity in CAA 1 and CAA 2, and a high level of sensory disturbance around active exploration sites and roads, and from aircraft-supported exploration activities. • In winter, there is a very low level of human activity, and a correspondingly low level of sensory disturbance.	• If the Casino mine and Freegold Road extension proceed as proposed, and other potential mineral development proceeds, the level of sensory disturbance in the Klaza herd range resulting from vehicle traffic, aircraft and industrial activities will increase substantially during the winter season. • Increased sensory disturbance will mainly affect the potential and/or recently utilized winter range in CAA 1 and CAA 2. • In 25-years, CAA 3 may be the only part of the Klaza herd range that remains largely free of both summer and winter human activities.	• Increasing sensory disturbance in the winter range is the major management concern associated with proposed and potential mineral development activities. • Given the potentially high levels of future human disturbance in CAA 1 and CAA 2, it is likely that Klaza caribou will avoid or abandon those areas with high levels of activity, resulting in a reduction in available habitat and declining habitat effectiveness. • As a result of sensory disturbance, new industrial roads with high levels of truck traffic may also create barriers to movement, resulting in parts of the winter range becoming inaccessible for caribou. RISK ASSESSMENT: HIGH CONCERN

Factor	Current Situation	Potential Future Situation (25-years future)	Risk Assessment
Snow conditions and anomalous weather events	SNOW CONDITIONS Snow conditions can limit access to forage based on snow depth, density, and hardness: • Winter snow depths greater than 74 cm are considered adverse to caribou for digging craters to access forage (Farnell et al. 1991). • Snow depth in the Dawson Range rarely exceeds 74 cm and the frequency of freezing rain or other icing events has been low. ANOMALOUS WEATHER EVENTS • There is a low frequency of anomalous winter and spring weather events resulting in adverse snow conditions.	• Increased climate variability is anticipated to cause a potential increase in the frequency and magnitude of anomalous weather events and adverse snow conditions. • The impact of such changes is uncertain but is generally expected to be negative, decreasing the fitness of individual animals, increasing mortality rates, and lowering calf recruitment.	• Potentially increasing climate variability represents a risk to individual caribou, and ultimately the Klaza herd population, by reducing individual fitness, survivorship, and calf recruitment. • In some areas of Yukon (e.g., Carcross herd range), caribou calf survival has been well correlated with late-winter, spring, and early-summer weather and snow conditions (Hegel et al. 2010). While this factor cannot be managed, it needs to be recognized as an additional environmental stressor on Klaza caribou that interacts with other natural and human disturbances. RISK ASSESSMENT: MODERATE CONCERN
Disease and parasites	• There is no known disease or parasite concerns associated with the Klaza herd population.	• Future conditions are uncertain, but climatic warming may increase the prevalence of disease and/or parasites, potentially lowering individual caribou fitness leading to decreased recruitment and/or increasing mortality. • A reduction in the extent and residency of late-lying snow patches may lead to higher rates and severity of insect harassment.	• In the future there may be an increasing prevalence and/or severity of disease or parasite impacts on animal fitness and population demographics. • However, at this time, disease and parasite impacts are considered a lower risk to Klaza herd than other factors. RISK ASSESSMENT: LOW CONCERN

5.4 Range Assessment Summary

5.4.1 Current Situation

The current situation of the Klaza herd and its range can be summarized as follows:

- The Klaza herd is estimated at 1,180 animals and is considered stable.
- The Klaza herd population appears to have increased over the past decades.
- Calf recruitment rates are average for northern mountain woodland caribou in Yukon and are considered adequate to sustain a stable population in the absence of increasing mortality rates.
- Since 1995, the level of licensed harvest has been well-below what is considered a sustainable harvest level.
- The Dawson Range appears to have a relatively natural wildfire regime with a range of fire ages and sizes, and the wildfire cycle (i.e., annual rate of burning) appears to be lower than the surrounding areas of the Yukon Plateau.
- Most mineral exploration interests and activities are located in the eastern (CAA 1, Freegold Road – Mount Nansen) and northern (CAA 2, Casino Trail – Coffee Creek) parts of the herd range, with the western and southern (CAA 3, Klottasin River-Nisling River) range areas currently receiving very low levels of human use.
- While there is a high level of human activity in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek), at this time most human activities occur during the summer (snow-free) season and are located in the lower elevation winter range areas, when caribou are not present.
- Given the currently seasonal nature of most human activities (summer season), a measurable reduction in late-winter habitat effectiveness does not appear to have occurred over broad areas, with the possible exception of CAA 1 (Freegold Road – Mount Nansen) in the vicinity of Mount Nansen and its all-season road.

Based on an assessment of the above factors, it appears that at this time there are relatively few immediate risks facing the herd. Mineral exploration activities that have occurred over the past decades, and the recent mineral exploration boom of 2009 to 2011, have likely had a small, long-term, negative impact on the Klaza herd population and its habitat. Our current assessment concurs with that conducted by Environment Canada as part of the "Management Plan for the Northern Mountain Population of Woodland Caribou *(Rangifer tarandus caribou)* in Canada" (Environment Canada 2012; see Appendix 5, Klaza herd) which concluded that the general risks currently facing the Klaza herd population are currently low[18]. However, while the overall Klaza herd situation appears positive, some management concerns do exist, and these serve to reinforce the potential risks that may affect the herd in the future:

[18] It is important to recognize that much of the Klaza herd information used in the Environment Canada (2012) assessment was collected or examined prior to the 2009 to 2011 White Gold and Dawson Range mineral staking rush. Therefore, the Environment Canada (2012) risk assessment for the Klaza herd does not reflect the high level of management concern associated with the mineral staking and associated exploration activities from that time, and that ultimately led to this Environment Yukon range assessment being conducted.

Areas of highest seasonal utilization

- Based on historical (Farnell et al. 1991) and recent (Hegel 2015) survey and GPS radio-collar information, some areas of the annual range appear to receive high levels of long-term, consistent, seasonal use by Klaza caribou.
- The areas of highest recent summer range use (based on 50% utilization distribution of GPS collar locations) are:
    - Mount Langham – Prospector Mountain;
    - Mount Cockfield – Mount Pattison; and
    - Britton Ridge.
- The areas of highest recent late-winter range use (based on 50% utilization distribution of GPS collar locations) are:
    - Hayes Creek – Selwyn River – Big Creek; and
    - Upper Klotassin River – Lower Klaza River.
- The areas of highest recent seasonal caribou utilization are generally situated away from the areas with the highest levels of seasonal human activity (Mount Freegold, Mount Nansen, Casino property, and the Freegold and Mount Nansen roads).
- As noted by Hegel (2015), while late-winter use of the upper Klaza River (northwest of Mount Nansen) was recorded by historical surveys (Farnell et al. 1991), this area has received only limited use by caribou in recent years. Similarly, Hayes et al. (2015) also noted that based on historical sheep surveys (Hoefs 1975), Dall's sheep have generally been absent from the Mount Nansen area for many decades, and have only occasionally been observed in other areas of high mineral activity since the 1970s. These findings suggest that high levels of long-term human activity and habitat disturbance in the Mount Nansen area, and potentially other locations, have already affected the distribution of caribou and sheep in some parts of the Dawson Range.
- If additional permanent or all-season developments occur in other parts of the Dawson Range, as is currently proposed, these areas may also be abandoned or used less frequently by Klaza caribou (and sheep).

Increasing predator and other ungulate prey populations

- Based on past surveys (Baer and Hayes 1987; Markel and Larsen 1988), wolf and moose population numbers in the in the mid-1980s were both very low.
- Recent wolf observations (EDI 2013) and modeling (Hayes et al. 2015), along with recent moose surveys (O'Donoghue et al. 2008), indicate that both wolf and moose populations have increased substantially since the 1980s.
- Increasing predation, along with other disturbance and habitat factors, may lead to a negative population trend in the future.

5.4.2 Future Situation

The future potential situation of the Klaza herd and its range can be summarized as follows:

- Given the planned and anticipated mineral development projects for the Dawson Range, it is likely that the level of all-season land use activity in the herd's range will increase substantially, as a result of all-season roads and mines.
- The major catalyst for increasing levels of all-season land use activity is anticipated to be construction of the Freegold Road extension—a situation recognized when the project was originally contemplated in the mid-1980s (Farnell et al. 1991).
- Most of the increase in human direct and indirect disturbance will affect the winter range, with the largest increases anticipated in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek); 22 to 32% of the late-winter range in these assessment areas may be affected by human ZOI.
- Areas with the highest level of all-season human activity may be abandoned, or utilized less frequently by caribou. The part of the winter range in the vicinity of Hayes Creek – Big Creek – Selwyn River in CAA 2 (Casino Trail – Coffee Creek), is an important late-winter use area for Klaza caribou, and is most at risk from proposed development. The Hayes Creek area has received long-term and consistent use by Klaza caribou during the late-winter period since at least the late-1980s.
- If the Freegold Road extension proceeds as currently proposed, and multiple mines or other road infrastructure are developed, CAA 3 (Klotassin River – Nisling River) may be the only large area of the Klaza herd annual range generally unaffected by all-season human activities.
- Much of the KIaza herd range is considered to have either a low or moderate risk of experiencing a wildfire in the coming 25 years. The area burned by wildfires under future climate conditions may increase; however given the amount of high elevation non-flammable fuel types and the pattern of historic fires, it is unlikely that a single fire event would affect a large proportion of the winter range.
- While the total amount of range disturbance resulting from the combined effects of human and wildfire activity is expected to increase, the largest increases are anticipated to result from human land use activities—with the Freegold Road extension being the major catalyst of change.
- Climatic change may result in adverse snow conditions for caribou (deeper snow and increased incidence of icing events), and an increased frequency of anomalous weather events (e.g., heavy snow fall or unseasonal temperatures), leading to changes in seasonal range utilization), and changes in habitat conditions (vegetation structure and/or composition).

The Klaza herd range future land use scenario developed for this project (Appendix B) allowed the effects of potentially higher levels of future human activity to be explored and quantified. While it is not possible to predict exactly where or when future mineral development will occur, the scenario currently being contemplated for the Dawson Range (extension of the Freegold Road, development of the Casino mine, and potentially one or two other mines along the road corridor) would result in increased human disturbance on the winter range, reduced late-winter habitat effectiveness, and fewer areas of undisturbed habitat.

Based on an assessment of risk factors that may affect the Klaza herd population and its habitat in the future, potentially large increases in the amount of all-season direct and indirect human disturbance is considered to be the greatest future management concern. The major anticipated risk facing the herd in the future is the conversion of current seasonal (summer only) quartz mineral exploration activities to all-season road infrastructure and mine sites. This situation will result in a potentially large increase in the amount of direct and indirect human disturbance and access on the winter range during the winter season—a season that currently receives a very low level of human activity.

Our future risk assessment concurs with that conducted by Environment Canada as part of the "Management Plan for the Northern Mountain Population of Woodland Caribou *(Rangifer tarandus caribou)* in Canada" (Environment Canada 2012; see Appendix 5, Klaza herd), which concluded that increasing mineral exploration and development activities represent the highest potential future risk to the herd and its habitat.

While increasing levels of human and wildfire disturbance are anticipated, it is currently not possible to directly link the level of range disturbance to Klaza herd population trends, as the assumptions and conditions for applying the boreal woodland caribou population viability model (Environment Canada 2011) to northern mountain woodland caribou may not be met (Reid et al. 2013). However, the potentially high levels of human winter range disturbance and increasing levels of human access that may be realized in 25 years, combined with other factors such as climate induced-changes to wildfire rate and intensity, snow conditions and vegetation, and increasing predator and other ungulate prey species populations, suggest that the Klaza herd is likely to face increasing risks to its long-term population viability. In the future, a negative population trend may result from the combined effects of decreasing amounts of undisturbed, high quality winter habitat, declining individual fitness and herd recruitment, and higher mortality rates.

6 MANAGEMENT RECOMMENDATIONS

This section provides management recommendations for the Klaza herd and its range. Based on results of the range assessment (Section 0, above) most recommendations are designed to address future potential human-caused disturbance within the winter range. Recommendations are structured in the form of goals, objectives and strategies[19].

6.1 Habitat-related Recommendations

The Klaza herd habitat management goal is as follows:

HABITAT GOAL:

Maintain the Klaza herd annual range in a condition that will support the current or an increasing caribou population size.

Ultimately, intact functional habitat at a landscape scale is a fundamental requirement for self-sustaining caribou herds to persist, and to be healthy and resilient to human and natural disturbances. In the past 100 years woodland caribou across Canada have declined significantly and some populations have been extirpated. Despite the general understanding that habitat conservation is critical to woodland caribou, the key issue affecting herds across the boreal forest continues to be the incremental loss of functional habitat due to human land use (see Thomas and Gray 2002, Schaefer 2003, Vors et al. 2007).

Maintaining the Klaza herd range in a condition that will support the current or an increasing caribou population size will require maintaining sufficient areas of land with limited human disturbance, minimizing the effects of human land use where it does occur, and reclaiming human-disturbed areas back to functional caribou habitat. Anticipated future human development and activity is expected to have the greatest impact on the Klaza herd winter range. Most habitat-related recommendations are therefore focused on mitigating potential impacts to the winter range, and during the winter season. The following strategies[20] are recommended to assist in meeting the Klaza herd range habitat goal.

6.1.1 Priority Winter Habitat Area

If development increases as anticipated in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek), maintaining the Klaza herd at a similar population level as current may largely depend on the future state of the late-winter range in CAA 3 (Klotassin River – Nisling River). In two or three decades, if current trends continue, CAA 3 may be the only remaining area largely unaffected by

[19] Goals are broad statements of desirable long-term condition. Objectives are specific desired conditions that contribute to achieving the goal, and are intended to address specific management concerns. Strategies are recommended approaches and actions that assist in achieving the stated objective. Specific recommendations are provided where appropriate.

[20] These recommendations are generally consistent with those originally proposed by Farnell et al. (1991) during the initial Klaza herd impact studies regarding the proposed Casino Trail in the late-1980s.

human activities. Given this situation, much of CAA 3 should be considered a priority winter habitat area, where woodland caribou habitat conservation is prioritized over other land uses. To achieve this objective, human disturbance in this area should be minimized.

Objective	Strategies
Habitat Objective 1: Maintain a large, intact part of the Klaza herd winter range in a condition relatively undisturbed by human development and activities.	**Habitat Strategy 1.1:** **The remaining intact late-winter range should be identified as a priority winter habitat area.** • In CAA 3 (Klotassin River – Nisling River), the late-winter range, as identified by the 95% utilization distribution illustrated in **Figure 6**, should be maintained in an intact condition, with no new surface access and minimal human footprint or activities. • If future land uses occur in this area, they should be seasonal, temporary and managed.

6.1.2 Late-Winter Range Habitat Management

Northern mountain woodland caribou require the ability to select different parts of their range in response to wildfires and to cope with variable snow and/or other environmental conditions. Relying on CAA 3 (Klotassin River – Nisling River) to provide for the long-term, late-winter habitat requirements of the Klaza caribou herd is a high risk strategy. Therefore, in addition to identifying the late-winter range of CAA 3 as a priority winter habitat area, maintaining adequate undisturbed, high quality late-winter habitat in CAA 1 (Freegold Road – Mount Nansen) and CAA 2 (Casino Trail – Coffee Creek), and ensuring that caribou can continue to move between these areas and other parts of the annual range, is also required for these areas to be used by Klaza caribou in the future.

Objective	Strategies
Habitat Objective 2: Maintain adequate undisturbed, high quality late-winter habitat in all areas of the Klaza herd annual range, and maintain connectivity among these areas.	**Habitat Strategy 2.1:** **Human development footprint and land use activity should be avoided or minimized in areas of high quality late-winter habitat.** • In the late-winter high and moderate habitat suitability classes as identified in **Figure 7**: ○ Direct human development footprint, including road building, should be avoided or minimized. ○ Human ZOI should be minimized by conducting activities seasonally, when caribou are not in the area, or by minimizing the level of sensory disturbance through operating practices (e.g., temporary shut-downs, noise reduction, etc.).

6.1.3 Access Road Management

6.1.3.1 Seasonal Use of Access Roads

As described in Section 0, if the Freegold Road extension is constructed (either on its own or as a part of the proposed Casino Project), it is expected to be an all-season corridor and a major source of new disturbance in CAA 2 (Casino Trail – Coffee Creek). Use of this road by haul truck traffic would result in a large increase in sensory disturbance during the winter season—a time when there is currently very little disturbance, and when Klaza caribou are on their winter range. The Hayes Creek – Selwyn River – Big Creek area is an important wintering area for Klaza herd, and the proposed road extension will pass through here. It is likely that areas adjacent to the road would be avoided or used less frequently by caribou, and it may also act as a barrier to caribou movement, limiting access to the high quality winter habitats to the north and east. If the Freegold Road extension is constructed in its currently proposed location, there will be relatively few options for minimizing disturbance effects, other than operational approaches (e.g., slow vehicle speeds, allowing caribou groups to cross the road, etc.).

To decrease the likelihood that caribou will abandon or use the winter range in CAA 2 less frequently, the level of indirect disturbance resulting from new or existing roads should be minimized.

Objective	Strategies
Habitat Objective 3: Minimize the level of indirect disturbance resulting from new or existing roads.	**Habitat Strategy 3.1:** **Access roads should only be used seasonally, when caribou are not in the area.** • If constructed, consideration should be given to making the Freegold Road extension a summer-only road (during the snow free period—May to November). Operating the road during the summer season only would greatly reduce the level of sensory disturbance on surrounding winter range areas. • If summer only operation is not possible: ○ Consideration should be given to closing the road for fixed periods of time during the winter season, to allow for undisturbed use by caribou during those periods; or ○ Temporary closures should be enacted when larger groups of caribou are in the vicinity of the road (based on monitoring or other observations). The current situation whereby most roads are only active in the summer season, when caribou are not on the winter range, is a major factor contributing to the relatively minor reduction in late-winter habitat effectiveness, despite high levels of summer activity.

6.1.3.2 Public Use of New Roads

If the Freegold Road extension is constructed, public use of this new road is likely to become a significant issue[21]. As new roads and trails are constructed branching off from the main haul road, and mineral exploration properties begin to utilize the Freegold Road extension for access, it will become increasingly difficult to manage or restrict public access on the road network. Public use of the Freegold Road extension will result in increased vehicle traffic, increased sensory disturbance to caribou, increased harvesting opportunities, and may also cause safety concerns. Given this situation, public use of any new roads in the Klaza herd range should be discouraged.

Objective	Strategies
Habitat Objective 3: Minimize the level of indirect disturbance resulting from new or existing roads.	**Habitat Strategy 3.2:** **Public use of any new access roads in the Klaza herd range should be discouraged.** • New roads, such as the proposed Freegold Road extension, or other connector roads, should be considered private roads and their use should be limited to industrial purposes. • To enforce private industrial use only, consideration should be given to gating the Freegold Road extension at its terminus with the existing public portion of the Freegold Road.

6.1.4 Habitat Reclamation

In addition to the habitat strategies listed above, habitat reclamation may also contribute to maintaining or increasing the amount and quality of Klaza herd winter habitat. Habitat reclamation assists in achieving the principle of 'no net habitat loss', and can assist in off-setting habitat loss or degradation in other areas.

However, it must be realized that it takes a significant amount of time for sites with high levels of soil disturbance to return to functional caribou habitat—potentially 50 to 70 years. For caribou, the reclamation efforts associated with land uses such as gravel pits, quarries, transportation, and mineral exploration and development, may not be realized for decades. Caribou habitat reclamation should therefore be viewed as a best management practice that is applied in all situations, as a complement to the habitat management strategies outlined above.

Habitat reclamation can be implemented where temporary land uses have been completed, or where legacy roads and trails, and use of them by people, are creating management concerns. Habitat

[21] The original Casino Project proposal proposed that the Freegold Road extension would be managed as a private industrial haul road (the existing portion of Freegold Road would remain a public road). However, this now appears unlikely.

reclamation is already part of many land use practices that require assessment and permitting. It can be implemented in different ways including:

- During the reclamation phase of mineral exploration, mineral development and their supporting transportation infrastructure;
- During forest or fuelwood harvest planning, reforestation and road decommissioning;
- Managing off-road vehicles and establishing designated trails or travel periods; and
- Reclaiming legacy roads and trails.

Objective	Strategies
Habitat Objective 4: Maintain the current amount of functional caribou habitat.	**Habitat Strategy 4.1:** **Return areas disturbed by human activities to functional caribou habitat.** • Areas disturbed by human activities should be reclaimed to functional caribou habitat. • In situations where permanent habitat loss may result (e.g., permanent roads or private land dispositions), habitat reclamation in other areas should be considered.

6.2 Population-related Recommendations

The Klaza herd population management goal is as follows:

POPULATION GOAL:

Avoid a human-caused decline in the Klaza herd population.

Maintaining the Klaza herd at or near its current population size (1,180) will require adequate levels of undisturbed high quality habitat in its seasonal ranges, sufficient recruitment to maintain a stable population, and no or limited additional mortality pressures. Caribou predation by wolves, grizzly bears or other predators is currently considered to be the largest source of direct mortality. The only known significant source of direct human-caused mortality on Klaza caribou is harvest (average of 7 licensed bull caribou per year plus First Nation harvest). In the future, maintaining similar or reduced levels of human-caused mortality may be necessary to balance increases in caribou mortality from other sources, or declining recruitment. Managing the level of harvest is an effective strategy to assist in achieving the population goal.

Objective	Strategies
Population Objective 1: Maintain future harvest rates at a sustainable level (2 to 3% of total population).	**Population Strategy 1.1:** **Continue the existing licensed harvest management strategy.** • Continue the existing permit hunt system for licensed harvest, as this contributes to reducing the potential harvest effort on the Klaza herd, and the amount of human access in the range.
	Population Strategy 1.2: **Continue to work with local First Nations and communities on harvest management plans and strategies.** • Community-based fish and wildlife management plans, or similar forums, can be used to discuss and develop harvest plans and strategies.
	Population Strategy 1.3: **Continue monitoring Klaza herd population trends and demography if conditions likely to negatively affect the population change from the current situation.** • Major changes in the level of human land use, wildfire, or other conditions should be used to determine when additional population trend and demography monitoring is required. • The indicators listed in Section 7.2, **Table 14**, should continue to be monitored as resources allow or determined necessary.

7 IMPLEMENTATION AND MONITORING

7.1 Implementation

This range assessment is intended to be a living document that will be reviewed when major changes in the level of human land use occur, or when risks to the Klaza herd increase as a result of human land use and/or natural factors.

The audience for this range assessment is project-level assessors and other land and resource managers and decision-makers. Other plans (e.g., local area plans, forest management plans, regional land use plans, etc.), specific project reviews during YESAA and non-YESAA processes, and other initiatives (e.g., land use policy development and implementation) are intended to be the main implementation mechanism for the recommendations in Sections 6 of this document. This range assessment is intended to complement and support these exercises by identifying management concerns in specific areas, and to provide recommendations that can then be considered during those exercises.

7.2 Monitoring

Ongoing or periodic monitoring of the indicators listed in **Table 14** will be required to determine if the Klaza herd habitat and population objectives, as stated in this range assessment, are being met. Many of the suggested indicators are being monitored as part of existing programs or management activities.

Table 14. Suggested indicators for ongoing monitoring in the Klaza herd range.

Indicator	Rationale	Frequency
CARIBOU HABITAT		
Direct human development footprint *	• Direct human development footprint is a consistent indicator of human-caused habitat change. • Direct human development footprint is the underlying human disturbance indicator in the Environment Canada (2011) suggested approach to assessing risk to woodland caribou population persistence. • The human development footprint mapping developed for this project can be used as the basis for future comparison.	5 years
Wildfire activity (area burned and location)	• Wildfire is a major disturbance agent within woodland caribou ranges. • The area affected by wildfire is the main natural disturbance indicator in the Environment Canada (2011) suggested approach to assessing risk to woodland caribou population persistence. • The Yukon Wildfire Management Branch wildfire history database can be used for ongoing monitoring.	Annual
CARIBOU POPULATION		
Population size/trend	• Population estimates and trend monitoring is required to determine if a population decline is occurring and if management intervention may be required.	As resources allow or as determined necessary
Calf/cow ratios	• Calf/cow ratios are a reliable predictor of recruitment and population trend. • Aerial surveys are used to determine calf/cow ratios.	As resources allow or as determined necessary
Human harvest	• Ongoing annual harvest reporting should be continued.	Annual
Predation	• Consideration should be given to gaining more information on current wolf and/or grizzly bear populations and predation rates.	As resources allow or as determined necessary
Caribou distribution	• Monitor range use to determine if avoidance effects are occurring in relation to human land use, and potentially determine improved ZOI values.	As resources allow or as determined necessary
LAND ADMINISTRATION		
Location of new mineral claims, mining land use permits, and other land dispositions	• The location of new, approved land dispositions should be tracked to understand the location and new human development footprint or activities within the winter range. • This indicator can be used as a proxy for changes in the amount and location of direct human development footprint.	Annual
Area of land with caribou conservation or protection zoning	• At this time no conservation areas or land use plans are in place. • Should this change in the future, new land use designations or management directions should be tracked.	5 years or as planning processes are completed

*Note: Annual tracking of mineral exploration-related footprint is currently challenging. Post-season mineral exploration reports submitted annually to Yukon Energy, Mines and Resources by industry could be the primary source of information for tracking annual road and trail, trenching and drill site activity. However, to be effective, improved standardization, quality and filing of such reports may be required (including submission of adequate mapping).

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APPENDIX A: Human ZOI References

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