Feasibility Study for a
Fenced Woodland Caribou Safe Zone
A Report to the OSLI Land Stewardship Working Group

Prepared by Terrain FX Inc.

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Executive Summary

This study examines the feasibility of the concept of creating a fenced caribou safe zone (the Project) on an undisclosed land parcel in northern Alberta. The fencing concept is analyzed as is the regulatory, constructability, financial and scientific aspects and risks that might be associated with the Project.

Strategically, the Project is feasible biologically in that a fenced, predator-free, managed population of caribou in suitable habitat can reasonably be expected to increase. The urgency of the status and prospects for woodland caribou has been expressed by several authorities. This gives impetus to an initiative such as the fencing Project contemplated; however, strategic feasibility is placed in doubt by four key issues:

- legal, regulatory and policy complexities and gaps;
- direct intervention such as a fence is novel, therefore untested and potentially controversial and politically risky, in that enclosed caribou could not be defined as "self-sustaining" and therefore "wild";
- the importance of considering the location context of the fenced safe zone and its potential role in caribou recovery. Without active management of surrounding areas, caribou from a successful project are unlikely to have a viable release site
- the risks inherent in the necessary consultation and public information process that would precede Project implementation.

The Project's objective of housing the entire range of a known herd within a fenced area of 600 – 2000 km^2 is not feasible; however, depending on the strategy adopted, woodland caribou in a fenced area of 600-2000 km^2 could be managed such that population density increases. It should be feasible to select a suitable area of this size range that meets a variety of key criteria; however, land use designations and competing and traditional land uses may affect feasibility negatively. Maintaining connectivity is important to population (herd) interchange and gene flow. A fence would disrupt any connectivity that exists between herds.

This study concludes that the Project is feasible in terms of caribou management. It will pose numerous but not insurmountable challenges. To ensure that caribou population performance meets the conservation objective, or for predator-prey management control, an active management program (including intervention actions) and continuous monitoring of population dynamics as well as caribou response over the time period of the Project will be required. The feasibility of the Project will hinge on predator control. Where knowledge is not available, wildlife inventory and understanding of population dynamics will be required as part of the Project.

A fenced caribou safe zone will provide numerous and unique research opportunities for woodland caribou ecology and behaviour. It can be used to guide management of the enclosed caribou and outside the enclosure. It could promote partnerships with researchers that can be used to guide the overall question of caribou survival.

Design, construction, maintenance and monitoring of a fenced area of 2000 km^2 will be technically challenging but feasible, presenting difficulties not uncommon to a project of this magnitude. In this sense, feasibility will be primarily dictated by willingness to incur high costs.

From a costs and timelines perspective, the study concludes that the Project is feasible though these aspects are difficult to discern for such a unique situation. Among the herds considered, the preliminary analysis suggests that the Richardson herd and range appears to offer the best prospects for a fencing project. Using this herd as an example, cost predictions on a fenced caribou safe zone of similar dimensions are provided. A seven-year budget estimate for implementation of a fenced caribou safe zone at $9,830,000. This project will require extensive management activities, along with the commitment to at least 10 years of funding in the order of $1 million to $1.2 million per year.

A series of recommendations concerning public consultation, public information program, educational outreach, a regulatory roadmap, an implementation organization, neighbouring disposition holders, research grants, and requirement for EIA. The process of pursuing a fenced safe zone will provide opportunities for achieving other goals, as yet unstated by OSLI, but which merit consideration; for example:

- Assist in halting the decline of the woodland caribou population
- Contribute to woodland caribou recovery
- Assist in mitigating the regional impacts of oil sands development.

In summary, the Project is feasible in that this study does not identify insurmountable barriers or “show-stoppers”, but has noted where and how implementation can move forward. The topic of an enclosed safe haven for woodland caribou is a novel, controversial and innovative concept. The regulatory process and stakeholder relationships are noted as being the critical factors in the feasibility of a fenced safety zone. It is recommended that this study be considered a preliminary first step in a broader process of implementing the Project. As a “stand-alone” study, it should not be used as a determinant to proceed with full implementation, but as a guide for additional analysis and risk assessment. If a decision is taken to proceed to the next step, the Project would be subject to widespread technical and public review. The next steps will be sensitive from several aspects, but the Project may be necessary to continue gaining knowledge on the survival of the caribou of northern Alberta.

Background

This report presents the feasibility for establishing a fenced safe zone for northern Alberta woodland caribou (*Rangifer tarandus caribou*). In the report, this fenced safe zone is referred to as the "Project".

Boreal forest caribou have been listed as Threatened in Canada since 2000, and the plight of the declining populations and loss of their habitat is widely documented. The Alberta Government has also recently released a policy statement, and recent reports have reaffirmed the need for action and have provided recommendations for woodland caribou recovery. These reports agree on one thing: habitat for woodland caribou must be protected and degraded habitat must be restored to keep the species on the landscape.

In the summer of 2011, as the Alberta government defended its on-going wolf culling program and the federal Minister of Environment was chastised for not embarking on a recovery initiative for woodland caribou, the idea of a fenced "safe zone" appeared in the Edmonton Journal.

> *"There is also talk, and it is just talk at this point, about doing something big, bold and experimental, such as building a fence around an area where it would be extremely expensive to do all that is necessary to protect caribou."* (Struzik 2011)

With that "bold experiment" in mind, the Land Stewardship Working Group, a subset of the Oil Sands Leadership Initiative, decided to prepare a feasibility study of the fenced "safe zone" concept. Terrain FX Inc. was requested to undertake the study, The first paragraph of the study's scoping document states:

> *"The Land Stewardship Working Group (LSWG) of OSLI is requesting a feasibility study for the design and implementation (i.e., construction, maintenance, and monitoring) of a fenced Woodland Caribou safe zone. The intent of the feasibility study is to identify the risks and opportunities of embarking on such a project, with the ultimate aim of assessing the overall practicability and likelihood of implementing a successful fencing program."*

Originally (June 2011) the scope of the feasibility reports was to encompass four areas of analysis. Later (July 2011), two other areas were added with the resulting scope of review to be:

1. Strategic design considerations of a fenced area,
2. Tactical design features of a fenced area,
3. Methods for erecting and maintaining a fenced area,
4. Caribou management,
5. Research opportunities,
6. Costs and timelines.

As well as addressing the subject areas listed above in Chapters 1 to 6, and summarizing the conclusions in Chapter 7, a number of recommendations are offered that would assist in achieving the ultimate aim of assessing the overall practicability and likelihood of implementing a successful fencing program.

Literature Cited

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1.0 Strategic Design Considerations

1.1 Current Caribou Planning and Management Approaches

With the possible exception of the population in the West Side Athabasca River (WSAR) range, it would seem that all the woodland caribou herds in North-eastern Alberta are declining and below minimum self-sustaining numbers. Reversing the trends is a daunting task. The decline of caribou herds in the boreal forest is attributed to loss of functional habitat, an altered caribou/moose/wolf/predator system and the resulting increased predation on caribou. The Athabasca Landscape Management Team (2009) provided a series of management options. These included a combination of habitat restoration approaches, Best Land Use Practices and aggressive mortality management (wolf control and alternate prey control). In addition, the Athabasca Landscape Team recommended a zoning approach, with the establishment of "conservation areas" (Zone 1), where caribou recovery and maintenance would be the land-use priority. Using the mean boreal caribou density of 3.3/100 km^2, and aiming at maintaining a population size of 150 animals with medium extirpation risk, the Team calculated the average caribou habitat required in each Zone 1 would be 4,500 km^2 (range 1,145 km^2 to 14,800 km^2), and concluded that larger or smaller zones would lead to lower or higher extirpation risk.

Regardless of the size of the conservation areas, the success of caribou recovery was seen as dependent on an effective wolf control program, carried out on an annual basis over several decades, to reduce wolf density to less than 33% of wolves present.

The recommendations of the Recovery Plan were largely accepted by the Alberta Government with the exception of a temporary moratorium on allocation of new resource extraction rights until a range-specific management plan was completed for caribou populations in immediate risk of extirpation (*N.B.:* none of the herds has been classified in the Status Update as "At Risk of Extirpation", and for the species to be so categorized, its status would have to be changed to "Endangered" under *The Wildlife Act*). A industrial moratorium as a management lever is currently in place in British Columbia, where the Ministry of Energy, Mines and Petroleum Resources in 2010 established "Resource Review Areas" within portions (c. 500,000 ha) of boreal caribou ranges where no new petroleum and natural gas tenures will be granted for the next five years)MEMPR 2010).

The Status Update indicates that current project-level land-use guidelines have been demonstrated to be ineffective as a sole tool in providing for long-term caribou conservation. Together with the decline of caribou herds, this suggests that new approaches are necessary, and provides impetus to initiatives such as consideration of a fencing project.

In the Athabasca region, management actions by government to date have consisted of preparation of management and recovery plans and application of operational guidelines for protection of woodland caribou habitat in site specific developments. Other than to prohibit hunting, actions have not included active intervention in caribou population management. A fenced area containing and managing caribou would be considered a hands-on intervention, directly manipulating the caribou population. In that sense, it would be new in this part of Alberta.

1.2 The Fenced Safe Zone As Management by Direct Intervention

In the ongoing debate regarding management approaches, there is hardly any mention of direct intervention to manipulate the population, and this may be the central issue surrounding the concept of a fence as a management tool. In its woodland caribou policy, the Government of Alberta (2011) has made it clear that it will lead the shared responsibility for conservation efforts; however, acceptance at a policy level of the need for a fence project may be perceived as an admission of failure of other approaches used to date. Even with the intent to use the fence project as a means to assist in restoration of the population at large, it may also be perceived as physical and visual evidence of the end of woodland caribou as a "wild" species, and a portent of the future of the northern Alberta populations. If this assessment is accurate, there will be political, public and scientific resistance to direct intervention by means of a fence and a managed area within. Gathering support or even tacit acceptance for a fence project will therefore be a major issue affecting feasibility.

1.2.1 A Vision for the Fenced Safe Zone

Fencing to enclose a caribou population would be considered "direct intervention". Woodland caribou conservation in Alberta currently focuses almost exclusively on the concept of a self-sustaining, free-ranging population for which the key management options considered are habitat restoration and mortality management, the latter primarily characterized by wolf and alternate prey control. This vision entails an open landscape. The only direct intervention technique with precedent in Alberta is that of cow/calf penning. Success of this technique for the Little Smoky herd has been termed "variable", and there are concerns about cumulative stress on individual animals (Athabasca Landscape Team 2008). That same assessment mentions "Predator / Other Prey Exclusion", entailing construction and maintenance of "a barrier to reduce predator and other prey movement into caribou habitat". This is described as a "speculative approach that has not been applied or tested", but an "opportunity for adaptive research / monitoring program to evaluate viability of these levers." These statements do not reject the idea of a fence project, which would be "a barrier" excluding (not necessarily "reducing") predators and other prey. Considering the declining status of woodland caribou and the immediate need for action described by the Alberta Caribou Committee (see below), limiting the potential opportunities arising from "a barrier" to "research and monitoring" omits the potential opportunities related to active intervention and recovery.

Without a vision for how it would be managed and to what purpose, the fenced safe zone is an empty concept. OSLI's basic concept involves enclosure of the primary range of a known herd of woodland caribou inside a barrier that keeps predators and alternate prey out. The number of individual caribou to be addressed is unspecified. Such an enclosure would allow active management and monitoring within a confined area, and reduction of caribou mortality by managing predation and alternate prey (moose and deer).

Fencing a caribou range, preventing egress of caribou, removing predators and preventing their ingress to the enclosed area is a fundamentally different vision from "self-sustaining, free-ranging" on an open landscape. The vision is one involving manipulation of conditions affecting caribou survival and recruitment. As a result, enclosed caribou are unlikely to be perceived as "wild". Within the fenced area, changes in behaviour of enclosed caribou (loss of flight response in the absence of predators, habituation and fidelity to the fenced area), plus increasing tameness, may occur. This may have

ramifications for the public image of the Project. While not expressed by OSLI's scope for the feasibility study, once thus enclosed, managed and monitored, the strategic management framework will involve a closed system. The caribou will be free-ranging only within the fenced area. The fence will fragment habitat and, for the enclosed and unenclosed caribou, may close corridors between ranges that might foster connectivity. The enclosed caribou could not be termed "self-sustaining" as the fence and associated management activities would be sustaining them.

There are many examples world-wide of major interventions involving fences to protect and augment endangered wildlife populations, or to separate large mammals from human populations. In Canadian conservation history, there are precedents for such areas enclosing endangered species (*e.g*., Elk Island National Park); however, we are unaware of any precedents involving caribou or of an example of exclusion of predators other than humans.

1.2.3 Population Intervention and Release

Adopting the management philosophy inherent in a fenced area would mean that the enclosed area would become a large refuge pen. It could logically lead to other direct intervention management techniques to improve survival and recruitment to the enclosed population, if not to the population at large. Presumably, intervention would be undertaken to halt any decline in the enclosed population. In order to best serve the objectives of the Project by maximizing probability of survivorship and recruitment to the adult population, management would have to consider veterinary issues such as disease, parasites, rehabilitation from injury and other topics. Active habitat management or forage supplementation might need to be considered. Techniques would have to be rationalized in terms of the fenced area. For example, if predators have been removed, cow-calf penning (capturing, penning, and feeding pregnant cows until 2-3 weeks post-calving) could no longer be rationalized on the basis of reduced predation risk, as predation risk in the enclosed area would be zero.

In order to move from notion to implementation, the vision will need to estimate the number of caribou that should be enclosed. There is no agreement, nor has any specific research been done, on the minimum number of animals that a herd/population of woodland caribou should be to remain self-sustaining under natural conditions. The size of a herd/population that should be enclosed is therefore a subject for analysis. At present, requisite population/herd size estimations emanate from research undertaken on open landscapes. The Alberta Landscape Team (2009), extrapolating the Alberta mean boreal caribou density of 3.3/100 km^2, calculated that a minimum population size of 150 animals, over about 4,500 km^2, "*would be desired to maintain a medium extirpation rate*", and that a smaller area would increase extirpation risk. The West Central Alberta Caribou Landscape Planning Team, in the development of the West Central Landscape Plan (West Central Alberta Caribou Landscape Planning Team, 2008), with specific regard to the Little Smoky boreal caribou herd, used a threshold of 120-150 animals ("*with at least 50 breeding females?*" page 64) for the herd to sustain itself in a caribou/moose/wolf predator system with a density of wolves of less than 6/1000 km^2. The Little Smoky range extends over about 3,000 km^2.

The recent Scientific Review for the Identification of Critical Habitat for Woodland Caribou (Environment Canada 2008), based on literature review and Population Viability Analysis, concluded that:

"*local populations of >50 but <300 caribou are less vulnerable but are still at risk of quasi-extinction, and populations greater than 300 can persist indefinitely when range conditions support average adult female and calf survival*".

It should be noted that the somewhat divergent estimates of minimum size for self-sustaining caribou herds assume range conditions with enough functional habitat to allow adequate calf and female survival (e.g., low early seral stages, low primary prey and predation). However, it is also generally agreed that even though smaller populations have a higher risk of extinction (stochasticity, isolation, etc.), they may persist for long periods when under special management.

Theoretically, by active management of both caribou, predators and other prey species within the enclosed area, the fence will provide a closed system enabling recovery of a sub-set of the boreal woodland caribou ecotype. While fencing *per se* is not mentioned in current management and recovery thinking, this vision is not ruled out by existing policy (see below). Simply fencing the caribou and monitoring their status would under-utilize the potential benefits of an enclosure. Presumably, management would be undertaken on the basis of feedback and adaptive management from monitoring. This could indicate a variety of enclosed population status scenarios, each one of which will invoke a decision: to act (and what action to take) or not? The vision would therefore be well served if it addresses questions such as the following:

- Will survival and recruitment by artificial stimulation or assistance be undertaken? At what point: from the start, or only when a decline is evident, and at what point of decline?
- Is release from the fenced area an objective? Where and under what circumstances?

1.2.4 Genetic Diversity

In terms of genetic diversity, despite the body of genetic research for woodland caribou, phenotypic differences among herds are poorly understood, and there is no evidence of local genotypic or phenotypic differences conferring adaptive advantages (Kinley 2009). This suggests that pursuing the goal of housing a population "with sufficient genetic diversity" may prove to be impractical; however, should the fencing Project be used as a breeding facility from which to restore populations, the Project will need to consider its long-term genetic implications (see Chapters 4 and 5).

1.2.5 Predator and Alternate Prey Removal

Until the present time, predator (primarily wolf) control to assist ungulate populations in western and northern Canada has consisted of shooting wolves (*i.e*., lethal control). Bears would also have to be considered. Successfully excluding predators from a fenced area may offer an opportunity to substitute lethal control with capture and release outside the fenced area, perhaps in areas where predation pressure on woodland caribou is not considered a limiting factor. In terms of alternate prey removal, large-bodied species that would have to be managed include moose, white-tailed deer, and beaver.

1.2.6 Habitat and Land Use

Decisions would have to made regarding compatible and incompatible activities. Access, hunting, resource use (*e.g*., forestry, oil and gas), etc., have been recognized as affecting caribou survival, either directly or indirectly. Ideally, the enclosed area would maximize the potential for successful outcomes if it is located in an area with habitat maximally conducive to caribou survival and recruitment.

Such habitat has been described in a variety of documents which are referred to in later chapters of this study.

In terms of the vision for the fenced area, the possible removal of predators will theoretically change the nature of impacts arising from linear features. While avoidance in terms of human use may continue, predators will no longer be using the linear features for access, thus removing the indirect impact of increased predation arising from access. If the stimulus of human presence along linear features is not associated with threat, habituation to human presence may take place. This could counteract avoidance behaviour, and rationalize a re-calculation of habitat quality which, given buffering models currently in use, could substantially increase the area classified as “good” habitat. In terms of habitat restoration, the degree to which this might be achieved will be a function of activities allowed as well as degree of direct intervention to encourage return to optimal conditions for caribou. The vision will therefore have to decide whether direct intervention in habitat restoration will be necessary and undertaken, and what kinds of land use activities will be allowed.

1.2.7 A Buffer Zone and the Future of Un-enclosed Areas

Since it would be a closed system, establishing the vision for an enclosed area has fewer constraints than that for an open range. Outside the Project’s enclosed area, without caribou-friendly management, the current spectre is one of continuing habitat degradation, predators and increasing numbers of alternate prey. These events may place ecological pressure on the enclosed area, and require stringent surveillance and maintenance of the fence. Designation of a buffer zone may assist. In this zone, management actions related to the enclosed area might be undertaken.

The concept of a buffer zone also raises the question of how the benefits of a successful enclosure Project might be disseminated. Among these, assisting the recovery of the caribou population would be paramount; however, without suitable habitat conditions, absence of predators and alternate prey, the probability of caribou surviving release would appear to be low. A buffer zone might partially mitigate this. Without ongoing land use management and restrictions on activities throughout the Lower Athabasca Region, current predictions are that the decline of woodland caribou will continue. This being so, the enclosed area’s value will be one of preserving a portion of the species that will not otherwise survive. This scenario therefore becomes a legitimate item for consideration as part of the Project’s vision.

1.2.8 Targets, Expected Outcomes and Measures of Success

While it discusses habitat targets at length, it should be noted that the Recovery Plan does not set a numeric population target, but seeks to achieve a “stable” population over a 10-year period. A fenced population would be expected to exhibit a positive population trend. A population target expressed as numbers of caribou per 1000 km^2 of fenced area should be established. The reproducing population should exhibit an appropriate age: sex structure. For free-ranging mountain caribou In British Columbia, provincially established standards include annual adult survival >88%, calves forming >15% of the late-winter population, and a positive growth rate (Kinley 2010).

In terms of density, the potential caribou population on the Athabasca Landscape is estimated to be 1,157 (range 596 to 4,594) using an average boreal caribou density of 3.3/100 km^2 (range 1.7 to 13.1)

and suitable habitat area of 35,070 km^2. The current population estimate is <900. The landscape minimum population objective of 750 represents 65% of the potential population and 80% of the current population estimate (Alberta Landscape Team 2008). Establishment of a suitable population density would therefore depend on the numbers of caribou enclosed and the amount of suitable habitat classified within the area selected for enclosure (see discussion in Chapter 2.1).

The fenced area would attempt to provide optimal habitat for caribou by setting habitat targets with management objectives of optimizing the necessary ratio of preferred habitat components by means of active management. The Recovery Plan describes a multiple regression model that documents the relationship between caribou population trend and functional habitat loss resulting from the occurrence of human infrastructure (*e.g.*, roads, trails, pipelines, geophysical exploration trails, cutblocks) and young fire-origin forest stands. This relationship can be used to evaluate current amounts, or recommend projected future amounts, of natural and anthropogenic habitat change within the fenced area in relation to goals for rate of caribou population increase. Maintenance of the desired habitat assemblage will be critically dependent on the absence (or prevention of) forest fires in the fenced area, as well as monitoring to determine that range quality is not being depleted by the enclosed caribou. It should also be noted that the above mentioned models apply to an open caribou/moose/predator system. In a fenced area where predation is managed or removed those habitat models may not apply.

Measures of success would primarily be measured in caribou population and habitat terms, and the degree to which the Project contributes to woodland caribou recovery. In terms of expectations for contribution to caribou recovery at a regional/provincial scale (*e.g.*, increased caribou recruitment amount, translocation opportunities), these will be determined by the number of caribou enclosed and the structure of the enclosed population. Success could also be measured in terms of community and stakeholder acceptance of the Project; however, this is not addressed by the present study.

1.2.9 Project Timeframe, Removal of the Fence and Project Termination

If the objectives of the Project, as well as those of the "Alberta woodland caribou recovery plan 2004/05-2013/14" (Alberta Woodland Recovery Team 2005) (hereafter referred to as "the Recovery Plan") are realized, the fence will become superfluous, and presumably would be removed. This begs the question: what is a reasonable time period during which the fence can be expected to fulfil its purpose? This question clearly implicates caribou status and quality of habitat in at least the Lower Athabasca Region (see above). In turn, this invokes the question of the life of the Project.

In relation to caribou objectives, and necessary budgeting of costs, the Project should establish a target time frame for its existence. A successful Project predicts that the fence would be dismantled at its end. Contingency planning should be used to determine an appropriate time frame in relation to what is biologically achievable. Desired outcomes may be achieved before the target time frame has passed; alternatively, events may conspire to terminate the Project early, or to prolong it.

Setting a timeframe will be subject to assessment of a variety of risks. In the absence of human activities, caribou population growth is primarily affected by predation, fire, natural succession, disease, and parasites. In addition, climate change may influence habitat composition in the fenced area, and

thus scenarios for setting the timeframe for achieving desired results. An enclosed caribou herd, free of predators, can reasonably be expected to show a positive rate of population growth, conceivably in the short term (< 5 years). This growth rate may be increased by direct intervention techniques to ensure survival and recruitment. If this occurs without changes on the outside, the scenario on the outside is one of continuing decline, leaving the enclosed caribou as an isolated, penned group that is increasing in number, but has no secure future outside the fence. This scenario influences projections of the Project's ultimate benefits and value.

Athabasca Landscape Team (2009) projects a 30-50 year lag time following reclamation before forest becomes old enough to be considered low quality for other prey, and suitably old to be used by caribou, and, at minimum, mortality management will need to be continued for this entire lag period. In "Zone 1" areas (see below), wolves and other prey would have to be controlled for 50+ years. These estimations give perspective on the time frame for the fence Project. If the fence is removed before the conditions on the outside meet those identified by Athabasca Landscape Team (2009), enclosed caribou are unlikely to survive. This also provides necessary perspective on the recurring costs and expenditure period for the Project.

1.3 Candidate Herds

1.3.1 Locations and Population Status

Although representing only a portion of the analysis, the selection of a specific herd or herds will be a key issue affecting the feasibility of the fencing Project. As a result, the rationale in determining which herds are most suited merits description. If the Project reaches the implementation stage, one would have to confirm that whatever area is selected has the adequate vegetation and minimal human activity to ensure habitat suitability. In the present Chapter, the over-arching issues of location as they affect strategy. Further details on the tactical approach to this topic are provided in Chapter 2.2.

Feasibility of a fenced safe zone will be partially dependent on its location. OSLI's stated preference is to attempt to house the primary range of a known Woodland Caribou herd. Criteria for determining whether a fenced safe zone should be considered therefore include appropriate location and population status of herds. The approach to proposing candidate herds presented here entails the following assumptions: [1]

- The fenced area would occupy an area where one or more woodland caribou herds are known to range that overlaps or is at least partially coincident with the oil sands lease holdings of OSLI members; It will be important to the implementation of the Project to approach other mineral lease operators or development proponents (see Recommendations in Chapter 7).
- Herds of woodland caribou that might be considered are among those listed in the Recovery Plan. Most recent information related to status is contained in Alberta Sustainable Resource Development and Alberta Conservation Association (2010), hereafter referred to as "the Status Update".

[1] As stated in the Recovery Plan, "a caribou herd refers to the animals that are habitually found within a given area, defined here as a caribou range. In Alberta, individual caribou within a given herd generally have no, or infrequent, interaction with caribou in other herds".

North-eastern Alberta supports a widely dispersed, non-migratory caribou population consisting of about 900 animals, patchily distributed over 4 distinct ranges: (1) Richardson, (2)West Side Athabasca River (WSAR), (3) East Side Athabasca River (ESAR) and (4) Cold Lake Air Weapons Range – Alberta (CLAWR) (Athabasca Landscape team 2009; ASRD and ACA 2010)[,,] The size of the ranges varies from approximately 5,000 km^2 for the CLAWR and Richardson, to 15000 km^2 for the WSAR.

Based on field studies conducted since the early 1990s, the caribou inhabiting the 4 ranges are believed to be quite distinct, with limited movements between them (ASRD and ACA 2010). However, within each range, one and sometimes several, distinct herds can be found. All herds are thought to be declining with recent trends indicating "*that there is a high risk that the population will not persist for more than 40 years*" (Athabasca Landscape Team 2009)

With the above in mind, candidate herds considered would be the following:

- Richardson
- West Side Athabasca River
- East Side Athabasca River
- Cold Lake Air Weapons Range

The following information is available on the status of the herds under consideration. Finite rate of population growth (lambda - λ) values of 1.000 indicate population stability, values less than 1.000 indicate population decline, and values greater than 1.000 indicate population growth.

Table 1. Herd Sizes, Growth Rates and Status

Herd	Estimated Population Size [1]	Herd Annual Population Growth Rate 2008-09 (λ) [1]	Number of Years Monitored For Population Trend [1]	Population Status [2]
Richardson	Unknown	No information	Not monitored	Unknown
West Side Athabasca River	300-400	0.78	16	Stable
East Side Athabasca River	150-250	0.84	15	In Decline
Cold Lake (includes SK portion)	100-150	0.81	10	In Decline

Sources: [1] Status Update [2] Recovery Plan

The Recovery Plan is now six years old. The above table indicates that two of the herds are categorized by the Recovery Plan as in a state of population decline, while one is stable. Since the Recovery Plan was published, without categorizing the herds the Status Update has provided growth rates that would now place all three in the "In Decline" category. In the Status Update, the Richardson herd remains with no information available. There is limited movement of caribou between the four ranges or populations; the caribou populations are discrete and largely non-interacting (Alberta Caribou Committee, undated).

Athabasca Landscape Team (2009) has produced a series of risk criteria relating to population status, including population growth rate, potential population size, and current population estimate. In summary, the order of least to greatest risk is as follows: West Side Athabasca River (all "moderate"

risk), East Side Athabasca River (mostly “high” risk, with one “moderate” exception; Richardson and Cold Lake (all “high” risk for the criteria for which there is information).

Recent trends for these herds indicate “that there is a high risk that the population will not persist for more than 40 years” (Athabasca Landscape Team, 2009); however, none of these herds are categorized as in “Immediate Risk of Extirpation” by the Recovery Plan. If they were to be so categorized, the Recovery Plan prescribes “A moratorium on further mineral and timber resource allocation (sales) should be put in place until a range plan is completed, evaluated, and implemented; and, to avoid herd extirpation, predator management and possibly management of other prey species will be required to improve caribou herd trend and affect a caribou population increase

These data, added to the opinion of the Athabasca Landscape Team (2009), provide compelling impetus for considering, if not implementing, actions as if the herds were in “Immediate Risk of Extirpation”. Among these actions, while providing a safe haven is not specifically mentioned, predator management is. Actions required by the Recovery Plan with respect to populations categorized as “*In Decline*” or “*Stable*” do not contemplate enclosures or barriers.

Given the overall decline of woodland caribou numbers, population “status” as a criterion for feasibility may be less important than other criteria, in that the structure of the fenced population may be more critical to success than the population trend. Further, if habitat is intact and predators are removed, it is reasonable to expect a positive population response inside the fence, regardless of population status outside. In terms of population thresholds, none have been identified as such to date; however, for the Athabasca Landscape, the Athabasca Landscape Team (2008) has proposed a minimum population objective of 750, and that a herd with a population growth rate (lambda) consistently <1.00 indicates that it “will not survive without intervention”. These could be used to gauge the potential and actual contribution of a fence project.

1.3.2 Status of Habitat and Use of Thresholds

The Athabasca Landscape Team (2009) has produced a series of habitat risk criteria relating to linear corridor density, young forest in caribou habitat area, young forest in range or planning area, energy sector trajectory, forest harvest trajectory (hardwood), and forest harvest trajectory (softwood). These are used to describe relative habitat “intactness”, a tool for defining “Zone 1 areas” where caribou conservation would become a land use priority. Of the six candidate Zone 1 Areas identified by the ALT, the WSAR and Richardson planning area candidates were considered to have the greatest potential to minimize long-term risk to caribou.

Landscape thresholds are now in current use as criteria for assisting decisions related to wildlife conservation, cumulative effects assessment and management. They have the potential to assist in determining where a fenced safe zone for woodland caribou might be best located. Habitat effectiveness (HE) is frequently used as a threshold measure. As far as research shows, the HE of the ranges occupied by these herds has not yet been calculated. For linear corridor density thresholds, the Athabasca Landscape Team (2008) cites Antoniuk’s (2006) figures of High (<1.2 km/km^2) and Low (<0.6 km/km^2). Other HE thresholds for which there is information relate to a seismic line density of 1.0 – 1.3 km/km^2 (Dyer et al. 2002) and a linear corridor density of >1.8 km/km^2 (Anderson et al. 2002).

Weclaw and Hudson (2004) modeled conditions of woodland caribou habitat, addressing natural factors (fire, snow depth, lichen quality), habitat loss, habitat effectiveness loss, moose abundance, and wolf and black bear predation. They propose management thresholds for linear corridors as follows:

- 1.65 km/km^2 total corridors with no wolves
- 0.3 km/km^2 total corridors with wolves
- 0.8 km/km^2 total corridors with wolf control
- 1.2 km/km^2 total corridors with moose control.

A wolf density of >6.5/1000 km^2 has been used by the Athabasca Landscape Team (2008) as a density predicted to lead to caribou population declines.

Forest fire areas less than 50 years old are also a habitat threshold measure used by the Alberta Boreal Caribou Committee.

1.4 Government Policy and Regulatory Considerations

A full review of the regulatory considerations potentially affecting feasibility is beyond the scope of this study. A regulatory "roadmap" should be undertaken as there is no doubt that the implications of the regulatory process and context will significantly affect the Project's feasibility. The following provides an outline of the salient aspects that relate primarily to woodland caribou.

1.4.1 Provincial Wildlife Act

Under *The Wildlife Act*, the Woodland Caribou is designated as "Threatened" ("a species likely to become endangered if limiting factors are not reversed"). It is our understanding that a listing under the *The Wildlife Act*, however, creates no legal obligations in relation to measures commonly associated with protecting endangered species, such as recovery strategies and critical habitat identification and protection. There is no legal requirement for the preparation or implementation of a recovery plan under *The Wildlife Act.* Pending legal review, the presence of the Alberta Recovery Plan for Woodland Caribou therefore neither appears to convey any legal basis for using it as a springboard for proposing a fence project, nor, in this sense, contributes to feasibility assessment. Recovery plans are a requirement of the federal Species At Risk Act (see below) to which Alberta is ultimately subject as a result of the national *Accord for the Protection of Species At Risk*. In the absence of enabling Alberta legislation, feasibility of the Project might be considered either (i) diminished or (ii) enhanced, since it is not explicitly prohibited.

Direct population manipulation of a species listed under *The Wildlife Act* as threatened or endangered has been undertaken to increase recruitment and facilitate restoration. Among examples are Peregrine Falcon, Swift Fox, and Northern Leopard Frog. This indicates a policy willingness to consider a project like the fence; however, we are not aware of any intervention to date that encloses all or part of the Alberta range of a threatened or endangered species.

1.4.2 Provincial Recovery Plan

The Project would be best conceptualized as an exercise complementary to the Recovery Plan. The Recovery Plan:

"*is based on the assumption that all land users on caribou range, including all affected branches of government, share responsibility for and are committed to the goal of caribou recovery. Commitment and action by all of these parties will be critical to achieve caribou recovery*" (p. 10).

The Recovery Plan does not mention enclosure as a means of assisting recovery. Under the Short-term Objectives for achieving self-sustaining woodland caribou herds and maintaining the distribution of caribou in Alberta, the Recovery Plan includes (p. 12) determination of the feasibility of restoring self-sustaining woodland caribou herds to former range areas. To accomplish this, "*the recovery team intends this review to consider a full range of restoration techniques and options*." This would appear to encourage consideration of approaches such as fencing.

1.4.3 Alberta Woodland Caribou Policy

Government of Alberta (2011) provides the policy. In terms of an OSLI-led enclosure Project, the policy's wording does not exclude this option, but also does not refer to direct intervention of this type. The following extracts might apply to some components of the fence concept:

> *"Caribou conservation is a shared government, public and private sector responsibility, led by government. A comprehensive, integrated partnership approach is needed to commit financial and other resources, in a manner which maximizes their effectiveness…. Immediate action is required to ensure the long-term presence of naturally thriving woodland caribou populations…. Effective management of wildlife populations (e.g., predators and other prey species) will be required….. Conservation tools to be considered include, but are not limited to; legislated and non-legislated designated areas, deferrals of development activities, conservation offsets, caribou habitat restoration, and predator and prey management."*

1.4.4 The Land Use Framework and the Lower Athabasca Regional Plan

The Land-use Framework calls for the development of seven regional land-use plans. The first of these is the Lower Athabasca Regional Plan (LARP), which states:

> *"Special management areas may be created that will place emphasis on enhanced management plans/programs to guide management decisions on disturbance, predator control and access management to protect caribou or for tourism and recreational value" (Lower Athabasca Regional Advisory Council 2010).*

Among seven specific regional outcomes for the Lower Athabasca Region, the Strategic Plan for the Lower Athabasca Integrated Regional Plan identifies management of air, water and biodiversity through management frameworks that take proactive approaches and set limits and triggers, and minimize land disturbance in the region; and designate new conservation areas that are large, interconnected and maintain intact habitats to support biodiversity. In April 2011, "conservation areas" were proposed under the Proposed Lower Athabasca Integrated Regional Plan Regulations. Draft regulations allow for rescission of Oil Sands Agreements within the "conservation areas". At the time of writing, it is unclear what land uses will be permitted in a "conservation area", if any.

1.4.5 The Alberta Caribou Committee

In advice to the Deputy Minister of Sustainable Resource Development, the Alberta Caribou Committee (undated) stated that:

> "*the time for management action to conserve caribou in the Athabasca Landscape is NOW. A suite of management options will need to simultaneously focus on reducing predation risk and restoring functional caribou habitat. None of the individual approaches examined by the Athabasca Landscape Team is capable of achieving caribou sustainability as a stand-alone mechanism."*

Since this issuance of this advice, the Alberta Caribou Committee (ACC) seems to have effectively ceased to exist. The demise of the ACC removes a window of policy advice through which a fence project might have been introduced. The resulting vacuum may increase risks to a fence project, particularly in terms of the lack of obvious body to which it could be referred for technical and scientific review. It received landscape-specific caribou conservation and recovery recommendations from the Athabasca Landscape Team. Some of the Athabasca Landscape Team's findings have been conveyed to the planning process for the Lower Athabasca Regional Plan. Athabasca Landscape Team (2009, p.45) states that "Caribou will not persist for more than two to four decades without immediate and aggressive management intervention."

The wording of the ACC's advice suggests that a proposal to fence and enclose a caribou herd could be viewed as meriting serious consideration. This should be tempered by the comment in Athabasca Landscape Team (2009) that "A speculative alternative discussed by the Athabasca Landscape Team was constructing and maintaining a barrier to impede deer and predator movement into the areas where densities are currently low"; however, while deemed "speculative", the concept of "a barrier" is not dismissed. One benefit of isolating caribou from alternate prey may lie in mitigating the risk of meningeal worm infection in white-tailed deer populations spreading to caribou (Bergerud and Mercer 1989). The worm has not yet been detected in Alberta, but northwards expansion of white-tailed deer range in Alberta gives cause for concern (Latham et al. 2011). A proposal to fence and enclose a caribou herd would probably be viewed as an "aggressive" intervention, and a stand-alone mechanism in need of integration with other recovery efforts. Feasibility of the Project will be improved if viewed in this light.

"When" to consider action therefore does not appear to be at issue. The issue appears to be "whether" to consider direct intervention, and if so, whether the "what" should include a fence project. Beyond this, some criteria to justify the "where", "how" and "who" of initiating a fencing project are described below.

1.4.6 ERCB Information Letters and SRD Caribou Protection Plans

Under the aegis of the Oil and Gas Conservation Act and the Oil Sands Conservation Act, the ERCB has issued and administers a variety of regulations and operating guidelines for industrial activity in caribou range. In 1994 the ERCB issued Informational Letter IL94-22 which stated the need for operational protection planning for energy developments in caribou areas. These do not address or contemplate fencing or enclosure, and as such do not provide regulatory guidance. The Caribou Protection Plans are now administered by SRD.

SRD's Caribou Protection Plans are required annually for a number of petroleum activities in caribou range. Petroleum operators in caribou ranges may choose to submit their plans with some mention of their participation in the fenced caribou safety zone.

1.4.7 Other Pertinent Alberta Regulation

Preliminary research indicates that initiation of the Project may require a Licence of Occupation (LOC) or reservation/notation similar to the Mineral Surface Lease (MSL) under the Public Lands Act, and may have to recognize existing surface dispositions. It would have to ensure compatibility with sub-surface dispositions and leases administered by Alberta Energy. A fenced area might be defined as a reserve or protected area. Under the Public Lands Act, the Minister of Sustainable Resource Development may designate lands for ecological reserves and protection. Under various pieces of legislation, fences will have been viewed primarily as related to livestock and land use (e.g., grazing leases), and thus an agricultural activity. It is noteworthy that recent amendments to the description of Ecological Reserves (Queens Printer 2011) allow for the establishment of a protected area:

> *"Subject to section 4.2, the Lieutenant Governor in Council, in order to preserve public land for ecological purposes, may designate as an ecological reserve any area of public land that, in the opinion of the Lieutenant Governor in Council,*
>
> *(a) is suitable for scientific research associated with the studies of natural ecosystems,*
> *(b) is a representative example of a natural ecosystem in Alberta,*
> *(c) serves as an example of an ecosystem that has been modified by humans and that offers an opportunity to study the recovery of the ecosystem from that modification,*
> *(d) contains rare or endangered native plants or animals that should be preserved, or*
> *(e) contains unique or rare examples of natural biological or physical features"*

Depending on how the Project is viewed by regulatory agencies and the public, the regulatory approval process might require an environmental assessment. This would be a discretionary decision of Alberta Environment under the Environmental Protection and Enhancement Act (a fence or structure of this kind is unique and thus not mentioned in the Mandatory or Exempt categories of the pertinent regulation), In an EIA, since a fence will have landscape-level influence on a number of wildlife species (benefits of the fence in offering a safe haven for caribou may be offset by its contributions to habitat fragmentation for other species) and other land users, the cumulative effects of the fence Project would have to be assessed. Given the risks inherent in a requirement for EIA, particularly those of time delay and cost, it is recommended that OSLI disclose to the Alberta Environment to determine whether an EIA would be required..This action would likely be part of the next phase of activity if the Project progresses, and will certainly be part of the regulatory roadmap (see Recommendations).

1.4.8 Federal Policy and Regulatory Context

Under the Species At Risk Act (SARA), the status of the boreal population of Woodland Caribou ranging through north-eastern Alberta is Schedule 1 "Threatened". In its sections 32 and 33, the wording of SARA may have implications for the fence Projects, as it makes it an offence to

- kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened

- possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened, or its part or derivative.

In terms of federal environmental assessment requirements, the presence of a listed wildlife species, a residence of individuals of the species or a critical habitat does not, in itself, trigger the Canadian Environmental Assessment Act (Environment Canada and Parks Canada 2010). In the absence of a Responsible Authority as defined in the Canadian Environmental Assessment Act (other CEAAct "triggers" may not exist as well), an EA under federal legislation appears unlikely to be required.

For a species listed as "Threatened" under SARA, a Recovery Strategy and Action Plan are mandatory. Under SARA, critical habitat is defined as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species", and destruction of it is prohibited on federal lands. "Critical habitat" must be identified by the time a Recovery Strategy or an Action Plan is developed (see Table 2).

The long-term recovery goal of the proposed Recovery Strategy (Environment Canada 2011) is to achieve self-sustaining local populations throughout their distribution in Canada to the extent possible. Its population and distribution objectives are framed "around the first 50 years of implementation that will assist in achieving the long-term recovery goal, whose ultimate attainment will likely take much longer". The Recovery Strategy does not address specific action items to support it, and makes no mention of direct intervention of the kind represented by a fencing project, saying "The suite of potential recovery actions will be governed by local opportunities and constraints, and the level of urgency for a given recovery action will be determined by local population and habitat conditions." In some areas, Environment Canada (2011) supports "specific management of other wildlife species (i.e., predators and/or alternate prey)" to stop population declines, and emphasizes the importance of maintaining connectivity within and between habitat patches and ranges.

A "self-sustaining" local population is defined in Environment Canada (2011) as one that on average demonstrates stable or positive population growth (more births than deaths; $\lambda \geq 1.0$) over 20 years, and is large enough to withstand random events (e.g., severe weather) and human-caused pressures, and persist over 50 years, without the need for management intervention (e.g., predator management or transplants from other populations). It identifies 65% undisturbed habitat in a range as the threshold which provides a measurable probability (60%) for a local population to be self-sustaining. "Undisturbed habitat" is defined as an area in a local population range that "does not include fire disturbance within the last forty years, anthropogenic disturbance plus the 500m buffer around anthropogenic disturbance" [*sic*].

The four herds considered in the present feasibility study (East Side Athabasca River, West Side Athabasca River, Cold Lake, Richardson) are all mentioned in Environment Canada (2011). The "range type" of all four is classified as "Local Population" (high certainty of range boundaries). All four are also considered "non-self-sustaining" populations with one variation: the Richardson herd is termed "non-self-sustaining that represents ecological conditions and maintains connectivity". **"**Critical habitat", arguably the most important aspect of the Species At Risk Act, is described in Environment Canada (2011) and summarized in Table 2 for the four herds under consideration.

Table 2. Critical Habitat of Caribou Herds as Described in the Proposed Federal Recovery Strategy

Herd	Critical Habitat Definitions			Definitions of Critical Habitat Destruction
	Location	Type	Amount (quantity of critical habitat)	
Richardson	Range of the local population	Biophysical attributes of the Location	The existing undisturbed habitat which must increase over time (i.e., over 50 years) to provide 65% of the total range area as undisturbed habitat [to be amended over time]	Any activity which results in habitat alterations that cause the undisturbed habitat to fall below the existing level of disturbance or prevents a gradual progress over time toward the 65% undisturbed habitat threshold within the total range area
West Side Athabasca River	Range of the local population	Biophysical attributes of the Location	Where the amount of undisturbed habitat: • 65% or more, the amount of critical habitat is 65% undisturbed habitat within the range of the Boreal population; • more than 5% and less than 65%, the amount of critical habitat required initially is the undisturbed habitat. This may be decreased in an amendment to the recovery strategy should jurisdictions provide a plan that will support stabilised local populations through the use of mortality and habitat management tools; and • 5% or less, the amount of critical habitat is all existing habitat. Jurisdictions must continue to use mortality and habitat management tools to ensure these populations remain stable.	Where the amount of undisturbed habitat is 65% or more, any activity which results in habitat alterations that causes the undisturbed habitat to fall below 65% of the range. Within the range identified for each local population with undisturbed habitat greater than 5% and less than 65%, any activity that would destroy undisturbed habitat. If a plan referred to in section 7.2.3 has been approved, any activity which results in habitat alteration of the critical habitat identified in the plan and published in an amended recovery strategy. Within the range identified for each of local populations with undisturbed habitat at 5% or less, any activity which results in habitat alterations to existing habitat.
East Side Athabasca River	Range of the local population	Biophysical attributes of the Location		
Cold Lake	Range of the local population	Biophysical attributes of the Location		

Cumulatively, Environment Canada (2011) describes the total disturbed area that is avoided by boreal caribou as including the anthropogenic footprint plus a 500 m buffer plus areas where a fire has occurred in the past 40 years (no buffer applied). The remaining habitat within a range is considered undisturbed. Restoration of anthropogenic footprint will result in a larger area becoming undisturbed. This is of particular importance when considering linear disturbance such as seismic lines that may only be a few metres wide that, when restored, will result in a kilometre wide corridor that will be included within the 65% undisturbed habitat threshold. Destruction of boreal caribou critical habitat involves any activity that results in a temporary or permanent alteration of the habitat required to support the population and distribution objectives.

Environment Canada (2011) also discusses thresholds and performance indicators (PI) that may help to guide a fence project. It identifies 65% undisturbed habitat in a range as the threshold which provides a measurable probability (60%) for a local population to be self-sustaining, and continues "it is important to note that this is a minimum threshold because there is still a risk (40%) that local populations will not be self-sustaining," and "it is expected that there is a threshold below which the level of disturbance will lead to boreal caribou local population declines due to lack of resources, such as forage, needed to support life stages. Such a threshold would be separate and distinct from the 65% undisturbed habitat threshold related to predator-prey dynamics." The latter point appears to suggest a distinction between undisturbed habitat thresholds according to predation levels; however, Environment Canada (2011) does not provide guidance in this respect.

For the Richardson herd, the PI is that undisturbed habitat area does not drop below existing levels and is increased over next 50 years at reasonable, gradual increments every 5 years to no less than 65% of the total range area. For WSAR, ESAR and Cold Lake, the PIs are:

- For local populations where the amount of undisturbed habitat is 65% or more, undisturbed habitat area is maintained at no less than 65% of the total range area.
- Local populations are stabilized within 5 years for those that initially had more than 100 animals.
- Local populations with initial estimates of less than 100 animals have an increasing population trend (i.e., $\lambda > 1$) within 5 years.

On non-Federal lands, SARA, and specifically its "safety net" provision, would come into force only if the federal Minister of Environment deemed that Alberta's provincial recovery and action plans were not effectively protecting critical habitat. Depending on the Project's "ownership" and execution, interpretations of the terms "harass", "capture", and "possess" may be applicable to enclosure of woodland caribou by a fence.

Under current administrative practices for endangered species legislation in Alberta, it would appear unlikely that SARA will have any direct impact on the Project. While Environment Canada (2011) must be considered in this feasibility study, subject to legal opinion, if SARA were to be applied, a breach of the *Accord for Protection of Species At Risk* by Alberta would presumably be deemed to have taken place, which seems unlikely. Pertinent review, therefore, is expected to take place under the aegis of Alberta's *Wildlife Act*. As is evident from the previous chapter, several key regulatory gaps are apparent in *The Wildlife Act*. This raises regulatory risks which in turn affect the Project's feasibility.

The Cold Lake Air Weapons Range (CLAWR), through which the Cold Lake Herd ranges, is held under lease by the Department of National Defence from Alberta. While DND is subject to federal regulations, current land use, including petroleum industry projects, is regulated by the ERCB advised by Alberta Environment and SRD. Oil and gas activities within the CLAWR operate under conditions of approval from AE that may include environmental assessment, protection planning and monitoring of caribou. Despite this, most Alberta-produced maps of land use administration, caribou habitat and referral systems exclude the CLAWR from consideration (e.g., Lower Athabasca Regional Plan, Proposed Conservation Areas and Recommended Land Use Classifications; Woodland Caribou Land Use

Referral Boundaries). This imply that the resource management objectives in the area could accommodate the Project

The implications of recovery planning under SARA for First Nations hunting rights recently invoked a court decision that may have implications for the Project. Regarding the Burnt Pine woodland caribou herd in the West Moberly area, the British Columbia Supreme Court recently issued a decision raising the prospect that broad federal population-level recovery plans may not insulate provincial permit-holders from allegations that their activities would have unreasonable impacts on asserted aboriginal and treaty rights. The court found that the Crown's failure to establish a plan for the protection and rehabilitation of the Burnt Pine Herd was a failure to reasonably accommodate the West Moberly hunting rights. The Court ordered the Crown to develop a plan to not just protect, but also ***augment*** the Burnt Pine Herd (emphasis added). Augmentation implies intervention of the type envisaged by the fencing Project. In all probability, the fencing Project would be located on traditional lands of Treaty 8 First Nations.

1.5 Participation and Primary Responsibilities

1.5.1 General Considerations

The Alberta policy for Woodland Caribou makes it clear that any initiative would be government-led, but would involve shared responsibility. Given this, it is expected that representatives of government, industry, aboriginal communities, ENGOs, and others would be involved. As an industry-led concept, government and others would expect that funding for a fence project would mostly emanate from the industrial representatives. Given that caribou ranges extend beyond the boundaries of OSLI-member leases, other industrial users of the land may have to cooperate with the Project in order for it to be successful. Powers existing under the law are likely to require that ultimate authority over the Project would rest with the Government of Alberta. This being so, industry would not control the Project.

Most of those involved would be involved primarily as part of a consultation process (see below). Project roles could range from advisory to project direction and management, construction, operation, monitoring, field implementation, and research. Overall direction and guidance of the Project could be given to a Board of Directors, suitably composed of members of industry, government, First Nations, research and management personnel.

In terms of responsibility for day-to-day operations, this would be developed as the Project is further conceptualized and made concrete. Some options are:

- OSLI-member staff
- Alberta Sustainable Resource Development staff
- A third party organization (e.g. Alberta Conservation Association)
- Staff hired under a separate organization (*e.g.*, a corporation or foundation)

1.5.2 Consultation and Ongoing Involvement

In order to establish the Project and obtain regulatory approval, a number of stakeholders would have to be consulted. If the Project were to be deemed feasible and were to be approved, such consultation would continue into the operation phase. The Alberta Caribou Committee was the fulcrum of

information exchange on initiatives related to woodland caribou and industrial activities, but is now unavailable for consultation. However, its network of contacts for consultation might be a source for a fence project.

The ACC (undated) indicated that:

> *"Consultation with First Nations, Métis and other directly affected stakeholders has not been undertaken, and is fundamentally important to prepare the way for implementation. First Nations have indicated that "deep consultations" are required. Various social, economic and policy issues need to be addressed. First Nations input would also enhance the reliability of the data regarding current populations and distribution of caribou."*

1.5.3 Media and Publicity

This study predicts a high level of media and public interest in the Project. Given the profile of oil sands developments in the politics of world energy, interest would likely extend beyond Canada. As a result, the Project would be subject to widespread public scrutiny. Release of information would have to be coordinated by means of a public information group. The potential exists for corporate image to influence the feasibility of the Project.

1.6 Conclusion

Based on the strategic analysis provided in this chapter, this study finds the Project is feasible biologically in that a fenced, predator-free, managed population of caribou in suitable habitat can reasonably be expected to increase. The urgency of the status and prospects for woodland caribou has been expressed by several authorities, including the Government of Alberta in its official policy for the species. This gives impetus to an initiative such as the fencing Project contemplated; however, feasibility is placed in doubt by four key issues:

- legal, regulatory and policy complexities and gaps;
- direct intervention such as a fence is novel, therefore untested and potentially controversial and politically risky in that enclosed caribou could not be defined as "self-sustaining" and therefore "wild";
- the importance of considering the location context of the fenced safe zone and its potential role in caribou recovery. Without active management of surrounding areas, caribou from a successful project are unlikely to have a viable release site
- the risks inherent in the necessary consultation and public information process that would precede Project implementation.

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2.0 Tactical Design Features

2.1 Size of the Area to be Enclosed

Strategic options for determining the size of the area to be fenced should be governed by four central determinants:

- Ecological and behavioural requirements of woodland caribou
- Land use designations, regulatory constraints and socio-political input
- Caribou population objectives for the fenced area
- Resources devoted to the fenced area

Caribou ranges and populations in North-eastern Alberta are largely distinct, with little movement by individual radio-collared (mostly female) caribou observed between ranges. Although the boreal ecotype caribou inhabiting forests of northern Alberta make extensive movements throughout the year, most do not make predictable migrations and therefore habitat use does not differ on a seasonal basis (Dzus 2001). Home range sizes of collared caribou in an area with roads in north-eastern Alberta (Dyer et al. 2002) range from 198.2 during calving to 289.4 (late winter) km^2. Woodland caribou in north-eastern Alberta tend to be restricted to local populations within peatland complexes (Bradshaw et al. 1995, Stuart-Smith et al. 1997). Movement between peatland complexes by caribou has been reported in north-eastern Alberta (Stuart-Smith *et al.* 1997). Maintaining connectivity between peatland complexes is therefore important to population (herd) interchange and gene flow. A fence would inevitably disrupt any connectivity that exists between herds; however, when conditions are appropriate to allow movement beyond the fence, its strategic design and placement might facilitate connecting movements. In order to be effective, and avoid expensive and time-demanding inventory studies (e.g., habitat assessment and potential habitat use, etc.), a fenced area should include at least part of the range of an existing caribou herd, where habitat conditions and animal movements and distribution are known.

The size and broad habitat features of the herd ranges selected in the preceding chapter are given in Table 3 below. Quality of woodland caribou range is expressed by estimated extent of recent forest fires, proximity to anthropogenic disturbance and linear feature density.

Table 3. Herd Range Sizes and Habitat Features

Herd Range	Area (km^2)	% of Range Area Covered by Burns <30 years old	% of Range Area Covered by Burns <50 years old)	% of Range in Proximity to Anthropogenic Disturbance	Linear Feature Density (km/km^2)
Richardson	10,867	Not Available	19.7	19.9	Not Available
West Side Athabasca River	33,378	2.8	4.1	42.7	1.2
East Side Athabasca River	36,247	22.7	26.5	49.5	1.8
Cold Lake	9,616	30.0	35.0	45.7	1.2 (Alta Only)

Source: Status Update & Athabasca Landscape Team (2008)

In order to meet OSLI's initial objective of housing the primary range of a known herd, Table 2 above indicates that the guideline for a notional size of the area to be fenced (600 – 2000 km^2) will be insufficient; however, depending on the strategy adopted, woodland caribou in an area of 600-2000 km^2 could be managed such that population density increases

Based on an understanding of woodland caribou biology in the Alberta boreal forests, and with the objective of retaining a "natural" caribou density of 3.3 animals/100 km^2, and a population of 150 animals (medium extirpation risk), a fenced "caribou safe zone" should extend over approximately 4,500 km^2. However, in an environment where the caribou/moose/wolf predation system has been changed and predation is controlled or largely removed, it is conceivable to envision a caribou density substantially higher, and similar to the densities of the migratory woodland caribou in winter in west central Alberta (~ 9 animals/100 km^2) (Thomas and Gray 2002). A variety of research also indicates that woodland caribou home ranges in northern and north-eastern Alberta vary between 198 and 1000 km^2 (e.g., Dyer et al. 2002; Schneider et al. 2000, Dalerum et al. 2007). Hence, it can be extrapolated that an area of 2,000 km^2 could support a population of about 150 animals with a density of 7.5 animals/100 km^2 and include a significant number of home ranges. Any smaller size will inevitably lead to a higher degree of caribou/wildlife management. Our understanding of woodland caribou in the boreal forests of Alberta, suggests that even as animals are widely dispersed, they show strong fidelity to their range (Thomas and Gray, 2002). Hence, a fence enclosure should try to include existing caribou ranges to the greatest extent possible and, in so doing, its impact on movement patterns and range/habitat use will be lessened.

The above estimates do not consider the carrying capacity of the enclosed "caribou safe zone". However, this may not be a concern. Currently, caribou populations are far below the carrying capacity of the vegetation (i.e., they are not habitat-constrained). Rather, current low densities reflect the ecological carrying capacity of the ranges; that is, the landscape conditions (habitat and forage availability) with predators and human activities. Recently, Environment Canada, in its Scientific Review for the Identification of Critical Habitat, set the carrying capacity to "*three times the initial female abundance*" since predation limits caribou populations to levels well below carrying capacity (Environment Canada 2008). Therefore, as long as the enclosed area includes the habitat mosaic currently used by a woodland caribou herd ("caribou critical habitat"), a population density of 7.5 animals/100 km^2 seems reasonable.

The initial number of animals should be large enough to support a self-sustaining reproducing population which may or may not need augmentation from other areas (i.e., translocations) (see Chapter 4).

2.2 Location of the Area to be Enclosed

The area selected would be all or part of the ranges selected in Chapter 2.1. The criterion for selecting a range might be the herd with the highest population growth; however, since all herds are in a state of negative population growth, the criteria discussed below focus on habitat. Thus, criteria for area selection may include:

- The range with the best physical habitat conditions under established thresholds, and least risk
- The range with the lowest densities of predators and alternate prey

- In terms of land use, the range with the least dispositions or with designation as land with a conservation objective
- The range for which support from stakeholders and the public is greatest

To be effectively employed, these criteria assume adequacy of baseline information. If baseline information is lacking for a particular area, it could not be selected on a comparative basis. Not all caribou ranges have adequate information to allow evaluation against all of these criteria. Energy companies and their various consultants have been surveying and mapping habitat in this region for many years, and Alberta-Pacific Forest Products (AlPac) has extensive vegetation mapping and modeling for a large part of north-eastern Alberta. Those sources of information will have to be explored upon initiation of the Project, possibly in a partnership arrangement between forestry and energy interests.

2.3 Physical Habitat Conditions and Least Risk

Caribou habitat occurs within a matrix of upland mixedwood forest that is avoided by caribou, but provides habitat for other prey species (*e.g.*, moose and white-tailed deer) that in turn support wolves, black bears, and other predators. The selection for peatlands is a spatial separation strategy critical to the survival of boreal caribou. Therefore, in relation to coverage by other habitat types, the selection of an area to be fenced should emphasize the peatland component. In the Athabasca Landscape, 35,070 km^2 of "suitable habitat" has been identified (Athabasca Landscape Team, 2008).

The Athabasca Landscape Team (2008) considered a series of risk criteria to rate comparative risk to caribou persistence within each range, planning area, or herd. In selecting an area for the Project, applying these criteria to the selection of the area may identify the most favourable conditions for an enclosure. The ALT's final criteria with quantified or quantifiable expression are:

- Lambda (herd growth rate) Indicator of current population status: declining growth rate puts herd at risk. If growth rate is consistently <1, herd will not survive without intervention
- Potential Population Size: Potential population based on area of suitable caribou habitat within range or planning area. Potential herd size is related to the amount of functional habitat. Potential herd size calculated using critical habitat area and average Alberta caribou density (3.3/100 km^2). Risk assigned using average density values to extrapolate potential herd size based on suitable habitat area; same ratings as population size.
- Current Population Estimate: Number of animals in the range/ planning area/ herd. Risk ratings: Low risk: >500; Medium risk: 150-500 High risk: <150
- Linear corridor density: Amount of linear disturbance per km^2 of landscape. High: <1.2 km/km^2; Low: <0.6 km/km^2
- Young forest in caribou habitat area: Amount of young forest (<30 years old) in designated caribou herd area or suitable habitat. Risk ratings: Low <10%; High >30%.
- Young forest in range or planning area: Amount of young forest (<30 years old) outside the caribou herd area. Key assumption is the size of the area outside suitable caribou habitat that influences predator numbers (e.g., how far away does a predator source area have to be before it has no influence?) For now, 20 km buffer zone was used.

- ❖ Energy sector trajectory (Bitumen thickness map will be applied to determine probability of future development): Use current township-based map until better data are provided by Alberta Energy. Development probability: Low <6 m; High >15 m)
- ❖ Forest harvest trajectory
- ❖ Predator abundance and distribution: wolf density >6.5/1000 km^2 is predicted to lead to population declines.

The results of the risk rating exercise undertaken by Athabasca Landscape Team (2008) reveals that, overall, the Richardson, East Side Athabasca, and Cold Lake ranges are "at high risk of caribou decline", while the West Side Athabasca is "at moderate risk of caribou decline".

Athabasca Landscape Team (2009) proposes "Zone 1" areas as a planning tool. These would designate large (thousands of square kilometre) areas where recovery of functional habitat and caribou mortality control would be the designated and enforceable management priority. Of six candidate Zone 1 Areas, Athabasca Landscape Team (2009) considers the WSAR and Richardson planning area candidates to have the greatest potential to minimize long-term risk to caribou.

2.4 Low Densities of Predators, Moose and Deer

Relevant data are provided in Table 4. The data suggest that of the four ranges, Richardson would be preferred as the area within which to locate a fence project.

Table 4. Densities of Predators and Alternate Prey

	Density per 100 km^2				
Range	**Moose**	**White-tailed Deer**	**Mule Deer**	**Wolf**	**Black Bear**
ESAR	17	27	3	1	11
WSAR	15	13	1	1	10
CLAWR	21	85	7	1	12
Richardson	8	2	0	<0.65	8

Source: Athabasca Landscape Team (2008)

2.5 Land Use

The information collected and analysis undertaken by Athabasca Landscape Team (2008) described in the preceding chapter can be used as a starting point for selection according to the industrial aspects of this criterion.

In terms of land designated with a conservation objective, this criterion could be addressed by matching the intent of the Project with named "conservation areas" proposed in April, 2011 under the Lower Athabasca Regional Plan. The Proposed Lower Athabasca Integrated Regional Plan Regulations that overlap the woodland caribou herd ranges selected for this study include the Richardson Wildland Park, Gypsy – Gordon Wildland Park, and Dillon River Conservation Area.

In terms of recreational or traditional use, information collection and analysis remains to be undertaken. For traditional land use aspects, much will be achieved by consultation with First Nations (see below).

2.6 Fence Design and Features

A number of variables will affect the efficacy of the fence, from planning for its alignment, through response of different species of wildlife, to methods of erection, materials used, monitoring and maintenance. Fencing for wildlife control has been used extensively, primarily in a highway safety role. In that application, fencing typically consists of 2.0 – 2.4 m high wire mesh material, usually with one-way gates to allow ungulates to get off the highway right-of-way (Reed et. al. 1974, Ludwig et. al. 1983). The following is a preliminary review.

2.6.1 Placement and Barrier Considerations

Selecting an alignment for the fence will depend on conditions of the area to be enclosed, as well as considerations of surrounding areas, particularly in terms of habitat connectivity. Conditions which facilitate erection may not coincide with those with best ecological effect or potential for enclosing optimal conditions for caribou or may not capture their range (see “size of the area” section). Land status may influence where a fence can be erected; however, it is unlikely that township lines will coincide with most efficacious alignment. Using best available information on caribou, together with an assessment of impacts and constraints, a fence alignment plan and survey will have to precede the Project. In order to provide a best “first-order” shape, data on caribou locations gathered from collaring studies may provide guidance.

The potential effects on other wildlife, particularly furbearers, small mammals and birds (potential for collisions in flight) will have to be considered.

The position in relation to snow accumulation and potential for snow drifting will have to be considered. For example, with chain link fencing, snow can pile up against the fence, creating a ramp that animals can use and thus escape. Plans will have to be developed for allowing animals to exit the enclosed area on either a contingency or planned basis.

2.6.2 Features and Dimensions

Reindeer behaviour studies suggest that movements are facilitated by fences with no dead-ends or right-angle corners, and that reindeer are more apt to keep moving forward if they do not see a blockade in front of them. Although the Project does not deal with reindeer, this suggests that woodland caribou may be better served by a fence that continuously curves rather than joins in corners with sharp angles. Also from reindeer husbandry, in a corral situation, reindeer will not challenge a solid barrier, but if they are pressured, they will try to run through a wire fence until burlap is strung across it to make it appear solid (Thompson et al. 1992). This suggests that the appearance of the fence to caribou may be influential. However, if the area fenced is large, and caribou are not harassed, this may not be an issue. Consideration will have to be given to the potential for entanglement, as caribou antlers may become caught in certain fence materials. Entanglement is less likely with smaller mesh size.

As well as caribou, consideration of the efficacy of the fence in relation to wolves, moose, bears and deer will be essential. The fence must serve to enclose caribou, but it must also ensure the exclusion of

predators, particularly wolves. Wolves may use the fence as a means of “cornering” caribou on the outside, or inside, if not all removed from the enclosed area. The fence may require consideration of special design features to ensure wolf exclusion, such as use of fladry and electrification (Lance et al. 2010).

Besides ease of maintenance, key features to be considered will be:

- materials (wire, wood posts (logs), etc.);
- composition (e.g., chain-link, paige wire, strand wire);
- strength (mil) of wire used;
- choice of mesh size in relation to potential for entanglement by caribou, especially of antlers;
- passage of non-target species; height (a minimum of 6 ft is recommended for reindeer corrals in Alaska (see Thompson et. al. 1992);
- grounding (flush to the ground or with a gap at the bottom? maintenance of ground contact by anti-burrowing wire);
- visibility (to avoid collisions, perhaps the fence should be flagged or made easily visible in some way);
- aesthetics (visual impact);
- posts (constructed of what material such that they survive in peatland soils and high water tables?);
- footings (are these necessary in all locations, or only under certain soil and geotechnical conditions?);
- post spacing;
- post height in relation to height of fence (e.g., Alberta Transportation standards indicate 2134 mm paige wire requires wooden posts at 3.75 metre maximum spacing);
- gate and one-way gate locations and positioning;
- gate purpose (access to the fenced area; release of trapped animals; management of caribou).

2.7 Fence Erection

2.7.1 Deployment, Access, Monitoring and Maintenance

For erection, the fence will require access by vehicles in all seasons. If no access exists (a desirable feature of caribou habitat), it will have to be created unless all materials and personnel are flown in by helicopter or other aircraft. A new line of perimeter access to accommodate machinery used in fence construction and surveillance would have to be carefully planned, as its effects could be negative for caribou. Ease of fence deployment therefore becomes an issue, potentially incurring impacts that are counter-productive to the intent of the Project. If a road exists, it will be used; if not, depending on the machinery used for transporting fence materials and drilling of post holes, a cleared strip may be necessary. This may vary depending on the depth of drilling to ensure integrity and anchoring of posts, which will vary according to terrain conditions. Deeper drilling means higher costs per post.

The fence will require regular monitoring to determine weaknesses, to identify breaks and areas of unexpected snow accumulation facilitating egress, and to undertake necessary repairs. The nature and

means of monitoring will depend on the terrain conditions, the time of year, and the nature of the fence erected. (see Chapter 3).

2.7.2 Process for Enclosing Caribou

The Project will have to develop a process for enclosing caribou within the fence. This will necessitate a strategy for how the fence will be deployed and erected in relation to caribou distribution at the time. If the area is large enough to capture the home range of a resident herd, the process may be fairly simple. Though a monitoring program with real time GPS data will be required to ensure that animals won't move outside the perimeter while the fence is being built. However, alternative techniques will have to be considered and assessed. These may include herding, capture, transportation and release, etc. Finally, the health and well- being of caribou subject to the stress of capture, transport and release in the enclosed area will have to be addressed, likely through an Approval for Animal Handling from SRD and use of standard protocols. A veterinarian with experience with wild ungulates can assist with these specific issues during the Project activities.

2.8 Stakeholders Within The Area

It is beyond the scope of this feasibility study to address the full range of stakeholder concerns and risks for the Project. It is also difficult to describe all the organizations and individuals that may be affected by the Project until more disclosure is conducted and a consultation plan is designed. Those stakeholders involved in the Project will depend upon the selected area for the Project and judgement as to the essential relationships that would be critical to implementation. Among stakeholder groups in the Lower Athabasca Region in which the four herds range, the following may or may not be involved (NB. this list is preliminary, incomplete and subject to study and refinement) :

Mikisew Cree First Nation	Fort McKay First Nation
Fort McMurray #468 First Nation	Chipewyan Prairie Dene First Nation
Heart Lake First Nation	Willow Lake Métis Local 780
Fort McMurray Métis Local 1935	Chard Métis Local 214
Métis Nation of Alberta Region One	Trappers
Keyano College	Regional Municipality of Wood Buffalo

Issues of stakeholder concern arising in relation to a fenced area may include:

- exact areas of traditional land use areas, cabin sites, spiritual sites, graves and other traditional use sites considered as historic resources,
- current fishing, hunting, trapping, nutritional or medicinal plant harvesting and
- cultural use by affected people; vegetation and wildlife used for traditional, food, ceremonial, medicinal and other purposes;
- views on fencing and management of caribou; access to traditional lands in the fenced area during its lifetime.

2.9 Conclusion

Based on the tactical considerations analyzed in this chapter, we believe that the Project objective of housing the entire range of a known herd within a fenced area of 600 – 2000 km^2 is not feasible;

however, depending on the strategy adopted, woodland caribou in a fenced area of 600-2000 km^2 could be managed such that population density increases. It should be feasible to select a suitable area of this size range that meets a variety of key criteria; however, land use designations and competing and traditional land uses may affect feasibility negatively. Among the herds considered, this preliminary analysis suggests that the area identified as “Zone 1” in the Richardson herd range appears to offer the best prospects for a caribou safe zone. A relative paucity of population information for the Richardson range would have to be overcome. Design, construction, and monitoring of a fence will be technically challenging but feasible; in this sense, feasibility will be primarily dictated by willingness to incur high costs (see Chapter 6).

Using the Richardson range as an example, cost predictions are provided in the Chapter 6 budget discussion on a fenced caribou safe zone of similar dimensions.

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3.0 Methods for Building and Maintenance

3.1 Fencing as a Management Option

Fencing has been used in woodland caribou management to mitigate the impact of land use practices either to re-direct caribou migration or to exclude caribou from potentially hazardous sites (e.g. Grande Cache Coal experiment with drift fences in western Alberta) (AWA 1996, Smith, pers.comm.)

More recently, fencing has been used to enhance caribou calf survival through the building of pens (maternal pens). This approach, pioneered by the Yukon Government in cooperation with the Canadian Wildlife Service and the World Wildlife Fund, to enhance the Chisana woodland caribou herd, involves capturing pregnant females, temporarily holding them in an outdoor enclosure, and releasing them and their calves in the wild 2-3 weeks after parturition to enhance calf survival. A similar program was implemented in the Little Smoky herd of western Alberta where, in March 2006, 10 pregnant females were captured and moved in a 4 ha enclosure to be released in June when the youngest calf was almost three weeks old (Smith and Pittaway 2006). Calf penning was also recently considered for Banff National Park (Kinley 2009) and the Purcell-South Mountain Caribou Population (Kinley 2010). However, based on logistic and economic considerations, the Project did not gain momentum and did not proceed.

With specific regard to North Eastern Alberta, the Athabasca Landscape Team considered cow/calf penning as a realistic approach in small planning areas such as the Richardson range, but noted that the practice would have to be carried out for more than 50 years. This option, though endorsed by CAPP, was not was not supported by the Alberta Caribou Committee Governance Board and was not included among the Board recommendations to the Deputy Minister of Alberta Sustainable Resources Development.

As noted earlier in Chapter 1 (1.4.5) the Athabasca Landscape Team, in its report to the Governance Board stated (ACCGB 2010):

> *"A speculative alternative discussed by the ALT was constructing and maintaining a barrier to impede deer and predator movement into the areas where densities are currently low. The Richardson planning area would be the most appropriate area to test the viability of this mortality management approach".*

The building of a fence to enclose a large area for caribou conservation and minimize predation, while maintaining a free roaming and self-sustaining caribou herd, has never been attempted and will present significant challenges.

In Scandinavian countries, caribou have been domesticated as "reindeer" for many years and the only wild caribou are reported to exist in southern Norway (Nellemann et.al. 2001). Caribou husbandry, as conducted by the Sami people (formerly called Lapp-landers) does not use field fencing, and predators have been eliminated.

In the late 1800's in Alaska, Lapp herders were hired to help bring Siberian reindeer to missions along the Bering coast. Fencing of herds was not one of the management options as the domesticated animals tended to stay put if the food supply was adequate (Taliaferro 2006).

3.2 Construction

The actual design of the fence is relatively simple compared to the regulatory steps that may be required for various approvals. A typical fence of 10" x 10" mesh of 10' height, with a "chicken wire" burrowing barrier would be similar to that recently installed at the Highway #1 twinning in Banff National Park. This type of general design has been used for the cost predictions presented in the budget discussion (Chapter 6).

Building a fence of this design may require >1m deep post holes, requiring machinery such as a bobcat- mounted auger. While highland (i.e., not muskeg) fence lines may allow such machinery to work, lowland areas will restrict any the use of heavy machinery and will restrict the effectiveness of post-holes in any event. The presence of organic, unconsolidated substrate will not support fencing of this size, and freeze/thaw and snow drift load may reduce fence effectiveness and result in considerable maintenance throughout the operational life. Post-hole augering in summer would be difficult in muskeg areas and winter conditions will also restrict the effective use of machinery (frozen conditions). Thus it would seem that fencing will have to be constructed in relatively drier, highland areas as much as possible to meet the area's design criteria. A fence line that is "meandering" would be the likely approach, and such alignment allows for best use of a suitable substrate and is likely to follow best habitat characteristics as well.

Once completed though, surveillance by helicopter would be an efficient means to survey the fence integrity. If parts of the fence are observed to need repair, a field crew could be part of the heli-survey crew, or could be brought to the site by helicopter once the need is identified. Extensive portions of the fence that are seen to have been brought down may need heavy equipment to be dispatched to the repair site. In these cases, the proximity to existing road networks will greatly reduce the cost of repair, but in any case, swamp-passable equipment will be required. Helicopter surveillance can also be used in winter, though snow-machines can be used for repair work. A repair/response crew would need to be kept on stand-by throughout the years that the Project operates. Vehicle access to fenced areas and repair sites would certainly be improved by having an all-season road proximal to the fence alignment. However, the need to keep vehicular access to a minimum within and close to the fenced area would be important to the caribou within. At the same time, the fenced area should have no, or very little, existing access by way of cut lines or roads (i.e., linear features on the landscape should be, or should be reduced, to as little as possible).

It is a continual struggle to maintain fences and one-way gates so that wildlife do not slip through and reach a roadside (or escape a fenced safety area) (Foreman et.al. 2003). Earth slumping or gullying on hillslides, inadequate installation techniques resulting in gaps between the earth and the fence bottom, and breaches of the fence by the public allow animals to gain entry to the roadside (or safety area).

3.3 Conclusion

The construction and maintenance of a fenced area of at least 2000 km^2 is feasible from an engineering and operational aspect, though it presents difficulties not uncommon to a project of this magnitude. The terrain of northern Alberta may present some unique challenges, but these can likely be overcome. The Banff Park highway fencing, Elk Island National Park fencing, and other infrastructure examples illustrate that a large fenced area can be built with proper planning, management, and financial support. These examples however, tend to occur close to existing infrastructure including access routes, so using the financial information from them would not be accurate for the Project.

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4.0 Caribou Management

In Canada, there is one precedent of a large area fenced with the objective of retaining and protecting a wildlife species in its natural environment. In 1906, approximately 41 km^2 were fenced to protect one of the last remaining herds of Rocky Mountain Elk. Over the years, the enclosed area was expanded to 192 km^2 and become what we know as Elk Island National Park. While it is possible to learn from Parks Canada's experience in managing the wildlife community of Elk Island National Park, range of which is constrained by a game fence, the ecological and behavioural patterns of woodland caribou and the significantly larger area that will be required for the safe zone will present unique challenges. Those challenges can only be addressed by a full inventory of the wildlife species present in an enclosed area, gaining an understanding of their population dynamics, designing an active management program (including intervention actions), and continuous monitoring of population dynamics over the time period of the Project.

4.1 Caribou Population Inventory/Monitoring

Prior to the designing and building of the fence, a detailed study of caribou movements and distribution will be required. Depending on the size of the area that is considered, a detailed habitat use study is unlikely to be necessary at this stage. Rather, what is important is to understand animal movements and distribution so that most or all of the "high use areas" are included within the "Caribou Safe Zone". If the enclosure is large enough to encompass several woodland caribou home ranges, it is reasonable to assume that they will provide enough habitat to support the resident population.

To assess caribou movements, distribution, and high use areas, several animals will need to be captured and instrumented with GPS collars. The presence of collared animals will also allow collection of data on population demographics (female and calf survival rates) and estimating population performance before a fence is erected. In a setting where there is time to conduct one to three years of monitoring to provide a good understanding of range use patterns, a scientific program may be possible. The number of GPS collars and the GPS-fix schedule in such studies would depend on the number of animals present in the area and the life-span and type of the collars selected. However, based on data collected on woodland caribou in Alberta, this study suggests that a minimum of 10 GPS collars would be required and should provide sufficient animal movement distribution data.

Note that a detailed study on animal movements and distribution may not be needed if previous studies have already been conducted, and the data are sufficient to outline the area to be enclosed. The question seems to come down to "is there time to conduct detailed population inventories when each year is critical in the caribou's survival.

Once the fence is erected, the density of caribou within the enclosure should be assessed, and a GPS monitoring program should be maintained to assess how the herd is adapting and its performance over time.

4.2 Population Size and Possible Augmentation

The initial number of animals retained in the "caribou safe zone" should be large enough to support a herd of at least 150 animals with a medium extinction risk. Based on the assessment conducted by the Athabasca Landscape Team, such a large herd will require an area significantly larger than 2,000 km^2.

Hence, the number of animals initially present within the enclosure may be less than 150. Depending on that, the herd may need some relocation efforts to increase animal numbers while the herd responds to a higher female and calf survival in the absence of significant levels of predation.

Translocations of caribou for either re-introductions or augmentations of existing herds have been frequently used in North America. Kinley (2009) describes 37 programs, of which, in the absence or with limited predation, 67% were successful with releases from 8 to 146 caribou. Failures were associated with predation or with animals travelling back to their point of origin. For the Purcells-South Mountain Caribou Population in BC, Kinley (2010) estimated that, with the release of 20 animals/year for two years, an initial resident caribou population of 10 animals could reach a stable size of 100 animals in a moderate growth scenario, with predator management and longer term habitat recovery. Hence, within an enclosed caribou safe zone, where predation is managed or non-existent, and dispersal is not a factor, augmentation of a small caribou herd may be a feasible alternative. The number to be released would have to be assessed depending on the size of the initial resident caribou herd.

No translocation should be undertaken unless the factors that are contributing to the decline of the resident herd are removed and there is sufficient habitat in the area (IUCN 1987). More recently, DeCesare et al. (2010) concluded that:

> *"translocation alone will not lead to recovery …. unless underlying vital rates are improved naturally or through additional conservation actions."*

Augmentation with translocations will present several challenges that need to be addressed. Translocations will pose significant operational and logistic obstacles associated with capturing, moving and releasing animals, plus animal welfare concerns. In addition, it will be critical to find a source herd of the boreal ecotypes that is not itself declining. With regard to genetic individuality of distinct herds, although Kinley (2009: see Chapter 1.2.4) states that there is no evidence of local genotypic or phenotypic differences conferring adaptive advantages, Miller et al. (2007), concluded:

> "*It should be a prerequisite in any conservation program that there be prior determination that both the endangered and donor caribou are indeed genetically, phenotypically, and ecologically the same. In the absence of a match, even out of desperation or even if highly similar caribou exist, no augmentation should proceed until we know with a high level of biological confidence that the functional characteristics of the caribou being augmented will not be lost."*

4.3 Foraging/Nutritional Considerations

Little is known on the diet and nutritional status of woodland caribou (NCASI 2007a, b). Most of our knowledge comes from studies on barren-ground caribou that may or may not apply to forest-dwelling animals. In winter, woodland caribou diets appear to be composed mostly of ground lichens, with arboreal lichens playing a major role in deep snow and late winter/early spring conditions. In spring and summer, the diet is believed to expand to include forbs, sedges and other plants. However, the seasonal dietary changes and their nutritional significance are poorly understood.

Calf survival in ungulates is related to their weights at birth, which is, in turn, affected by food availability during pregnancy and during the calf's first winter. Therefore, it is reasonable to assume that in severe

deep-snow winters, during snow crust or freezing rain conditions in spring, and with generally unfavourable weather patterns, forage availability may be reduced and that may negatively impact woodland caribou energy budgets (Thomas and Gray 2002). This could lead to lower pregnancy rates and reduced calf survival. In a recent review of research on woodland caribou nutrition, Brown and Mallory (NCASI 2007b) observed that of the 14 studies that quantitatively assessed woodland population dynamics, only one (an unpublished report) "*implicated an interaction among forage, predation, and extreme winter condition*" in the decline of a woodland population. No study tested the relationship between nutritional status and susceptibility to predation.

Seip and Cichosky (1996) suggested that forage quality may have been a factor in the decline of woodland caribou in BC. However, in recently published research on woodland caribou in the Yukon, Hegel et al. (2010) concluded;

> "*There was little support for a pre-conception climate effect influencing female body condition and hence fecundity. These results confirm that recruitment in these populations is limited by predation and that forage-limitation is not a significant factor in their population dynamics*".

In conclusion, despite the overall poor understanding and lack of quantitative data, the potential impact of nutritional condition on woodland caribou populations is widely believed to be minor, whereas predation is considered to be the proximate and most important factor.

Considering the low density of woodland caribou in North Eastern Alberta (3.3 animals/100 km^2), an enclosed caribou safe zone extending over some 2,000 km^2, with a potential caribou population of 150 animals, should be sufficient to provide forage to meet the animals' nutritional requirements. However, considering how little it is known about boreal woodland caribou dietary habits and nutritional conditions, once the area is enclosed, a study should be initiated to assess fine-scale habitat use and foraging behaviour. It is important to determine the role of lichens and the relative contribution of other types of vegetation. Woodland caribou consume various forage types, and lichens may not be as integral to caribou survival as thought. Caribou may be able to substitute other plants into their diet with little effect on their nutritional condition.

4.4 Predation Management

Although woodland caribou are not considered to be the primary prey species of any large predator, they exist in low population densities within a multiple prey system that is mostly supported by moose and white-tailed deer. Any increased in the numbers of primary prey species will result in a higher number of predators and increased predation on caribou. An enclosed area will retain a primary prey base, existing predators, and a predator/prey system that will likely defeat the effort of maintaining a reproducing woodland caribou population with a density higher than is naturally found in the boreal forest.

High level of predation has been widely identified as the major proximate factor responsible for woodland caribou population declines in the boreal forest, influencing distribution and limiting animal density (Thomas and Gray 2002). Although some caribou populations are subject to multiple predators (e.g. Adams et al. 1995), where the additive impact of mortality from various predators is bound to limit population sizes, predation by wolves is believed to be the primary limiting factor (ASRD 2010). A

recent study conducted in North Eastern Alberta by Latham et al (2011) reported that caribou increased "*10-fold in the diet of wolves*" as caribou population began declining.

Over the last several decades, extensive efforts have made to control wolf predation in North America (NCASI 2004) to help recovering caribou herds and populations. Various methods have been thought out or attempted, from reducing the size of the main prey base, moose, to sterilization (Farnell 2009, Spence et al. 1999), but most proved to be unpractical or not effective in controlling predation. Although several predator control programs have involved the help of local trappers, trapping is not believed to be effective in removing enough wolves to have a prey population response (Robichaud et al. 2009). Throughout North America, the principal means of controlling wolf populations has consisted of removing wolves by shooting from the air using helicopters.

In a recent review of wolf management programs in Alaska, Yukon, British Columbia, Alberta and Northwest Territories, Russell (2010) noted that ungulate density will respond to predator control if:

- wolves are the limiting factor,
- at least 65% to 80% of the pre-control level are removed,
- the control is implemented over at least four years and over a large area (> 10000 km^2) and
- the habitat can support higher caribou numbers,
- hunting is curtailed.

Following the Finlayson wolf management program, carried out as part of the Caribou Herd Recovery Program in the Yukon (Farnell 2009), where about 451 wolves were removed over a 6-year period over 23,000 km^2, a recent summary listed the following lessons (Government of Yukon 2011) :

- The recovery program provided compelling evidence that wolves and harvest were primary factors limiting the numbers of both caribou and moose.
- The recovery program showed that lethal wolf control for a defined period (7 years) could not establish a long-term recovery of moose and caribou.
- Once wolf population reduction ceased, wolves increased rapidly and pack size recovered in six years. Seven years after wolf reduction stopped and once harvest resumed, moose and caribou numbers appeared to be decreasing.
- The Finlayson area represents a multi-predator prey system. However, even with bears in the area, wolf reduction resulted in an increase in prey numbers.

There is clear evidence suggesting that, once control ends, wolves will respond to lower densities by rapid population growth. However, in his review of wolf control programs, Adams et al. (2008) noted that wolf numbers increase and stay high due to immigration from the surrounding areas rather than an increase in reproduction rates or lower mortality.

In a fenced caribou area, where predator control is implemented, the issue of predators immigrating may not be an issue. However, a fence enclosure will bring several challenges associated with the management of a predator/prey system which is dynamic, complex, and, in North Eastern Alberta, little understood. Therefore, without predator removal, the Project will not be feasible. Assuming predators have already been removed and are effectively excluded, removing alternate prey would make little

difference, as they do not compete with caribou for forage. Also, with the passage of time, disturbed habitats will revert to more caribou-friendly conditions, thus discouraging moose and deer. If habitat conditions continue to become more moose and deer-friendly on the outside, predators will have less reason to get inside the enclosure. If moose and deer remain on the inside, and flourish, predators may have an incentive to get inside the enclosure, thus placing caribou at risk.

As outlined by the Athabasca Landscape Team in the Current Status Report, there is little knowledge of predator density in North Eastern Alberta (Athabasca Landscape Team 2008). There is a good database available on wolf ecology, movements and diets in the WSAR and eastern portion of ESAR ranges (Latham et al 2011). However, for the rest of the region little is known. In general, wolf average density is thought to be between 1.1 and 0.65 wolves/100 km^2, with higher densities in the southern portion of the region. These densities are well above the minimum density that leads to declining caribou numbers. Little is known about black bears, their movements and their impact on caribou. That lack of knowledge, particularly the effects of predator control on the ecosystem (NRC 1997), may have to be addressed by research associated with the Project.

The establishment of an enclosed large “caribou safe zone”, and the resulting higher caribou density established by a reproducing population, will inevitably alter the caribou/moose/wolf predator system. Initial baseline data will have to be conducted and a long-term monitoring program established to ensure that the enclosed system continues to function. Ultimately, the enclosed area will require continuous management for years to come.

A caribou safe zone enclosure, where caribou density will be much higher than in a natural system will require a long-term predator/prey management program to ensure the existence of a reproducing herd. While it may be conceivable to build a fence and then assess the predator-prey system, a more sound approach is to pre-determine initial predator density and understand predator-prey dynamics in the area that is being considered.

Within the fenced caribou safe zone, coupled with predator density assessment, and possible wolf control, a continuous monitoring of primary prey base, its abundance and its response to fencing and predator control will have to be implemented. Active management of alternate prey species is unlikely to be required as those species will not likely to compete with caribou above the carrying capacity of the area.

Once the area for an enclosure is selected, wolf occurrence and density needs to be determined following standard fixed-wing aerial survey methodology. A more detailed study that identifies wolf packs, their movements and overlap with caribou high use areas, following Latham et al (2011), is recommended. Ultimately, a reduction in the number of wolves in the area will have to be conducted, either through lethal means or by other means potentially more publicly acceptable. The sterilization programs carried out in the Yukon (Farnell 2009) should be consulted, since it seems to offer some potential, particularly in an enclosed environment where immigration of animals from the surrounding region is not a factor.

4.5 Animal Health Issues

Woodland caribou are subject to a variety of diseases and parasites. Although these could be a potentially major limiting factor through their debilitating effects by impacting fecundity or increasing mortality, their impacts on herds or populations are poorly understood.

During spring and summer, harassment by insects may greatly influence animal behaviour, and is the source of insect-born parasites. Heavy infestations of warble larvae, for instance, have been reported in Alberta (Kelsall 1975), and it has been found to impact physical condition of barren-ground caribou (Thomas and Kiliaan 1990).

The incidence of internal parasites is also little understood. Adult caribou are likely to carry a large number of various nematodes and cestodes. High incidence of *Echinococcus granulosus* and *Taenia hydatigen* has been associated with high moose and wolf densities (Pybus 1990, Thomas 1994). These parasites reside in wolves and other canids and cycle through snails and ungulates. It has been suggested that heavy infestations may make animals more susceptible to predation (Messier et al. 1988). Another nematode (*Elaphostrongylus cervi),* known to cause serious neurological disease in wild and domestic reindeer, has been found in woodland caribou in Newfoundland, where up to 88% of animals were infected (Lankester and Northcott 1979).

A more recent concern is about the impact of meningeal worm infections (*Parelaphostrongylus tenuis*) on caribou *(Latham et al 2011)*. This nematode is carried by white-tailed deer but is a potential limiting factor for caribou (Pitt and Jordan 2004). In this regard, as white-tailed deer expand northward they will constitute a serious threat to resident caribou herds. In this context, management of white-tailed deer within the enclosure, and the reduced exposure of caribou to the expansion of white-tailed deer range, would benefit the caribou population.

A fenced enclosure, even one that extends over a large area, will impact the dynamics of the wildlife community. That includes also the parasite/host cycle and the spreading of possible diseases. Therefore, although the occurrence of parasites and diseases in woodland caribou in north-eastern Alberta is not well known, and their impact on caribou populations is little known, these issues will need to be addressed through a specific research/monitoring program.

4.6 Access Management

Roads and other linear features will have an impact on habitat suitability and caribou distribution as animals will tend to avoid the area in the immediate vicinity. Road density can affect caribou presence, and road traffic can affect feeding and resting times (Murphy and Curatolo 1987). Road density will compound the effects that predation may have on a caribou herd. Hence, if predators (e.g. wolves) and road traffic still occur within the enclosed area, effective habitat (see Chapter 1.3.2, Status of Habitat and Use of Thresholds) available will be less than the size of the area would suggest. With higher population density in the enclosed area (see discussion in Chapter 2 – size of area), the natural caribou anti-predator strategy to disperse would be impaired and, due to predation, it will be unlikely that a reproducing herd of some 150 animals could be maintained. However, if predator management is implemented and wolves are removed from the caribou safe zone, it is reasonable to expect that a higher caribou density would be achieved and, overtime, even with vehicular use of existing roads, the

animals will habituate to the linear features, hence increasing the amount of potential habitat available. Some form of traffic controls (speed, frequency, etc.) may have to be developed to augment the reduced predation effects being sought in the safe zone.

It has been stated in relation to studies in Alaska that caribou density is inversely related to road density, with the first road into an area deemed to have the largest relative impact on caribou distribution (Nelleman and Cameron 1996,1998). In northern Alberta, caribou were found to avoid areas within 250m of roads (Dyer et.al. 2001, James and Stuart-Smith 2000) and wolves were also found to prey on caribou near roads than farther away.

The enclosed caribou safe zone will most likely include a road network associated with resource development. Its existence will pose several challenges that will need to be managed. Studies have described how linear disturbances affect caribou habitat and the hunting efficiency of wolves (Dyer et.al. 2001, James and Stuart-Smith 2000; Oberg 2001).

Where possible, and consistent with the recommendations by the Athabasca Landscape Team (2009), linear features should be reclaimed to facilitate the return of the caribou safe zone into a more natural state supporting a self-sustaining caribou herd (see recommendations in Chapter 7).

In the scenario where predators are managed or removed from the caribou safe zone, roads may still be used by wolves as travel routes to enter the caribou safe zone. Control of such a potential access will be difficult. Hence, in addition to limiting or possibly reducing the number of roads that access the area, a program should be established to monitor wildlife use of potential entry/exit points. Detailed evaluation of road density and road use issues will be required as the actual fenced safe zone area is investigated and ultimately defined.

The establishment of a fenced caribou safe zone will be a high profile initiative and will likely attract visits by the public at large. That will add to the possible existing industrial use of roads. A well-designed educational program coupled with extensive signage and surveillance/patrolling is recommended (see recommendations in Chapter 7).

4.7 Conclusion

The establishment of a fenced area to support a self-sustaining caribou herd has no precedent and it will pose considerable wildlife management challenges.

The complex and dynamic wildlife community constrained within a fenced boreal forest will have to be actively managed, whether to ensure that caribou population performance meets the conservation objective, or for predator-prey management control. An active management program (including intervention actions) and continuous monitoring of population dynamics as well as caribou response over the time period of the Project will be required. The challenges are not insurmountable, and hence, from a biological perspective, the Project could be defined as feasible.

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5.0 Research Opportunities

The challenge for those managing caribou in the Arctic will be to develop a better understanding of how natural and anthropogenic factors interact to affect caribou populations over long periods. This understanding can be accomplished not only by implementing new and innovative research programs, but also by making the best use of the large volume of data already available (Murphy and Lawhead 2000).

5.1 Research Discussion

Despite the large amount of intellectual and financial resources that governments and the industrial sector have spent on the subject of woodland caribou, there are still significant knowledge gaps that limit our ability to address caribou conservation and management. This observation speaks to the intricate ecology of the species and its relationship to industrial development in the boreal forest. Two recent reports, one for woodland caribou across Canada (NCASI 2007a) and one specific to Alberta (Bentham 2004), have summarized the "state of the science" and attempted to identify research needs.

A fenced caribou safe zone of the size that is being considered has no precedent and will provide a unique opportunity to better understand woodland caribou ecology and behaviour. Research should focus on providing insights on caribou ecology that can guide not only management of the local population, but can also be applied to caribou management outside the enclosure. In this context, research endeavours should be kept distinct from studies aimed at assessing population response to the fence.

In Chapters 2 and 4, several inventory and monitoring programs were identified and suggested. Their objective is to collect data that should guide, if needed, the selection process of the area to be fenced and assist in wildlife management decisions during the first five years of its existence. Baseline data will allow assessing wildlife population response to various management initiatives, from the establishment of the fence to a possible predator management program. Specifically:

- Caribou population monitoring: Radio-telemetry, with at least 10 GPS collars, should be used to monitor caribou movements and distribution before (pre-construction) and after the fence is put in place. GPS-fix schedule should be selected based on the specific animal behaviour question that is investigated (e.g., distribution, movements, habitat selection, etc.) and on the life-span and type of collars used. This data will assist in selecting the Project area, documenting range and habitat use within the enclosure, and will provide the foundation to determine population response (calf survival, recruitment, etc.) and animal behaviour in relation to the existence of the fence.
- Moose and other ungulates: Standard ungulate aerial surveys should be conducted to assess numbers and distribution, and to monitor population response to the fence, to the reduction of predators and to the overall constrained environment.
- Predator/prey dynamics: Once the area for the Project area enclosure is selected, wolf occurrence and density needs to be determined following standard fixed-wing aerial surveys methodology. A more detailed study that identifies wolf packs, their movements, overlap with caribou high use areas, and their diet, following Latham et al (2011), is recommended before any management program for wolves is implemented.

- Health, diseases and parasites: A program should be initiated to determine the health of the animals within the enclosure and the incidence of parasites through blood serum and fecal analysis following the methodology used by Johnson et al. (2010).

As we have mentioned in Chapter 4, for the first few years habitat-vegetation inventory and use, though desirable, will not be necessary if the area selected includes the home ranges of resident caribou

> *"Critical habitat for boreal caribou is most appropriately identified in terms of the local population range (the geographic area used by a local population)" (Environment Canada 2009)*

Although specific landscape thresholds have been identified that would allow the area to support a self-sustaining population in a natural system (Environment Canada 2008, see Table 2 Chapter 1), a fenced environment, with little or no predation, creates a different landscape where the standard threshold metrics may not apply. The assumption is that those ranges meet the needs of caribou and, given the right conditions (e.g. low or no predation), will allow the existence of a reproducing population.

It should be noted that these studies should be conducted regardless of whether a fenced caribou safe zone is established. There is a need for basic inventory knowledge, and these types of inventory initiatives are needed for knowledge-based caribou conservation-related land use decisions throughout northern Alberta and potentially beyond the provincial border.

The inventory programs suggested will provide a first solid database on which specific research programs can be designed. We see research as the application of the scientific method to answer specific questions and predict future behaviour. In 2009, Musiani (University of Calgary) and Hebblewhite (University of Montana), in an unpublished letter to the Alberta Caribou Committee Research Subcommittee, made some specific recommendations for caribou research and conservation. While the recommendations were specific to the migratory woodland caribou in west-central Alberta, they have value for the resident woodland caribou in the rest of the province. Specifically, they focused on research on gene flow and connectivity between herds and populations, spatial population and viability analysis, and the development of planning tools.

A fenced large area will provide numerous research opportunities that could all be rationalized and justified. Here, building on the Musiani and Hebblewhite recommendations, we will focus on some of the aspects that we believe should be a high priority for caribou conservation and predator-prey management. More specifically:

- Habitat use. There have been numerous studies of habitat selection by woodland caribou and various site-specific Resource Selection Functions (RSF) have been developed. The fenced enclosure, where caribou limiting factors are controlled and habitat disturbance is minimized, will offer the opportunity to test and refine multi-scale habitat modeling approaches. These could then find a more reliable application in the surrounding region.

- Caribou response to corridors/linear disturbances inside (absence of predators) vs. outside the enclosure could be investigated. A hypothesis could be developed for the possible habituation to corridors/linear disturbances in the absence of predators. This research could have significant

impact on management decisions and activities for land use, industrial developments, and caribou protection outside the enclosed area.

- Population size assessment (new approaches). Estimating caribou population sizes is a significant challenge and still surrounded by uncertainties. Recently, Hettinga (2010) has shown that sampling of fecal DNA could be a reliable and non-invasive alternative to monitoring caribou population sizes. The fenced, "controlled" environment that is being considered would provide an unique opportunity to test this technique which may also complement our understating of caribou genetics in the boreal forest (see below).

- Predator management. Most of the wolf control programs in North America have consisted of removing wolves by shooting them from the air. However, in the early 1990s, in the Yukon, "*experimental wolf fertility control was effective in reducing the rate of increase of wolves and that it was more publicly acceptable than lethal control*" (Farnell 2009). If the decision is made not to extirpate all the wolves from the enclosure, the fenced environment will provide a unique opportunity to research and refine this approach (Spence et al 2009).

- Nutritional condition. Little is known on the diet and nutritional status of woodland caribou (NCASI 2007 a, b). However, it is well understood that the nutritional conditions of ungulates negatively impact body conditions, calf survival and, potentially, susceptibility to predation. The fenced caribou safe zone will provide a "controlled" environment where animal diet and nutritional status can be assessed, population parameters better understood, and specific questions related to population performance answered.

- Health and parasites. Following or in combination with an assessment of the incidence of parasites in caribou (see monitoring), the importance of parasites as mortality factors should be examined.

- Connectivity, isolation and gene flow. Most of our knowledge of caribou movements and distribution comes from radio-telemetry of female caribou, and it seems to indicate little movement between ranges and even between herds (ASRD 2010). However, gene flow may still occur as a result of male dispersal, which has not been studied and is not understood. The fence may actually result in the genetic isolation of the caribou herd. A research program that focused on collaring and monitoring of male caribou movements (Musiani and Hebblewhite unpublished) in and outside the fenced area is recommended.

- Genetic structure. To address concerns about genetic isolation, a research program should be initiated focusing on the genetic structure of the herd within the enclosure in comparison to the surrounding area, using a combination of mitochondrial DNA (mtDNA), microsatellites and spatial ecology, following McDevitt et all (2009),

- Population viability Analysis. The fenced caribou safe zone will allow the development and testing of spatially-explicit population viability analysis models for boreal woodland caribou that, by linking habitat to demography, could then be used to assess viability under different

management scenarios. This research is consistent with the program supported by CAPP and PTAC in west-central Alberta (Hebblewhite et al. 2010).

5.2 Conclusion

A fenced caribou safe zone of the size that is being considered will provide a unique opportunity to better understand woodland caribou ecology and behaviour. Inventory, monitoring and research initiatives will provide insights on caribou ecology that can guide not only management of the local population, but can also be applied to caribou management outside the enclosure. Furthermore, it will promote partnership with researchers and research institutions for the common objective of caribou conservaton. A recommendation for research funding is provided in Chapter 7.

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6.0 Costs and Timing

> *Economists and ecologists treat each other warily and often sceptically...the disciplines are rooted in a very different set of values and beliefs. Yet, the less they talk past each other, the more likely progress will be made in resolving road ecology issues. (Foreman et. al. 2003)*

6.1 Discussion

The previous chapters in this report have outlined the regulatory and scientific aspects that may be precursors to the actual implementation of a fenced caribou safe zone. There is of course considerable uncertainty that the Project would be initiated despite the possible conclusion that it is feasible on several counts. It is very possible that government decisions (political or regulatory) and/or public reactions, may curtail implementation.

The official Woodland Caribou Policy for Alberta (Government of Alberta 2011) indicates the need for "immediate action". Other key planning and management documents are unequivocal in their call for a response "now" (for review, see below). The urgency of the situation therefore does not appear to be at issue. The actions necessary in terms of landscape and habitat conservation and management are widely accepted at the scientific and technical level. Implementing them is recognized as a major challenge requiring "aggressive" intervention and "tough choices"

Nonetheless we have assumed here that the Project is viable to this point, and an analysis of timing and financial needs is required to complete the overall feasibility assessment of the Project.

The cost of predator control programs is extremely variable and is dependent upon, among other things:

- the degree and duration of preliminary inventory and survey information required in the proposed Project area and in the land areas adjacent to the Project,
- the predator control method (culling, sterilization or non-lethal capture and removal),
- the cost of aircraft for surveillance or helicopter for management activity,
- the remoteness of the control area,
- the aerial extent of the study area,
- the role of the public (e.g., trappers, hunters, First Nations personnel),
- the duration and intensity of the control program,
- the degree of monitoring and follow-up, and
- the establishment and monitoring of control areas.

Listed below are the references that illustrate the cost of predator control programs.

Van Ballenberg (2004) quotes that the cost of removing 1300 wolves between 1976-1983 was $824,000 ($2.4 million in 2010) or about $63,000 ($183,000 in 2010) per wolf (Russell 2010).

Schneider (2010) reported that a pilot wolf control in the Little Smokey range in Alberta cost $35 per km^2 per year

Schneider also estimated that the average cost of wolf control per herd in Alberta was $3,720,000 ($380,000 to $8.23 million) for 10 herds in Alberta.

The cost of current Alaskan control programs is over $3.7 million per year (Russell 2010).

The Southwest Yukon predator/prey study between 1982 and 1987 cost $1.375 million ($2.8 million in 2010) (Russell 2010).

Although official figures for the Finlayson project are not available, Farnell (Russell 2010) maintains that the annual budget during the control program from 1983 and 1990 was between $50,000-$70,000 ($96,000 - $135,000 in 2010) per year for the wolf removal activities and caribou monitoring. This value does not include the cost of monitoring and research studies and moose surveys conducted post-control program. The Finlayson area was about 23,000 km^2. The wolf population estimate in 1983 was 238 animals in 24 packs. Six years later, when the cull was suspended, only 29 wolves in seven packs remained (about 14–17% of the original population). The total number of wolves killed was 451 wolves. Of course, every year new pups were born. In 1994, there were again 20 wolves. The Finlayson project was conducted in eastern Yukon and expanded over 23,000 km^2. So, $50,000/year might be considered low in relation to with the estimated $ 35/km^2 that Schneider estimates for the Little Smoky, based on D. Hervieux (pers.comm.) ($35 over 2000 km^2 = $70,000/year). The cost of aerial shooting will vary widely depending on weather conditions, visibility, topography, and size of the area. Note that we are talking about an area 10 times as large as the one that might be considered in north-eastern Alberta. The overall cost was estimated at $96,000/year-$110,000/year ($US 2010). On a km^2 basis, the cost is substantially less than what Hervieux estimated for the Little Smoky (4-5 $US vs. 35 $C). Considering how many variables can play a role in such a program, and looking at cost estimates from the other programs, $35-$45 / km^2/year may be a reasonable estimate.

Kinley, in a caribou population augmentation report (Kinley 2009) prepared for Banff National Park, determined that wolf monitoring and management would cost over $92,000/year. The majority of that amount devoted to helicopter use for wolf surveys and control activities. He also found that caribou monitoring by the use of 40 telemetry collars would have costs of $265,000 over three years, again including considerable helicopter time. He assumed that labour costs would be nil, as that portion would be donated by the BC Ministry of Environment, which gave him considerable efficiencies with his estimates. The main cost for this type of monitoring was the initial capital cost of 20 radio-collars in each of the first two years of the monitoring program. Kinley provides a complete analysis of estimated costs for caribou translocation and monitoring in his report.

Morgantini 2011 (pers. com) advised that over a five-year period, the costs of caribou inventory (including aerial surveys and analysis) cost just under $600,000. This cost covered radio-collars ($200,000) and helicopter surveys ($100,000).

The following spreadsheet presents a seven-year budget estimate for implementation of a fenced caribou safe zone with the input from the previous chapters regarding science, regulations, and design.

Activity	Year One	Year Two	Year Three	Year Four	Year Five	Year Six	Year Seven
EIA Process (if required)							
EIA preparation and process	$ 500,000	$ 500,000					
Outreach by staff (travel, documents)	$ 150,000	$ 150,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Predator & Prey Control			$ 100,000	$ 100,000	$ 20,000	$ 20,000	$ 20,000
Construction of 1/2 area by four teams (20)			$ 1,000,000	$ 1,000,000			
Administration & staffing							
Project Director	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Project Science Advisor	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Construction Manager			$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Administrative Staff			$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000
Lease of yard area/office			$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Operations and Maintenance							
Seasonal Construction Staff (4)					$ 250,000	$ 250,000	$ 250,000
Equipment & Materials							
Posts			$ 250,000	$ 250,000	$ 10,000	$ 20,000	$ 10,000
Wire fencing			$ 200,000	$ 200,000	$ 5,000	$ 5,000	$ 5,000
trucks, posthole auger, transport			$ 100,000	$ 100,000	$ 10,000	$ 10,000	$ 10,000
snowmobiles (3)			$ 35,000	$ 5,000	$ 30,000	$ 5,000	$ 5,000
helicopter			$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 10,000
Fuel			$ 80,000	$ 80,000	$ 20,000	$ 20,000	$ 20,000
Science							
Collars (10)	$ 60,000	$ 10,000		$ 60,000			
Helicopter Capture	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Helicopter Surveys	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
Leveraged Research			$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
TOTALS	$ 955,000	$ 905,000	$ 2,450,000	$ 2,480,000	$ 1,030,000	$ 1,015,000	$ 995,000
						7 YearTotal >>	$ 9,830,000

6.2 Design and Pre-construction

Comments on design specifications and construction activity are presented in Chapter 3.

Preconstruction activities would involve establishing a staging site for crew deployment, equipment storage, post and wire storage, and administrative/office facilities. These aspects are relatively easy to implement, and a construction firm awarded the Project would likely have experience with the logistics required for the Project. The pre-construction aspects of the regulatory framework and stakeholder outreach are predicted to need considerable planning and regulatory activity compared to preparing for construction.

Prior to construction there will be considerable amount of discussion, meetings, and presentation with regulatory staff and the public. This aspect is critically important to the success of the Project and appropriate time and resources will need to be brought into action. We thus suggest that a full year (Year One in the budget) be devoted to outreach and discussions with “stakeholders”. If, however, an EIA under provincial regulation is deemed necessary before proceeding, at least 18 months (Year One and Year Two) would be added to the pre-construction timeline and $500,000 added to the costs for those two years. If an EIA is not required by provincial jurisdictions, a saving of $1 million in the overall budget can be realized. It is possible, perhaps even likely, that the regulatory process will present numerous obstacles to the establishment of a fenced safe zone.

The science component of the pre-construction period was outlined in Chapter 4. This aspect may involve extensive field work to collar and monitor the subject caribou herd, and management of wolves and alternate prey within the zone once it has been defined geographically. These management activities can take place prior to and during fence construction, but will also have to be extended for several years post-construction within the established fenced zone.

6.3 Construction

While it may be safe to assume that the construction activity would be sent to a standard tendering process with the best (not necessarily lowest in terms of expenses) bid awarded the work, an overall estimate is required to provide costing information. Thus a seven-year budget is provided from the aspect of a new project being implemented in a relatively remote area.

On the basis of several assumptions and preliminary design criteria, it is estimated that the time required to install a fence of 40 km X 50 km dimensions would take at least two years (Year Three and Year Four in the budget), with four crews working concurrently in each working season. Contractors with experience with wildlife fencing projects such as the Highway #1 fencing in Banff National Park, similar fencing along the Coquihalla Highway in British Columbia, illustrate that long fencing projects are viable. The specific difficulties that will be found while constructing a fence in northern Alberta will increase the costs considerably.

6.3.1 Short Term Management Actions

The main activity of any short term management will be the introduction of the Project to the public and stakeholders. The regulatory roadmap (a recommended action in the short term) needs to be prepared and implemented prior to the Project being approved by the industrial partners.

Recommendations are also provided for biological inventory activities and development of a regulatory framework. If taken to the next stage of implementation, there are several aspects of the Project that need to be defined, and discussions with regulatory staff and stakeholders need to begin. Costs associated with these actions are incorporated in the budget in Chapter 6.

6.4 Post-construction and Ongoing Maintenance

A large component of the Project costs will be allocated to maintenance and repair of the fenced enclosure. In addition to the patrol of the fence line and repair of downed or damaged sections, the surveillance of the caribou, alternate prey, and wolf populations and population dynamics will be required. The costs outlined in the Chapter 6 budget place appropriate emphasis on these aspects.

Foreman et. al. (2003) makes the observation that fence maintenance is usually neglected shortly after construction and is a major concern because priorities and budgets change over time. Meanwhile, fence damage and gaps are a continual problem.

6.5 Conclusion

Industrial partners such as those in the OSLI group have vast experience with complicated development projects in northern Alberta. A fenced safe zone with an area of approximately 2000 km^2 or more is a relatively small construction project by comparison. Nonetheless, the regulatory process and stakeholder relationships are seen as being the critical factors in the feasibility of a fenced safety zone. This study recommends that the Project, if implemented, be administered by a new corporation with management policies (e.g., HSE) in place and with salaried staff focusing on the Project.

This study finds the construction aspects, including pre- and post-construction, as being feasible. It also finds the financial aspects of the Project as being feasible though difficult to discern for such a unique situation.

6.6 Literature cited

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7.0 Conclusions and Recommendations

"There are very few alternatives. The alternatives for example to predator control is building vast fences and maintaining protection, which is economically just not feasible. It is difficult." (Federal Environment Minister Peter Kent quoted in The Canadian Press, 2011)

7.1 Conclusions

1. The process of pursuing a fenced safe zone will provide opportunities for achieving other goals, as yet unstated by OSLI, but which merit consideration; for example
    - ❖ Assist in halting the decline of the woodland caribou population
    - ❖ Contribute to woodland caribou recovery
    - ❖ Assist in mitigating the regional impacts of oil sands development

2. Based on the analysis of Strategic Design Considerations provided in Chapter One, it is concluded that this aspect of the Project is feasible biologically in that a fenced, predator-free, managed population of caribou in suitable habitat can reasonably be expected to increase. The urgency of the status and prospects for woodland caribou has been expressed by several authorities, including the Government of Alberta in its official policy for the species. This gives impetus to an initiative such as the fencing Project contemplated; however, feasibility is placed in doubt by three key issues that must still be investigated:
    - ❖ legal, regulatory and policy complexities and gaps;
    - ❖ direct intervention such as a fence is novel, therefore untested, and potentially controversial and politically risky, in that enclosed caribou could not be defined as "self-sustaining" and therefore might not be considered "wild"; and
    - ❖ the risks inherent in the necessary consultation and public information process that would precede Project implementation.

3. Based on the analysis of Tactical Design Features provided in Chapter Two, it is concluded that the Project objective of housing the entire range of a known herd within a fenced area of 600 – 2000 km^2 is not feasible; however, depending on the strategy adopted, woodland caribou in a fenced area of 600-2000 km^2 could be managed such that population density increases. It should be feasible to select a suitable area of this size range that meets a variety of key criteria; however, land use designations and competing and traditional land uses may affect feasibility negatively. Among the herds considered, our preliminary analysis suggests that the area identified as "Zone 1" in the Richardson herd range appears to offer the best prospect for a caribou safe zone. A relative paucity of population information for the Richardson range would have to be overcome. Design, erection and monitoring of a fence will be technically challenging but feasible; in this sense, feasibility will be primarily dictated by willingness to incur high costs.

4. Based on the analysis of Methods for Construction and Maintenance provided in Chapter Three, it is concluded that this aspect of the Project is feasible. There is considerable experience in building long fenced enclosures, though few extensive fences have been built in typical northern Alberta conditions. Nonetheless we believe the construction and maintenance issues can be

overcome with basic project management processes, financial commitment into the future, and adaptive operational approaches. Thus, this aspect is feasible.

5. Based on the analysis of Caribou Management provided in Chapter Four, it is concluded that the Project is feasible. The establishment of a fenced area to support a self-sustaining caribou herd has no precedent and it will pose numerous wildlife management challenges. Though these challenges are not insurmountable, a complex and dynamic wildlife community constrained within a fenced region of boreal forest will have to be actively managed, whether to ensure that caribou population performance meets the conservation objective, or for predator-prey management control. Where knowledge is not available, an assessment of the critical predator/prey relationships present, and understanding their population dynamics, will be required as part of the fencing program. An active management program (including intervention actions) and continuous monitoring of population dynamics as well as caribou response over the time period of the Project will be required. The feasibility of the Project will hinge on predator control.

6. Based on the analysis of Research Opportunities provided in Chapter Five, it is concluded that the Project is feasible in that it can provide numerous research opportunities and promote partnerships with researchers and research institutions. Research on caribou in other regions and for other objectives will still need to be conducted, but the Project offers several unique research opportunities that can be used to guide the overall question of caribou survival.

7. Based on the analysis of Costs and Timelines provided in Chapter Six, it is concluded that this aspect of the Project is feasible. This Project will require extensive management processes, along with the commitment to at least 10 years of funding in the order of $1 million to $1.2 million per year. It is difficult to express this amount in the terms of $$/caribou saved. Note that significant cost savings could be realized if a provincial EIA process could be streamlined.

7.2 Overall Conclusion

It is difficult to determine the feasibility of the Project with limited exploration of the issues. This report offers an identification of the barriers and opportunities facing the Project, and more work is required to fully appreciate how high the hurdles are going to be. Nonetheless, this study has not identified insurmountable barriers or “show-stoppers” to the Project but have noted where and how implementation can move forward. It is recommended that that this study be considered a preliminary first step in a broader process of implementing the Project. As a “stand-alone” study, it should not be used as a determinant to proceed with full implementation, but as a guide for additional analysis and risk assessment. If a decision is taken to proceed to the next step, the Project would be subject to widespread technical and public review. The next steps will be sensitive from several aspects, but the Project may be necessary to continue gaining knowledge on the survival of the caribou of northern Alberta.

7.3 Recommendations

The topic of an enclosed safe haven for woodland caribou is a novel, controversial and innovative concept. If implemented further, the Project's next steps must include an analysis of the complex regulatory environment, and development of a consultation plan. It will be a complicated undertaking. In this context, it is recommended that a number of initiatives be considered.

1. Many sources indicate that public consultation, particularly with First Nations, will be essential before land-related actions related to woodland caribou recovery are taken. Without such consultation having taken place, a fence project is unlikely to be feasible. If a decision is taken to take the next step, we recommend that a consultation plan be developed.

2. Establishment of an expert advisory group to guide the scientific and technical foundation of the Project if it progresses to the next stage.

3. Release of Project information and subsequent outreach activities should be coordinated by a public information group. This role would be best conducted at the next stage of Project design as well as during the consultation and operational stages.

4. A well-designed educational program for land users, now and in the Project's future (e.g. extensive signage and outreach), is recommended.

5. A regulatory roadmap needs to be prepared and implemented prior to the Project being approved in principle by the industrial partners, A regulatory guide of this nature would reveal legal and regulatory risks and should include a review of provincial and federal regulation and case law that may be applicable (e.g., West Moberly decision of the BC Supreme Court).

6. If the Project advances to a further stage of assessment, the potential institutional vehicles for implementing the Project must be considered. In that the private sector is not the authority for management of endangered species, and has the potential for perceived conflict of interest, but may well provide funding, an arm's–length entity may be necessary. This could be a public-private partnership representing the collective interests of all stakeholders with a common objective. If the Project is deemed feasible overall and approved for implementation, we recommend that a corporation of this type be created to administer the construction of a caribou safe-zone, and to manage the on-going operations it will require. This organization will administer the financial, communications, construction, and maintenance of the fenced safe zone under a formal corporate structure.

7. Neighbouring disposition holders (e.g., energy and forestry), must be brought into the next stages of implementation (before the Project proceeds to the stage of implementation). These stakeholders would be necessarily brought into the discussion as part of a broad consultation program, but we believe it would be more effective and bring added resources to the Project if these organizations were added as partners to the Project.

Alberta-Pacific Forest Products (AlPac) has extensive vegetation mapping and modeling for a large part of north-eastern Alberta. This source of information should be explored upon initiation of the Project, possibly in a partnership arrangement between forestry and energy interests.

8. Promote caribou research through an annual grant contribution of an amount that would attract several research proposals. Specific research projects could be developed through a workshop process that would include researchers, industry stakeholders, government staff, and biological/wildlife consultants.

9. Plans should be developed for the recovery and recycling of fencing materials and reclamation of ground disturbances at the close or abandonment of the Project. This topic would be part of a broader environmental management plan developed for the implementation of the Project.

10. If the Project is deemed feasible overall and approved for implementation, we recommend that roads and other surface disturbances within the safe zone be reclaimed through a systematic process of prioritizing and implementation of reclamation standards. This will augment the effectiveness of the fenced area.

11. Given the risks inherent in a requirement for EIA, particularly those of time delay and cost, it is recommended that OSLI approach the Alberta Ministry of Environment and the Canadian Environmental Assessment Agency to determine whether an EIA would be required.

12. Once the area for an enclosure is selected, wolf occurrence and density needs to be determined following standard fixed-wing aerial surveys methodology. A more detailed study that identifies wolf packs, their movements and overlap with caribou high use areas, is recommended.

7.4 Literature Cited

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