OFFSETTING FOR CARIBOU

TOWARD AN ASSESSMENT FRAMEWORK FOR THE NORTHWEST TERRITORIES

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Executive Summary

The Northwest Territories has been interested for some time in developing a policy respecting the use of biodiversity (aka conservation) offsets as a tool for resource conservation. This interest has been lent currency by the Dominion Diamond Ekati Jay Mine Project and its environmental assessment, by the Mackenzie Valley Review Board, the Wek’eèzhìı Renewable Resources Board, and the general interest of the territorial government in managing the total disturbance in the range of the Bathuurst barren-ground caribou herd. Concurrent with those pressures, the maintenance and recovery of woodland caribou, especially the boreal population, has been rising in priority as a result of a federal Recovery Strategy that requires range planning from provincial and territorial governments across Canada.

Biodiversity offsetting is a concept that proposes that the intentional creation of measurable ecosystem benefits can compensate for those ecological losses from human development that remain after all reasonable steps have been taken to avoid and minimize those losses. The concept requires that we have sufficient knowledge and experience to confidently predict offset activities will in fact produce the desired and expected outcomes and benefits, and that we have a framework to quantify both losses and gains to assure that compensation is adequate. The final part of the definition is often called the “mitigation hierarchy,” which prescribes that losses are to be avoided and minimized to the full extent of reasonableness before offsetting is considered, so that offsetting is undertaken only as a last resort for unavoidable “residual” losses.

The rationale for the mitigation hierarchy is the risk involved in offsetting, risk that the offset projects will fail or that they will not produce the necessary compensation. In keeping with this concern, when dealing with ecological resources of high value and sensitivity, which cannot be reliably replicated, offsetting ought not to be held out as a viable or appropriate measure. This is often called the doctrine of “non-offsetability.”

When offsetting is held to be appropriate, it is important that it be guided by clear conservation objectives and priorities. Often this is expressed in terms of no net loss of a particular ecological components or set of attributes. Assessing the value to society of components will combine science, traditional ecological knowledge, and the values expressed by communities, stakeholders, and aboriginal peoples.

An offset system requires a framework to draw equivalency between those ecological features lost to development and gained via offset activities. This includes considerations of kind, proximity, condition, and quantum. Such a framework may be challenging when offsetting is being pursued on a

like-for-like basis. The complexity of pursuing out-of-kind offsetting should, according to many commentators, limit that direction to those situations where there is a compelling and clear conservation advantage.

One common equivalency framework for habitat offsets uses a metric of area, modified by a condition rating of the degree of anthropogenic degradation of each site. Such an approach may be applicable to boreal caribou, where habitat changes are a limiting factor to species recovery. Federal policy prescribes that each range of boreal caribou have at least 65 percent undisturbed habitat.

Metrics have also been proposed for various species of concern, mainly base upon population numbers and factors. Conceptual difficulties arrive, however if one must convert between currencies, such that for example, habitat loss (measures in hectares x condition) are to be compensated for by augmenting the species population. This requires that a reliable common factor be found between the two metrics. This may be required for offsetting for barren-ground caribou, where habitat is not the limiting factor for the population. The report examines some situations where this conversion of currencies has been attempted, admittedly imperfectly.

Offset measures and outcomes must be additional, meaning that they would not have occurred in the absence of the offset initiative. Judging this requires consideration of how conditions would have unfolded in such absence, which is referred to as a baseline. It is against the baseline that the legitimacy and value of offset measures is to be assessed.

Offset measures are often broken into two types: positive management actions (physical interventions to improve ecological conditions) and averted losses (legal or other measures to preserve existing ecological conditions in the face of a threat). Each of these has its strengths and weaknesses, which are reviewed. The option of using research and education as an offset is often viewed skeptically, though it is being considered under Alberta's new wetland policy.

Offsetting inevitably involves certain risks and uncertainties. One of the more common mean of compensating for this risk is to apply multiplier ratios to offsetting, requiring the offset benefit to be some multiple higher than the expected negative development impact. The multiplier may be a standard one set by policy or it may be customized to each situation.

In order to adequately compensate for ecological losses an offset may have to persist for a very among time, even perpetually. It is important in planning the offset, then, to provide for future monitoring, management, governance, and finances sufficient to cover all those expenses. Governance is particularly important as a way of involving all those with an interest in the offset. It is important that the legal authority of the governance body be clearly set out.

Offsetting occurs within a social context. Planning must take into account existing rights of several types. Further the traditional activities and ecological knowledge of aboriginal peoples and communities can offer important insights to the offset process. The changes in conditions caused by offsetting may cause social disruption or inequities. Open community and stakeholder consultations can help to avoid such situations.

In the final section of the report four Canadian case studies of offsetting for boreal caribou are reviewed.

Contents

1. Background

The Northwest Territories has been interested for some time in developing a policy respecting the use of biodiversity (aka conservation) offsetting as a tool for resource conservation. While GNWT has been exploring offsetting as a tool to manage total disturbance on the range of the Bathurst herd as proposed in the Draft Bathurst Range Plan, the notion has received further traction through recent decisions of the resource co-management boards. For the environmental assessment for the Jay Project, proposed by Dominion Diamond Ekati Corporation (DDEC), the Mackenzie Valley Review Board (MVRB) required DDEC to use offsetting benefits for barren-ground caribou to counteract the negative impacts of the project. The MVRB has also required the Government of the Northwest Territories (GNWT) to evaluate the effectiveness of the offset measures proposed by the proponent in its Caribou Offset and Mitigation Plan. In addition, the Wek'eèzhìı Renewable Resources Board, in considering the GNWT- Tłı̨chǫ Government joint proposal for management of the Bathurst caribou herd in 2017, has recommended that the two governments investigate the use of offsets and develop criteria to assess the effectiveness of different types of offsets. The need to consider a range of options for recovery of barren-ground caribou has grown with the formal assessment of barren-ground caribou as 'Threatened" by both the NWT Species at Risk Committee and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).Concurrent with this, the maintenance and recovery of woodland caribou is of pressing policy interest across Canada and within the NWT. The woodland caribou is distinct sub-species from the barren-ground caribou. According to a COSEWIC classification system the woodland caribou is divided into six geographically distinct populations, of which the boreal population (hereinafter "boreal caribou") is the most widespread across Canada (Environment Canada 2012b). Boreal caribou are listed as "threatened" under both the NWT Species at Risk Act the federal *Species at Risk Act*, and a Recovery Strategy under the federal legislation was released in 2012 (Environment Canada 2012b). The strategy assigns responsibility for the development of range plans providing for the maintenance and restoration of ranges to the provinces and territories within three to five years of the strategy's release, meaning those range plans are now due.

The currency of all of these interests and developments has brought a sense that now is the time to launch an active investigation into the advisability and effectiveness of offsetting. This report is intended to contribute to that process. It outlines a series of questions and considerations that may be applied in any situation where biodiversity offsetting is being considered as a tool of environmental stewardship. From it might be derived principles and processes which might apply to the larger work of offset policy development.

The bulk of this paper considers the fundamental elements of biodiversity offsetting, making special reference to the applicability of those elements to both barren-ground and boreal caribou. Canada has had a good deal of experience in offset programs for other species and ecological features, particularly fisheries and wetlands. A list of all Canadian biodiversity offset programs known to the author is included as Appendix II.

While the use of offsetting for caribou is still quite new, there are a handful of Canadian pilot projects or other experiences with respect to the boreal sub-species. These are briefly reviewed in the final section of the paper.

1.1 Barren-ground Caribou vs. Boreal Caribou

Barren-ground caribou and boreal caribou have very different ecology and are subject to different types of pressures, which will influence how offsetting might be approached for each subspecies. Barren-ground caribou are migratory and on an annual basis travel many thousands of kilometres from wintering grounds within the treeline to calving areas on the barrenlands. Migration is a key adaptive strategy allowing for barren-ground caribou to respond to variability in environmental conditions, predation and parasitism. During winter, barren-ground caribou are spread out in small to moderate sized groups. During calving, the females congregate in an attempt to reduce vulnerability of newborn calves to predation. Populations of barren-ground caribou (also referred to as “herds”) are known through traditional and western scientific approaches to cycle from periods of high to low abundance over several decades. While the causes of population fluctuations are complex and likely driven by interactions between forage availability, predation and parasites, unprecedented pressures from changing climatic and environmental conditions, forest fires and, for some herds, industrial development have cumulatively contributed to unprecedented lows in several herds.

Boreal caribou live in forests year-round, and while they may make seasonal migrations, they do not undertake the long distance seasonal migrations seen in barren-ground caribou. In winter, they congregate in small groups (usually <20 individuals), while at other times of the year, particularly calving, females space out throughout the range to reduce the risk of predation. Boreal caribou require large tracts of older forest to space themselves away from other ungulates such as moose and deer, and predators such as wolves. The location and configuration of habitat for Boreal caribou is highly dynamic over time, primarily due to forest fires. The primary threat to boreal caribou is habitat loss and fragmentation from human and natural causes (e.g. fire) which facilitates unnaturally high predation rates.

While this paper provides a broad overview of the concept of offsetting with reference to considerations that may apply to caribou, given the different ecology and threat profile of barren-ground and boreal caribou, further assessment of specific approaches for each sub-species will constitute a "next step" to be undertaken by the GNWT.

2. Offsetting for Biodiversity: Concept, Assumptions and Limitations

2.1 Offsetting: The Concept

Offsetting for biodiversity is a concept which proposes that the intentional creation of measurable ecological benefits can substitute, compensate, or provide a counterweight for those ecological losses from human development or activity remaining after all reasonable steps have been taken to avoid and minimize those losses (BBOP 2013, Bull et al 2013). This definition holds within it several components which are critical to understanding, designing and administering offsets.

The first is that offsetting focuses on measurable ecological benefits (i.e., outcomes). While intention and activities to implement that intention are important, it is the beneficial outcome which forms the essence of the offset, just as the substance of the loss from development is the essence of the problem to be addressed. This focus on outcomes dictates that in order for offsetting to be a legitimate tool of conservation, we must have sufficient knowledge and experience to confidently predict that offset activities will in fact produce the desired and expected outcomes and benefits. The centrality of this expectation is further discussed below.

The second important part of the above definition is that the benefits produced are an adequate substitute, compensation for, or counterweight to the negative impact. This implies a framework for measuring and comparing losses and gains based on some notion of equivalency (Quetier & Lavorel 2012). Implicit are questions of how similar the losses and gains must be and how proximate in location and time. Again, this will be further addressed later in this report.

Finally, the definition notes that offsets are only meant to address those ecological losses remaining after all reasonable steps have been taken to avoid and minimize the losses from development, often called the "residual losses" (BBOP 2013, Bull et al 2013, Poulton 2014). This is an expression of the "mitigation hierarchy," which is expressed in offset guides and policies almost universally (Darbi et al 2010, eftec & Ieep 2010, McKenney & Keisecker 2010, BBOP 2013, Bull et al 2013, Environment

Canada 2012a, Fisheries and Oceans Canada 2013, Birdlife International et al 2015, CSBI 2015, Poulton 2015).

2.2 The Mitigation Hierarchy

As the name implies, the mitigation hierarchy is a principled ranking and sequence of types of conservation measures. First and foremost, development proponents and those who regulate them are expected to take all reasonable measures to *avoid* causing environmental harm in the first place. This includes, but is not limited to, locating development away from sites of ecological importance, reduction of the primary physical footprint, design features that maintain ecological features intact, and timing activities to avoid intersecting with temporary or seasonal environmental values (such as breeding or migration seasons) (Birdlife International et al 2015, CSBI 2015). Avoidance can also include giving active consideration to a "no project" option (Gardner et al 2012). This latter aspect, however, may be more a function of conservation and resource planning than the consideration of an individual project (Birdlife International et al 2015).

The effective implementation of avoidance will usually require its consideration at the pre-planning stage of a project, as important opportunities to avoid may be lost by the time the project fundamentals are decided (CSBI 2015). However, avoidance should also be borne in mind throughout the life of the project, for opportunities and options to exercise avoidance may arise at any point including operation upon completion (CSBI 2015).

The second step in the mitigation hierarchy is *minimization*, which has been defined as "measures taken to reduce the duration, intensity, significance and/or extent of impacts (including direct, indirect, and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible" (CSBI 2015). This is typically implemented though the environmental assessment and mitigation process, but should not necessarily be limited to the measures legally required by that process. The Cross-Sector Biodiversity Initiative, a partnership between the petroleum, mining and finance sectors, has classified minimization measures into three types of controls: physical (structures), operational (behaviour), and abatement (technology) (CSBI 2015).

Minimization often requires more active management than avoidance and offers the opportunity for ongoing innovation and demonstration of effectiveness. It must be acknowledged, however, that minimization is generally less certain in its effectiveness than avoidance (CSBI 2015).

The next step in the mitigation hierarchy is *on-site restoration*. These are measures to reduce or repair degradation that may occur on the development project site in early stages, but which are not necessary to the long-term operation of the facility. Restoration goals may refer to baseline conditions prior to the project, to external reference conditions, or to new conditions based on special environmental objectives (CSBI 2015).

The rationale for restoration has been as follows: "*Restoration* is the most important remediative component of the mitigation hierarchy because it aims to reverse the impact damage directly, and arrive at a desired upgraded state. *Restoration* therefore has the potential to reduce the liabilities associated with residual impacts." (CSBI 2015, italics in original)

Offsetting, the creation of measurable environmental benefits, is the fourth and final step in the mitigation hierarchy, aiming to counterbalance the residual negative impact after full application of the previous three approaches. It is, of course, the primary subject of this document, but its primacy here ought not to suggest its primacy in the hierarchy. Indeed, it ought to properly be viewed as the last resort to address only those impacts which cannot be eliminated by the prior steps of the hierarchy.

The rationale for the sequence in the mitigation hierarchy is risk. The complexity of ecosystem and ecological processes means that one can avoid impacts with much more certainty than one can restore or create ecosystem functions. (CSBI 2015, Fisheries and Oceans Canada 2013). Those natural values which are the victims of residual impacts, and which require offsetting, therefore, are placed at greater risk than those which are left intact by avoidance and minimization.

One of the common critiques of offsetting is that it provides an invalid rationalization for applying less rigour to project review, amounting to a "license to trash" (ten Kate et al 2004). Strict adherence to the mitigation hierarchy by both proponents and regulators is a safeguard against any such inclination.

2.3 When Offsetting is Not Appropriate

This same consideration of risk dictates that there will be some circumstances where the risk of loss of an object of environmental value will be unacceptably high. There are, therefore, limits to those circumstances where offsetting will be feasible or appropriate. In those circumstances the residual environmental loss ought to be squarely acknowledged as the likely outcome of the development.

One often-cited model offers guidance as to whether the residual impact in any particular case ought to be considered to be offsetable (BBOP 2012a, Pilgrim et al 2013). It prescribes that the vulnerability of the object of ecological concern in the residual loss, and the irreplaceability of that object, be weighed against the theoretical and practical opportunities and barriers for providing effective offsets.

If the species or ecosystem of concern is highly vulnerable or irreplaceable, and there is low opportunity to provide effective offsets, then the object should be considered to be non-offsetable. Further, the authors suggest that the more risky the offset proposition, the heavier should the onus be on the developer to establish that offsetting can actually be done effectively (Pilgrim et al 2013).

Where it is found that it is not practically possible to offset the impacts of a project regulator face the hard choice between allowing the project and accepting the negative impacts, or rejecting the project in the name of conserving the vulnerable ecological resource. The unrealistic prospect of offsetting should not be used to gloss over a stark either-or decision. Because of the serious implications of such a decision, non-offsetability should be considered in land use and resource planning so as to avoid luring a development proponent into an untenable situation. The failure to consider it in the planning process, however, ought not to imply that it not be looked at the project assessment stage.

Because of the importance of determining offsetability and the scope of factors involved, it should be considered at the beginning of the project planning process so as to avoid investing resources in planning a project likely to produce non-offsetable impacts. As well, it should be considered at the end of the process to assure that the initial assumptions supporting offsetability are actually borne out by the findings of the environmental planning and assessment process.

2.4 Assessment Process Summary

The Mitigation Hierarchy

1. ***Has the proponent taken all reasonable measures to avoid environmental impacts?***
2. ***Has the proponent taken all reasonable measures to minimize those environmental impacts which are unavoidable?***
3. ***Has the proponent taken all reasonable measures to restore on-site environmental loss which might be temporarily unavoidable, but which can be restored?***

Clarifying Residual Loss(es)

4. ***What is the nature of the residual environmental loss(es) after all questions 1 to 3 have been answered in the affirmative?***

Determining Offsetability

5. ***Are the objects of the residual loss of high conservation concern?***

6. ***Is the object of the residual loss replaceable given the state of knowledge and experience with restoration techniques?***
7. ***Are there actual offset opportunities available within the trading rules established? (See the discussion of equivalency below.)***
8. ***Is there sufficient expertise and capacity available to actually deliver the planned offset in a timely and reliable manner?***

3. Key Issues

3.1 Conservation Objectives and Priorities

In seeking to apply the offset model it is important to consider and be explicit about conservation objectives and priorities. It is impossible for an offset project to replicate all of the features of the location and ecosystem that will be impacted by development, so it is critical that all involved have clear guidance as to what features are critical or highly valued.

Often offset programs prescribe a goal of "no net loss" of biodiversity (McKenny & Kiesecker 2010, Poulton 2015). Indeed, one internationally-noted definition of biodiversity offsets includes no net loss as an essential element (BBOP 2013). Not all policies, however, do in fact make such an absolute commitment (Alberta 2013, Poulton 2015a). Whether or not the goal of no net loss of biodiversity is accepted, there is a need to define the substance of the concerns in question in the particular circumstances. Biodiversity is a concept encompassing a vast multitude of elements and characteristics, which inherently vary by location and circumstance. To be meaningfully applied it must be pinned down to particular objects of concern in a particular social and ecological circumstance.

This process is a combination of social values, science and traditional ecological knowledge. Communities, stakeholders and aboriginal peoples may inform the assessment of the social, economic, cultural and aesthetic value of ecological functions, landscape features, species communities, etc. Science and traditional ecological knowledge can inform as to the functions and relationships necessary to sustain or replicate those valued objects, and thus where second-order values may lie.

Often the true object of conservation value may not be directly observable or measurable. It is thus frequently necessary to use science to identify proxies and indicators that will adequately represent the underlying objects of value (BBOP 2012b). It is important to understand when particular objects are valued in themselves and when they are indicators of other valued aspects of the ecosystem, for this may help to frame offset options. For example, the presence of a particular species may be valued for its own utility or social or cultural value. Alternatively, a species might be a valued as a proxy for a healthy ecosystem (an "umbrella" or indicator species). In the first case, where the conservation priority is the sustaining of the species itself, offset measures to sustain the species such as captive breeding or supplemental food may be permissible offset measures, even if they do not address the degradation of the surrounding ecosystem. In the case of an indicator species, however, a healthy ecosystem might be pursued without regard to the species itself, so long as one refers to other reliable indicators of ecosystem health. If both aspects are of value, then combination of both types of measures may be required.

3.2 Equivalency

At the heart of the offset model is the notion that the key features of the impacted site can be adequately replaced through offset measures, with the two in a relationship of equivalency. In other words the relevant features of the two sides of the offset balance sheet must match in a way which meaningfully serves conservation objectives and priorities. There are three aspects to the issue of equivalency that should be considered: kind, condition and extent. These have been most thoroughly explored where offsetting is conceived of in terms of habitat, with one piece of habitat being exchanged for another. Analogues may be found in other types of offsetting, however.

Equivalency of kind refers to the degree of similarity in features and functions between the impact and the offset sites. Given that no two locations will be identical, what degree of similarity is necessary to be deemed acceptably equivalent? The underlying assumption is that sufficient similarity of the sites will allow for the same elements to be included in the loss and gain constituting the offset.   This judgement will be informed by the conservation objectives and priorities. Often equivalency of kind will be determined by reference to some landscape or ecosystem classification scheme.

Part of the equivalency of kind is a consideration of the proximity of the two impacts. The offset model assumes that the negative impacts of development and positive impacts of offset measures will affect the same ecosystem, and therefore counterbalance one another.   The physically closer the two, the more likely that is to occur. The distance will vary, however, according to the particular focus and objective of the exercise. To maintain a wildlife movement corridor, for example, the impact and offset might have to be directly adjacent. On the other hand, for other functions it may be sufficient that they be in the same watershed or natural region. On a similar note, where offsetting is aimed at maintaining a particular species, it may be desirable to limit offsetting to the same herd, range or regional sub-population.

The second aspect of equivalency is condition, which typically means the degree of anthropogenic degradation. Two sites might be alike in kind, but quite different in the degree of degradation they exhibit. This typically has been applied to habitat conditions, as discussed in Section 3.2.1 below. The concept, however, might be expanded to apply to species exhibiting a measurable level of health or resiliency.

The third aspect of equivalency is extent, or the quantum of the negative and positive impacts. The metric by which the extent is measured is often called the "currency" as it forms the medium of exchange of ecological features between the impact and the offset site. The notion of currency requires that both the positive and negative impacts be meaningfully measured using the same indicators and metrics.

The fidelity of the currency to the underlying social values and conservation objectives will in large part determine the success of offsetting. The currency will drive offsetting measures that enhance the value that the currency represents. If the currency is not faithful to the underlying values, it will likely produce offset measures which do not satisfy the requirements of those values (Salzman & Ruhl 2000). A proper accounting of all significant environmental values may require the use of multiple currencies (BBOP 2012b). For example where a development project impacts habitat on which several species of concern are dependent, it may be necessary to have a currency reflecting habitat metrics and other currencies for the relevant metrics of each of the particular species. If the impact affected twenty hectares of habitat and also reduced the population of two species, the required offset might be (not taking into account multipliers for the sake of this example) the restoration of twenty hectares of comparable habitat and the reintroduction of individuals of the same two species. Some examples of species-based offsetting are set out below in Section 3.2.2..

The above discussion presumes that offsetting will occur on a like-for-like basis, that is that the offset design seeks to replicate that same ecological features and functions as are lost to the impact. There may be circumstances, however, where there is an opportunity to advance a conservation objective of a higher priority than the values being lost to development. For example, it has been proposed that it would be more cost-effective to direct offsetting for oil sands mining in Alberta toward conservation of caribou or dry mixedwood forest than to replicate the features of the boreal forest lost to mining (Habib et al 2013). This proposal, while widely noted, has not been adopted into Alberta policy.

Because offsetting out-of-kind creates many conceptual challenges, and amounts to a redesign of the ecosystem, it should be approached with caution. Many commentators and policies urge that offsetting should be presumed to be on a like-for-like basis, and that offsetting out-of-kind should only be pursued where there is a compelling rationale and a clear conservation advantage (BBOP 2012b, Environment Canada 2012a, British Columbia 2014, Poulton 2014, Bull et al 2015). This position is often summarized as “like-for-like or better.” The remainder of this discussion, therefore, is based on the objective of offsetting like-for-like.

3.2.1 Habitat Metrics

Most offsets are based on habitat. For these the most common currency components is area. That is, the area of the offset will be compared to the area disturbed by the development. Area alone, however, is rarely an acceptable currency even if they sites are similar in kind (BBOP 2012b, Quetier & Lavorel 2012, Bull et al 2013). This is because differences in condition may make sites of the same area quite different in terms of the magnitude of their ecological functions.

One type of currency which seeks to address this modifies area by a factor representing ecological condition. The most well-known of these is the “habitat-hectare” developed in the State of Victoria in Australia. It is based on a rating of 0 to 1 for the condition of a piece of land, 1 representing undisturbed or pristine ecological features and functions and 0 representing total ecological loss (Parkes, Newell & Cheal 2000). A moderately impacted site may, for example by rated at 0.65. If the area was 10 hectares, it would be assigned a measure for offset purposes of 6.5 habitat-hectares (0.65 condition score X 10 hectares). The Alberta Biodiversity Monitoring Institute has developed a similar “area x condition” metric for the Canadian context called “impact-adjusted area” or IAA (ABMI 2012). Note that a condition-modified area metric treats the measures of area and condition as functionally interchangeable, such that an area of 10 hectares with a 0.65 condition score is deemed equivalent to an area of 6.5 hectares with a condition score of 1.

The *Alberta Wetland Policy* is a good example of an area-based habitat metric, though it recognizes wetland values beyond wildlife habitat (Alberta 2013). First, it uses a rating of condition and function which is based upon a detailed survey of five factors: biodiversity and ecological health, water quality improvement, hydrologic function, human uses and relative abundance. These factors yield a four level function rating of A to D (A representing highest function and D the lowest). The function rating of the wetlands lost to development are compared with those of the wetlands restored, constructed, enhanced or protected as offsets and the relationship of the two yields the applicable standard multiplier (Alberta 2013). Finally, there is a strong preference for offsetting to occur in the same municipality, region, and watershed as the loss, which brings proximity into the formulation of the offset prescription (Alberta

2015). Within the constraints of proximity and condition, however, the core currency in the Alberta policy is area, as measured in hectares.

Such area-based habitat metrics are applicable to the situation of boreal caribou,where the limiting factor on populations is directly tied to habitat changes. According to the federal Recovery Strategy:

> Boreal caribou require large range areas comprised of continuous tracts of undisturbed habitat. In general, boreal caribou prefer habitat consisting of mature to old-growth coniferous forest (e.g. jack pine (*Pinus banksiana*), black spruce (*Picea mariana*)) with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas. Large range areas reduce the risk of predation by allowing boreal caribou to maintain low population densities throughout the range and by allowing them to avoid areas of high predation risk, such as areas with high densities of alternate prey species (e.g. moose and deer) and predators (e.g. wolf and bear). Boreal caribou use a variety of habitats to avoid predators, including muskegs and bodies of water, as well as mature and old-growth forests. (Environment Canada 2012b, references and cross-references omitted.)

Further, boreal caribou avoid recently disturbed or early seral stage forests in favour of more nutrient rich mature forests. The more mature forests also provide more protection from predators. These habitat needs are particularly important for calving and early life (Environment Canada 2012b).

The causal chain threatening boreal caribou populations, and the recommended response to it, are concisely set out in the Executive Summary of the federal Recovery Strategy of 2012:

> The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of human-caused and natural habitat loss, degradation, and fragmentation. These habitat alterations support conditions that favour higher alternate prey densities (e.g. moose (*Alces alces*), deer (*Odocoileus* spp.)), resulting in increased predator populations (e.g. wolf (*Canis lupus*), bear (*Ursus* spp.)) that in turn increase the risk of predation to boreal caribou. This threat can be mitigated through coordinated land and/or resource planning, and habitat restoration and management, in conjunction with predator and alternate prey management where local population conditions warrant such action. (Environment Canada 2012b at vii)

The federal recovery strategy prescribed a habitat recovery target of 65 percent undisturbed habitat in each of the 51 identified boreal habitat ranges. Only one of the ranges is in the Northwest Territories. This is the Northwest Territories Range (NT1), encompassing 44,166,546 hectares in the western part of the Territories. With an estimated disturbance of 33 percent, of which 27 percent is due to fire, the range is deemed to be likely self-sustaining (Environment and Climate Change Canada 2017).

This is in contrast to the ranges found in the western provinces which clearly tend to be not self-sustaining, particularly severely so in Alberta (Environment Canada 2012b).

3.2.2 Species Metrics

Currencies have also been developed or proposed where the population of a vulnerable species is the key target of an offset scheme. Specifically, in two studies of seabirds, increasing mortality from one source has been proposed to be offset by reduction of mortality from another. In Scott Cole's examination of the deaths of White-tailed Sea Eagles (*Haliaeetus albicilla*) from wind turbine collisions in Norway, he proposes that these deaths can be offset by retrofitting electrical transmission lines to prevent sea eagle electrocution (Cole 2010). This assumes that the power company is not responsible for such retrofitting, meaning that the action by the wind company is value added and thus additional. (See Section 3.3.1 below respecting additionality.) Similarly, Wilcox and Donlan (2007) have proposed that the population impacts to seabirds of mortalities by fisheries bycatch might be offset by gains from eradicating invasive predatory rats on islands where the birds breed. In both of these proposals the authors note the importance of making an adjustment in simple mortality figures to take into account any difference in the life stage and age of birds that die at the impact and offset sites, adjusting the currency accordingly. In this regard Cole suggests that losses and gains not be measured simply by counting birds but by accounting for "bird years" such that the longer life expectancy of a young bird would count for more than that of its elder. On the other hand one might imagine that a robust and breeding adult might in some circumstances count for more than a vulnerable juvenile.

3.2.3 Currency Conversion

The issue of currency choice becomes more difficult where conversion between two or more currencies is envisioned. How, for example, does one compare a loss of habitat with measures to reduce mortality or otherwise boost a species population? How can habitat-hectares be converted to surviving adults? The task requires some work to understand and define a common measure between the two currencies. With respect to bridging habitat losses and population changes, one route for this conversion is through the use of habitat suitability indices, which purport to predict species abundance based on habitat characteristics. The reliability of such indices, however, is often questioned and should be considered in applying them to management decisions (Burgman et al 2001).

This is relevant to the management of barren-ground caribou because the focus of concern with the species is the precipitous drop in the population of some herds, especially the Bathurst herd, which has suffered a 96 percent population loss in 30 years (GNWT 2016). The limiting factor does not appear to be habitat, yet there may be energetic costs to a caribou of encountering, residing near or diverting around the site of a development project that can impact reproduction If enough caribou experience these impacts, this could translate to impacts at a population level. There is a need, therefore, to find some common factor and currency which will allow habitat losses (and gains) to be compared with population changes including projected gains from offset actions.

While there is a good deal of experience in Canada in the formulation of offsets and offset policy, the issue of relating habitat losses (gains) with population change has not been often confronted in many cases, and where it has system designers admit it has been done in a very loose manner.

British Columbia has had at least two experiences in currency conversion. The first, and most fully considered, is concerned with Northern Spotted Owl (*strix occidentalis caurina*), which has suffered from both a loss of habitat, due to the destruction of old growth forests, and direct loss of population. The British Columbia government has developed a species recovery and action plan that addresses both habitat and population. Officials are currently satisfied that habitat restoration is likely to result in sufficient habitat to meet the needs of the owl to the planning horizon, but not that there will be a sufficient owls to populate the new habitat (Lensky 2017). In the absence of clear policy guidance (now under development) program administrators within the British Columbia government developed a system whereby development proposals are evaluated in terms of the type and quality of habitat they would compromise or destroy. The cost of replacement of that forest habitat is estimated based on well-established silviculture standards and pricing. Proponents and regulators are presented with the options of creating replacement habitat at that cost or contributing that amount of funds to an owl recovery fund. That fund may be used to finance any aspect of owl recovery, but currently is primarily expended on a captive breeding program and barred owl eradication (barred owls being an aggressive habitat competitor to northern spotted owls) (Lensky 2017). Note that this system does not use an owl-for-owl currency, or a habitat-to-population conversion. Rather, the replacement cost of the forest acts as a proxy to allow habitat loss to be compared with the expected outcomes of population enhancement measures (i.e., a habitat-to-dollars conversion followed by a dollars-to-owls conversion with no intent to establish a habitat-to-owl equivalency).

The more informal example from British Columbia focuses on the Oregon Spotted Frog (*rana pretiosa*), which resides exclusively in the Fraser Valley at the northern extent of its range (Lensky 2017). A shallow pool specialist, the frog's habitat has come under severe pressure from agricultural development. Many of the residual populations exist in agricultural drainage ditches which must be periodically dredged. Fortunately, shallow dredging of vegetation only allows frogs to escape from the resulting vegetation pile back into the water. More aggressive dredging of rock and silt, however, is a significant cause of frog mortality.

As a safety net for the frog population the Province maintains three captive breeding programs at zoos across Canada. Using graduate student research, it has assessed the average cost for these programs to produce a single adult breeding female, successfully reintroduced to the wild, at $50,000 (perhaps more given that the breeding programs enjoy a good deal of in-kind support) (Lensky 2017). The Province uses this impressive figure in communications with dredgers and the development industry to stress the importance of avoidance and to encourage offsetting of various forms. While this program is far from fully fleshed out, it is another example of how the intermediary metric of financial cost might bridge impacts and offset actions.

Some admittedly-imperfect examples from afar may be also be instructive. Bull et al (2013) considered the plight of Saiga Antelope, which roams widely on the plains of Uzbekistan and Kazakhstan. The antelope population was, at the time of the study, threatened by poaching (the primary threat), the range-shifting effects of climate change, dust from the lowered level of the Aral Sea, competition from domestic grazing, and disturbance and fragmentation of habitat and migration routes from petroleum development. In exploring offset opportunities for new petroleum development the research team recommended the financing of an anti-poaching system, exchanging habitat and migration disturbance for a lowering of direct mortality. Implicit in this process is that the common currency is the antelope population, and that loss of habitat can be notionally quantified in terms of antelope population impacts, which can then be compared to the gains from reduced poaching.

The State of Alaska does not currently provide for offsetting or compensation for habitat impacts on barren-ground caribou (Winters 2017). A federal program, custom-designed for the Northeastern National Petroleum Reserve is currently being proposed by the Bureau of Land Management (BLM 2016). The draft program does not dwell on caribou, but does include them with many other environmental, social and cultural values within its consideration. It concludes that compensatory mitigation (i.e., offsetting) is appropriate for the subsistence, sociocultural and environmental justice impacts of petroleum development on subsistence of local (especially indigenous) populations and also perhaps upon the environmental impacts (USBLM 2016).

Admittedly still subject to consultation and feedback, the draft program does not appear to attempt to quantify impacts nor to draw any quantity-based equivalency with compensatory options. Potential impacts are simply identified as minor or major. A ranked list of compensation options is to be the subject of consultations with communities. Either stakeholders or the BLM may identify preferred actions. Once a suite of actions is settled upon, the development proponent may take those actions directly or may pay a per-acre fee set at a level to adequately cover all costs of the actions (USBLM 2016). The extent of action to be taken seems to be set by reference to stakeholder perceptions and tolerance rather than any refined notion of equivalency. If so it is less an offset program based on biodiversity or natural values than a compensation program aimed at assuaging stakeholder anxiety.

The potential for a more sophisticated form of conversion may exist with respect to barren-ground caribou in the form of a model to assess the population impacts of energy and protein intake (White et al. 2014, Russell 2015). The model purports to be able to link seasonal nutritional intake to birth rate, age of first reproduction, impacts on calf survival, and impacts on cow survival, which collectively may be linked to changes in population. Considering the disruptive effects of development on habitat and migration, and how those factors affect nutritional intake, the chain from development to population impact is completed. If this model is valid (its evaluation is far beyond the expertise of the author) it would be very valuable in assessing the type and extent of offset options and obligations for development. It would provide a foundation for assessing the range of offset measures from habitat restoration to nutritional supplementation (both of which would compensate for nutritional loss) to other population support measures (predator management, harvest reduction, etc.), as well as the amount of each that would be equivalent to the negative development impacts.

3.2.4 Assessment Process Summary

Are the conservation objectives relevant to the project impact clear? Has adequate consultation taken place with communities, stakeholders, indigenous populations, etc. to understand the values at stake?

Has enough scientific knowledge been gathered to understand the ecological functions and relationships which support the values and objectives?

What proxies and indicators are necessary and appropriate to measure the status and any change in those objectives?

Has the anticipated or actual residual loss from the development project been adequately quantified in the selected metric(s)?

Are the outcomes of the offset measures under consideration capable of being measured in those same metric(s)?

Using those metric(s) which are common to both the outcomes of the development and the offset measures, what amount of offset measures must be undertaken to produce positive outcomes equivalent to the negative impacts of the development.

3.3 Permissible Offset Measures

The range of conservation measures which may qualify for recognition as offsets will be defined, and limited, by the conservation values at stake. These may be particular to each particular situation. Offset theory is helpful, however, in prescribing some basic concepts.

3.3.1 Additionality and Baselines

Foremost among these is the doctrine that offset measures and outcomes must be additional. An offset proponent cannot legitimately claim credit for action that would have been taken otherwise or outcomes that would have occurred otherwise (i.e., in the absence of the offset initiative). This includes not only actions that might have been taken, or outcome produced, by the offset proponent themselves, but by other parties, including government agencies. The rationale for this doctrine is that the proposed development is bringing an additional negative impact, so the offset must bring an additional positive one if it is to be a true counterweight.

The application of the doctrine of additionality requires that an assessor consider how things would have unfolded in the absence of the offset initiative. What ecological conditions would have prevailed and what actions might have been taken by a variety of actors? The scenario thus constructed will form the baseline against which the additionality of the offset initiative will be judged, as well as the extent of the offset calculated. (For a full discussion of the nature and potential complexity of additionality in the context of greenhouse gas offsets see Gillenwater 2012.)

The baseline will give guidance as to what kinds of offset measures are legitimate and valuable. For example, if the baseline assumes that existing conditions will continue and persist, then measures to assure their persistence through protective measures, for example, may not be considered additional. If existing conditions are assumed to be threatened, however, then action to alleviate the threat and maintain the status quo is likely a legitimate offset (ten Kate et al 2004, Bull et al 2014).

The concept of baseline can helpfully be divided into two further concepts: baseline proper and counterfactual (Bull *et al* 2014). Baseline proper assumes that the existing situation will continue, and simply assesses the proposed offset outcomes against current conditions. A counterfactual, on the other hand, sets out a specific alternative course for future events, perhaps based on perceived trends or plans. Any offset proposal should make clear whether it is using a baseline proper or a counterfactual.

The offset proponent should set out the assumptions of the baseline in detail. This will allow the reasonableness of the assumptions to be assessed. If they are accepted, they will be foundation for the measurement of the offset. An uncertain baseline makes for uncertain measurement of the extent of the offset.

3.3.2 Types of Offset Measures

Offset measures are often broken into two types: positive management actions and averted losses. Each of these has positive, negatives and risks.

Positive management actions direct physical interventions in the ecosystem to improve conditions or functions. This often takes the form of habitat restoration, enhancement, or creation. Where an individual species is the target, such measures as captive breeding, predator control, and disease control are positive management actions.

The most common criticism of offsets based on positive management actions is that the interventions bear a risk that they will fail, in whole or in part, or produce unintentional negative impacts, with the result that the offset will underperform or fail outright. The negative impact of the development will therefore be uncompensated. (Gibbons & Lindemayer 2007 Maron et al 2012, Gardner et al 2013.Critiques of the effectiveness of particular types of interventions are abundant, whether or not considered in the context if offsetting.) For this reason, it is important that any offset plan make clear how the risk of failure will be handled and by who.

Averted loss offsets aim to protect existing conditions against some perceived threat. This may be a specific threat, such as a development planned for the offset site or, more commonly, may simply be a perceived trend which places the persistence of status quo ecological conditions in doubt. Averted loss offsets implicitly accept a declining ecological baseline scenario.

Typically averted loss offsets take the form of some form of legal protection of habitat. The placement of conservation easements (or similar legal covenant) or the transfer of private land into public stewardship are often used for this purpose. Obviously such offsets can only be implemented where the necessary legal and policy tools exist. This is not always the case. For example, conservation easements and covenants are not interests in land recognized in English common law, so require enabling legislation. As well, most jurisdictions do not have a legal instrument that allows a private party to place and secure a conservation action on public land (Poulton 2015b). Similarly, many of the private conservation instruments that do exist yield to access to sub-surface minerals (Poulton 2015b).

More rarely, especially, in Canada, averting loss may be accomplished by intervening in some economic or social process which is driving negative change. For example, the provision of an alternative protein source might be used to stem growing demand for “bushmeat” (ten Kate et al 2004).

Averted loss offsets, especially in the form of legal protection, have the advantage that it is easy to determine what natural values and functions actually exist and will be maintained. The site can actually be visited and assessed as it exists, so there is less need for prediction or speculation. They often have greater cost-certainty as well, as the value of an interest in land can be determined through the real estate market.

The major critique of averted losses as offsets lies in the fact that they rely on a baseline or counterfactual of ecological decline. An averted loss is not an ecological gain unless one accepts the assumption thatloss was in fact a real threat. Expanded to the program level, a system of offsets that relied exclusively on averted losses would generate no improvement in ecological functions, but merely slow the rate of decline.

There is also a risk that the conditions which an averted loss offset seeks to maintain will be compromised from another unforeseen source (such as a catastrophic natural disturbance or unanticipated human activity) against which the protective measures are ineffective. For example, forest habitat might be legally protected against industrial disturbance, but suffer a loss of its intended ecological purpose through wildfire.

A third category of activities are sometimes proposed as offsets, but are often not considered acceptable. This includes such general and indirect measures as educational programs, contributions to research, and capacity-building. Such activities might be justifiable if they could be directly linked to a desired and relevant conservation outcome (such as an educational program changing the problematic behaviour of resource users) but that link is usually not clear. A seminal 2004 study of offset practices and perspectives commented, “Several [interviewees] referred to the ‘cynicism’ stakeholders and observers would feel if companies presented training and scientific research in lieu of damaged ecosystems” (ten Kate et al 2004). Presumably based on a similar rationale, the U.S. federal rule for wetland compensation specifically provides that expenditures on educational programs are not a valid use of offset funds (73 Fed Reg 19657).

On the other hand, reportedly Alberta and the federal government are considering allowing limited use of offset funds for research and education. The *Alberta Wetland Policy* provides that a development proponent impacting a wetland may satisfy offset obligations by either “restorative replacement” (the restoration, enhancement, or creation of an equivalent wetland) or by “non-restorative replacement” (payment of a calculated fee to a designated agency). The non-restorative replacement funds may be used, according to the policy, for averted loss offsets, but also for specified research into wetland restoration measures, provincial level monitoring, wetland inventory and data acquisition, landscape level wetland health assessments and modelling, and public education and outreach (Alberta 2013). After consultation with stakeholders, it is currently intended that expenditures on such activities will be capped at ten percent of non-restorative replacement funds with the allocation decision to be made by responsible government department, not the proponent (Alberta 2015, Hebben 2017). Fisheries and Oceans Canada is rumoured to be considering a similar capped allowance for funds for offsetting for fisheries.

The range of possible offset measures shows the flexibility available in designing an offset system. Such flexibility reinforces the importance of clearly defining conservation objectives and the currency of offsets. Clear objectives will assure that flexibility does not degenerate into opportunism. The selected currency will prescribe which actions and outcomes are actually to receive credit. While other actions may be available, the self-interest of proponents will drive them to undertake only those things for which they will receive credit. Again, the correct selection of one or more currencies will determine the “fit” between those actions and the identified conservation objectives.

3.3.4 Assessment Process Summary

Is the current ecological composition and status of the offset site (or object, if not site-based) well understood and documented sufficiently to describe baseline conditions?

Are trends and factors inducing change well understood and documented sufficiently to describe a counterfactual?

Do the proposed offset measures serve the conservation objectives?

Would the offset measures be carried out otherwise, by the proponent or some other party (including government)?

Would the intended outcomes of the offset measures occur otherwise?

If the offset is based on positive management actions, what does experience tell us about the chance of success or failure in achieving stated objectives?

If the offset is based on averted losses, what is foundation for expecting the losses in the absence of the offset? Is it sufficiently real that the offset adds value?

3.4 Risk Management

Offsetting inevitably involves certain risks and uncertainties, and it is important to the credibility of the exercise that these be acknowledged and accounted for. Potential sources of uncertainty include deficient understanding of ecological features, functions and processes at either or both the impact and the offset site, inaccurate baselines and counterfactuals, partial or total failure of restoration techniques and other positive management measures intended as offsets, legal uncertainties, and the poor long-term management of the offset project due to financial insecurity and human failings. The United Kingdom's Department of Environment, Food, and Rural Affairs (DEFRA) has classified this set of risks as "delivery risks" (DEFRA 2012).

A second set of risks has been labelled by DEFRA "spatial risks," those factors contributing to uncertainty that the provision of ecological benefits at the new offset site may not actually serve the same functions and processes as those features lost at the impact site. Finally, the time lag that very often occurs between the negative effect of the development impact and the positive effectiveness of offset measures creates both a temporary loss of ecological values and a time interval during which other sources of risk might come into play (Moilanen et al 2009, BBOP 2012, DEFRA 2012). The DEFRA classification scheme has been accepted by Canada's National Energy Board in a series of caribou mitigation plans submitted by Nova Gas Transmission Limited in response to conditions placed on development permits (NGTL 2016), as described further below in section 4.3..

One means of managing these sources of risk is the strict application of the mitigation hierarchy and the doctrine of non-offsetability, so as not to subject ecosystems to more risk than necessary. A second suggestion is that offset projects should use a variety of positive management techniques in order to spread the risk that any particular technique might fail (Moilanen et al 2009, BBOP 2012b).

One of the most common risk management tools is the adjustment of the size of the offset by use of a multiplier ratio. At its simplest, the use of multiplier proposes that if there is a 33% chance of failure of the offset (i.e., that 33% of the offset will be ineffective in producing the intended outcome) that may be compensated for by making the offset 50% larger, as measured in whatever currency applies. Of course, this calculation is rarely so simple when applied to actual cases.

In practice, a standard multiplier or set of multipliers may be applied as a matter of policy, often without any explicit calculation or rationale (BBOP 2012b). For example, Ducks Unlimited uses a standard 3:1 multiplier for wetland offsetting in which it is involved throughout North America. More elaborately, the *Alberta Wetland Policy*, released in 2013, prescribes a set of multipliers ranging from 8:1 to 1:8 depending on relationship of the assessed ecological value of impacted and offset wetlands (Alberta 2013).

There have been a few prescriptions recently for formulae to determine customized multipliers. These typically have two broad components: time lag and uncertainty. Time lags are taken into account often by use of time discounting, the same concept by which interest rates and return on investment is calculated (Moilanen et al 2009, Laitila et al 2014). Time discounting is based on the notion that a present benefit (whether an ecosystem or a bank balance) is more valued than a promised future one. To compensate for that gap, the future benefit is subjected to a discount rate reflective of the concerns associated with the delay. (A discount rate can be thought of as the inverse of an interest rate.) The use of time discounting does yield a method of calculating a multiplier for time lags but still requires a discount rate to be decided upon. In financial markets discount rates can be estimated by reference to central bank policy and economic forces such as the demand and supply of money. The absence of such factors in a biodiversity market can mean that time discounting simply moves the best estimating of a figure from the setting of a multiplier to the setting of a discount rate.

Moilanen et al (2009) attempt to set out a more complete rationale for calculating multipliers based upon the degree of uncertainty n particular circumstances. This involves assessing the risk of offset failure based on the past record of techniques used in similar circumstances and calculating a time discount factor to compensate for the time lag in offset effectiveness). A similar approach has been suggested by the Business and Biodiversity Offset Programme (BBOP 2012b). More recently Curran et al (2014) have used statistical techniques to compare the ecological richness of old growth forests lost to actively restored second growth ecosystems, and found that multipliers of up to 100:1 may be applicable in such circumstances. In doing so, their purpose is to cast doubt on the validity of offsetting overall, whereas others have responded that their case merely reinforces the need for caution in the use of offsets and the need for a doctrine of non-offsetability, a discussed above in section 2.3 (Quetier et al 2015). The cost of implementing high multipliers may preclude high risk developments and offsets, making non-offsetability a practical reality through financial pressure. On a similar, but less extreme, note, DEFRA suggests that the use of different multipliers for locations of different ecological importance can be an incentive to promote development and offsetting in respectively optimal locations (DEFRA 2012). Proponents would be motivated by cost o develop in low priority areas, where a lower multiplier would be required, and offset in a high priority area, where they would receive more credit per unit of offset delivered. (This is also part of the rationale for the range of multipliers in the *Alberta Wetland Policy* (Alberta 2013).)

It is important to note that multipliers are not an appropriate means of mitigating some forms of risk. Where, for example, there is a significant risk of total failure of a positive management technique multiplying the size of that failure will bring no benefits (BBOP 2012b).

3.4.1 Assessment Process Summary

Are the "delivery risks" (the risk of offset measures failing to deliver intended outcomes) well understood and quantifiable?

Are the positive management measures the best available?

Is the offset employing a variety of techniques or relying on a single technique?

Is the risk from the change in location of ecological features or functions well understood and quantifiable?

What time lag is expected between the development impacts and the implementation of offset measures? What time lag is expected between the implementation of offset measures and achievement of the target condition? What margin of error surrounds these time estimates?

Based on the above, what multiplier is most representative of the total risk and time lags and most likely to mitigate them?

3.5 Long-Term Management and Financing

As will be clear from the above, there can be a significant time lapse between the initiation of an offset project and its attaining its desired ecological condition. In some cases this can be decades or even centuries. Further, if a goal of no net loss, or something approximating it, is to be achieved, then it is commonly agreed that the duration of the offset should be at least as long as the duration of the development impact (ten Kate et al 2004, McKenney & Keisecker 2010, Bull et al 2013, BBOP 2013). In some cases that may be perpetual.

It is highly unlikely that the development proponent will wish to maintain responsibility for the management of the offset measures over the long time frame, and it probably lacks the expertise to do so. Therefore, it is important that the planning of the offset include consideration of how long-term management will be carried out. There are at least three standard considerations: governance, financing, and monitoring (BBOP 2009b).

While the developer has received credit for the offset measures, interest in its benefits may be widespread among conservation groups, local communities and indigenous peoples. It is therefore often useful to involve these groups in the management of the offset project. One common way of doing this is through the governance structure. In many cases the offset proponent will partner with a conservation group, such as a land trust, in the design and implementation of the offset. Once the project has been proven viable and stable, the proponent will receive the desired credit, and the project will be turned over to the conservation group for continued management, including ownership of the relevant interest in land. In some cases this will be a long-standing and broad based group (such as a nation-wide land trust), while in other cases it may be formed precisely for the offset purpose. In either case it is important to legally define the authority of the management body and how decisions will be made. This is particularly true if the group is new. Regulators will likely have a role in assuring that the governance provisions are adequate to meet the commitments that the offset entails.

Management and monitoring are not free. It is important that management arrangements include consideration of how it will be financed. Typically, this will be done by the proponent establishing a trust or bond sufficient to cover management expenses for the foreseeable duration of the offset (BBOP 2009b). Again, this is usually considered in the early stages of offset planning and included as a cost to the proponent.

Finally, if regulators and stakeholders are to be satisfied that the offset measures will in fact produce the desired ecological outcomes, a monitoring regime will be necessary. Note that typically monitoring is considered for two distinct purposes. The first is compliance monitoring, in which the regulator will check to see that actionable commitments are in fact being carried out. The second is outcome or effectiveness monitoring, which reviews and records outcomes. It is the second concern that is our primary concern here. The specifics of the monitoring regime will depend on the nature of the offset project and its intended outcomes. Likewise, the duration of the monitoring program will depend on the time frame in which the offset project is expected to reach a stable state and predictable succession. (As an example, in the case of the Nova Gas boreal caribou habitat offsets mentioned above, the National Energy Board has required annual monitoring and reporting on vegetation regrowth and species use of restored areas for a period of fifteen years (NGTL 2016).

3.5.1 Assessment Process Summary

Is ownership of the offset project (including land and all other assets) clear and legally secured?

Is authority and accountability for the long-term management of the project clearly defined? Is it secured through necessary legal arrangements and clarity around decision-making, etc?

Does the long-term management system take into account a variety of interests? Is the structure satisfactory to achieve this, if desired?

Is there sufficient funding secured to cover all costs of long-term management and monitoring?

What are the monitoring requirements of the offset project? Are their clear monitoring protocols and defined time intervals? How is data reported and to whom?

3.6 Social Aspects of Offsetting

While offsetting might sometimes appear to be an exercise in scientific assessment and rigour, it is important to remember that it is fundamentally a social exercise reflecting a community ethic of environmental stewardship. The chances of success are enhanced if an offset program reflects community values and contributes benefits to the community (BBOP 2009a, 2009b).

An obvious first step in considering the social implications of offsetting is to note that offsetting must occur within a set of pre-existing legal rights and obligations. Property rights, treaty rights, and rights of traditional use, among others, must all be respected in whatever offset plans and activities might unfold.

This report has already discussed the critical need to clearly identify the values which an offset program is intended to serve. An important part of that exercise will be gathering input from all segments of the community respecting their knowledge, views and activities with respect to the environment.

The traditional knowledge and activities of aboriginal peoples and communities can be invaluable in this process. Consultation with First Nations and other indigenous peoples is a legal obligation, but not only that. Such engagement can pave the way for better project planning at both the impact and offset sites.

The same holds true at the more grounded level of mitigation and offset design. With proper consultation with all concerned, particular features of value may be preserved at the impact site, or provided for in the offset plan.   For example, if boating is a popular activity, an offset designer may provide for a dock on a restored lake. Not all aspects of an offset project have to be strictly ecological.

Just as the shift in features and functions from the impact site to the offset site carries a risk of ecological disruption, so might it result in social disruption For example, a wetland might provide recreational and aesthetic value to Community A. If that wetland is lost to development, but compensation is provided through the enhancement of another wetland that benefits Community B, then Community B benefits will come at the expense (lost amenities) of Community A. This raises a question of equity and social and political tensions may arise. Open community and stakeholder consultations can help to avoid such circumstances.

Finally, involving communities in the design and implementation of offsets may bring social and economic benefits. The management and physical work of constructing the offset project may create employment. Further, the need for ongoing monitoring and management measures may create an opportunity for mobilizing traditional knowledge and enhancing it with new training. In short, the offset project has the potential to be an economic driver.

In considering the social aspects of offsetting it is important to distinguish between the consideration of community input as means of designing an offset program which achieves biodiversity goals in a manner that is social acceptable or beneficial, and a program which accepts biodiversity loss but seeks to assuage community concern through the provisions of other unrelated benefits. As mentioned in Section 3.2.3 above, the federal compensatory mitigation program under development in Alaska may be of the latter type.

3.6.1 Assessment Process Summary

Does the offset project respect all legal and traditional rights?

Has consultation with affected communities and stakeholders been adequate to understand their values and concerns?

Is traditional knowledge being adequately considered in impact mitigation and offset design?

Are there questions of equity between communities or stakeholder groups as a result of the offset? Has that been adequately addressed?

Is the offset project creating new opportunities for involvement, education, or employment?

4. Offsetting for Boreal Caribou: Canadian Case Studies

As discussed above, the federal recovery strategy for boreal caribou focuses on habitat, and assumes that forest disturbances can be restored in order to become suitable habitat in the future. It is this process of forest restoration that has become the focus of most of the thinking on boreal caribou recovery and the consideration and experiences of offsetting to date. In anticipation of the need for progress in this area, there have been a handful of Canadian experiences in offset design for boreal caribou in the last few years.

4.1 The Algar Caribou Habitat Restoration Project ("the Algar project")

The Algar project is a pilot project sponsored by the Oil Sand Leadership Initiative (OSLI).[1] Starting in 2011 it had the five-year goal of restoring linear disturbance in an area of 570 sq km in a region of boreal forest adjacent to the Athabasca River upstream of Fort MacMurray, Alberta. The goal was to test the viability of forest restoration as a means of eventually offsetting (at least in part) the forest impacts of oil sands development. Because the project was collaborative, a pilot, and mainly concerned with the technical viability of restoration, there was no attempt to draw any equivalency between the projects benefits and any particular disturbance, nor the scope of oil sands disturbance overall.

The Algar project used techniques of mounding the soil to alter the line of site on linear disturbances (often used by predators to spot caribou), seeding, placement of course woody debris and winter planting (because of the boggy and wet landscape). In some sites where natural regeneration was proceeding, only protection of that process was provided. The first tree was planted in 2012 and by the completion of planting in 2016, 162,000 trees had been planted in this manner, combined with the protection of natural regeneration, this covered 341 km of linear disturbance. The rate of planting accelerated through the life of the project. The project work, assuming successful maturation, would increse the intactness of the project area (as assessed by the methodology of the federal Recovery Strategy) from 33 percent to 62 percent.

The project sites are currently being monitored for the growth of the new vegetation, the obscuring of sightlines through growth, and for wildlife use of the restored areas. There has also been a systematic program of monitoring ecosystem services through the project. Preliminary results indicate

[1] OSLI was a collaboration among six oil sands operators with the mission of improving performance, including environmental performance, in the oil sands industry. Since the commencement of the Algar project it has been subsumed into the larger Canadian Oil Sands Innovation Alliance (COSIA): see http://www.cosia.ca/.

that growth is occurring, and site lines are growing in, but that the browsing of the young plants is an inhibiting factor. While it is unknown to date whether caribou will re-inhabit the restored area, the project is showing signs of enhancing other attributes and ecosystem services of a healthy boreal forest.

Sources:

John Peters, "AACO: The Algar Caribou Habitat Restoration Project Case Study," webinar given for the Alberta Association for Conservation Offsets, January 5, 2017, online: <http://www.aaco.ca/events--publications.html>.

COSIA, "Caribou Habitat Restoration," webpage, online: <http://www.cosia.ca/initiatives/land/land-projects/caribou-habitat-restoration>.

Silvacom Ltd., *Assessing the Ecosystem Service Benefits of the COSIA LEAP Program, Phase 2, Interim Report 1 of 3,* (Edmonton: Silvacom Ltd., 2015), online: <https://ecoservicesnetwork.ca/media/uploads/contributor-11/Interim%20Report%201%20of%203_FINAL%20DRAFT_Dec%202015_for%20web.pdf>.

4.2 Linear Deactivation (LiDea) Project

Similar in intention to the Algar project the LiDea project has been an initiative of Cenovus Energy, working in co-operation with COSIA. The project is focussed on the restoration of old seismic lines and other linear disturbances in an area in the northeast corner of the Cold Lake Air Weapons Range of eastern Alberta. The area is also part of the Cold Lake caribou range. Using treatment methods similar to the Algar project, the LiDea project has restored an area of 39,147.89 hectares (391 linear kilometres, plus 500 metre buffer on each side) since its inception in 2011. This represents approximately 17 percent of Cenovus' mineral leased area in the region.

Like the Algar project, the LiDea project is aimed primarily at establishing the feasibility of landscape-scale restoration of boreal forest. It has not included consideration of some of the technical aspects of offsetting respecting the goal of equivalency. Its ongoing monitoring program indicates that tree growth is occurring on treated areas (though not necessarily equally among all tree species) and that animal movement and use is gradually returning, though evidence of the latter factor is less thorough for practical reasons.

Sources:

Cenovus Energy, "Caribou Range Fragmentation Metric" n.d., map

Cenovus Energy, "Cenovus's Linear Deactivation Project: Restoring Caribou Habitat in Northern Alberta," April 2014.

Cenovus Energy, "Cenovus Caribou Habitat Restoration Project," June 2016.

Angelo Filicetti & Scott E. Nielsen, Éffectiveness Monitoring of Restoration Treatments for Seismic Lines in Treed Peatlands" n.d., poster.

4.3 Nova Gas Transmission Ltd. Caribou Habitat Offsets

Canada's most extensive experience with offsetting for caribou habitat has come as a result of conditions imposed by the National Energy Board. Nova Gas Transmission Ltd. applied to the NEB to build a series of pipeline extensions in northwestern Alberta in the years from 2010 to 2015. In considering each application the NEB imposed increasingly strict and detailed conditions requiring the offsetting of boreal caribou habitat. The NEB placed the onus on the company to develop an offset plan, and such a plan was eventually developed to the satisfaction of the Board.

The NGTL plan, which is now well into implementation, included explicit consideration of the mitigation hierarchy, a methodology for the calculation of the residual habitat loss, and the application of multipliers to arrive at the amount of offsetting required. Of particular interest is how the multipliers were arrived at. Environment Canada had made the recommendation that a standard multiplier of 4 to 1 be applied. In spite of this the NEB insisted that a customized multiplier be developed. The company chose to follow a methodology that had been developed by the United Kingdom Department of Environment, Food, and Rural Affairs (DEFRA). The methodology included distinct multipliers for each of three risk factors: delivery risks (possible failure of offset measures), spatial risks (the difference in location between impact and offsets), and temporal risks (time lags). It also discounted impacts which added incrementally to previously existing disturbances as compared with entirely new disturbances. In one area the result of this calculation was that a total residual disturbance (including both direct and indirect disturbance) of 38.1 hectares was deemed to be properly offset by habitat restoration on 43.09 hectares.

The selection of offset sites was complicated by the absence at the time of an Alberta policy on offsetting and the lack of caribou range plans identifying priority areas for restoration. As a result of discussions with Alberta Energy and Parks the decision was made to undertake the restoration of linear disturbances in newly created wildland parks in northeastern Alberta, a considerable distance from the impact sites. This plan and method of offsetting was held to be acceptable by the NEB.

Sources:

National Energy Board, *Reasons for Decision: NOVA Gas Transmission Ltd. GH-2-2010*; National Energy Board, *Reasons for Decision: NOVA Gas Transmission Ltd. GH-2-2011*; National Energy Board, *Reasons for Decision: NOVA Gas Transmission Ltd. GH-004-2011*. Each of these decisions reports may be found on the NEB website by making use of its search engine at <https://apps.neb-one.gc.ca/REGDOCS>.

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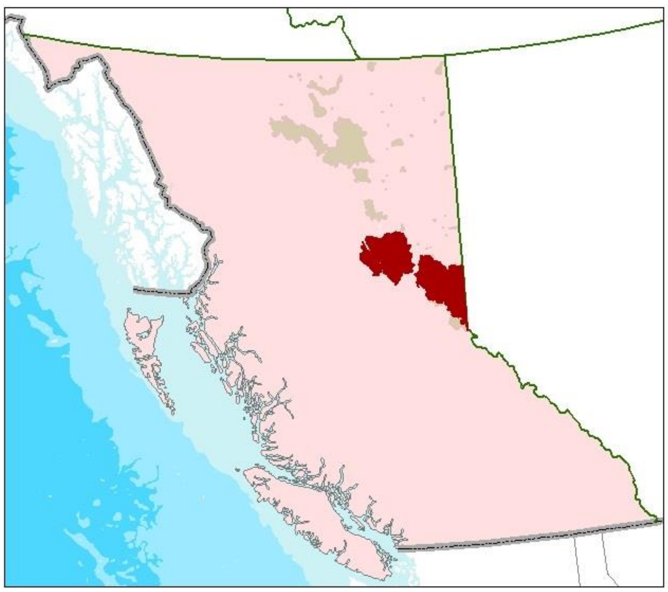
4.5 British Columbia: Offsetting under the Peace Northern Caribou Plan

The British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development operates an offset program for woodland caribou based upon the Peace Northern Caribou Plan. That plan covers several ranges in the northeastern part of the province. The plan currently covers only high elevation winter range, but is expected to be expanded to include low elevation habitat.



The major focus of the offsetting requirement is the expectation of mining development in the region. Operational policy requires two forms of offsetting for any new mine activity: habitat and financial. Both are required on an area (per hectare) basis.

With respect to habitat offsetting, mining proponents are required to protect high elevation winter range at a ratio of 4:1 to that which they disturb. This ratio was arrived at informally by estimating what was needed to achieve the habitat protection targets in the PNCP. For example, Anglo- American (one of the two mining companies currently covered by the policy, the other being Teck) has disturbed habitat of 452 hectares. As the habitat component of their offset they have purchased all tenures to approximately 1800 hectares of high elevation winter range. The company is keeping the coal leases, with a commitment not to develop, and has turned back all other tenures to the provincial government. The metrics of this habitat offsetting are based upon actual disturbed area, with no consideration of buffers or indirect impacts.

In addition to the habitat offsets, a mining proponent is required to provide a financial offset. This again is based on a per hectare formula. The amount of the required payment is not based upon any attempt to draw equivalency between the habitat loss and the impact to the caribou population. Rather it is reflective of a calculation based upon a target budget figure for population work, and a rough estimate of anticipated mining activity. In particular, the goal was to arrive at a fund of $30 million from an environment where political statements had forecast eight new mines. Based upon that, payment of $5000 for each hectare of high quality habitat, and $9000 for each acre of very high quality habitat. These payments have resulted in a fund of approximately $3.5 million, which has been spent mainly on wolf control and maternal penning. As other sources have been identified to finance those population augmentation measures, the remainder of the fund (perhaps $2 million) is now planned to be dedicated to habitat restoration. The fund was held and administered by a non-profit association, Resource North, but that association wrapped up in 2015, so it has now been passed on the Fraser Basin Council.

The design of offsetting in this situation has been left to one member of the Ministry, the regional Director of Resource Management. To date there has been little policy guidance, though the development of practices under the Environmental Mitigation Policy and the offset equivalency calculator will help to remedy that.

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Appendix 1 – Assessment Process Summary

The Mitigation Hierarchy

1. ***Has the proponent taken all reasonable measures to avoid environmental impacts?***
2. ***Has the proponent taken all reasonable measures to minimize those environmental impacts which are unavoidable?***
3. ***Has the proponent taken all reasonable measures to restore on-site environmental loss which might be temporarily unavoidable, but which can be restored?***

Clarifying Residual Loss(es)

4. ***What is the nature of the residual environmental loss(es) after all questions 1 to 3 have been answered in the affirmative?***

Determining Offsetability

5. ***Are the objects of the residual loss of high conservation concern?***
6. ***Is the object of the residual loss replaceable given the state of knowledge and experience with restoration techniques?***
7. ***Are there actual offset opportunities available within the trading rules established? (See the discussion of equivalency below.)***
8. ***Is there sufficient expertise and capacity available to actually deliver the planned offset in a timely and reliable manner?***

Conservation Objectives and Priorities

9. ***Are the conservation objectives relevant to the project impact clear? Has adequate consultation taken place with communities, stakeholders, indigenous populations etc. to understand the values at stake? Has enough scientific knowledge been gathered to understand the ecological functions and relationships which support the values and objectives?***

Equivalency

10. ***What proxies and indicators are necessary and appropriate to measure the status and any change in those objectives?***
11. ***Has the anticipated or actual residual loss from the development project been adequately quantified in the selected metric(s)?***
12. ***Are the outcomes of the offset measures under consideration capable of being measured in those same metric(s)?***

13. ***Using those metric(s) which are common to both the outcomes of the development and the offset measures, what amount of offset measures must be undertaken to produce positive outcomes equivalent to the negative impacts of the development.***

Permissible Offset Measures

14. ***Is the current ecological composition and status of the offset site (or object, if not site-based) well understood and documented sufficient to describe baseline conditions?***
15. ***Are trends and factors inducing change well understood and documented sufficiently to describe a counterfactual?***
16. ***Do the proposed offset measures serve the conservation objectives?***
17. ***Would the offset measures be carried out otherwise, by the proponent or some other party (including government)?***
18. ***Would the intended outcomes of the offset measures occur otherwise?***
19. ***If the offset is based on positive management actions, what does experience tell us about the chance of success or failure in achieving stated objectives?***
20. ***If the offset is based on averted losses, what is foundation for expecting the losses in the absence of the offset? Is it sufficiently real that the offset adds value?***

Risk Management

21. ***Are the "delivery risks" (the risk of offset measures failing to deliver intended outcomes) well understood and quantifiable?***
    a. ***Are the positive management measures the best available?***
    b. ***Is the offset employing a variety of techniques or relying on a single technique?***
22. ***Is the risk from the change in location of ecological features or functions well understood and quantifiable?***
23. ***What time lag is expected between the development impacts and the implementation of offset measures? What time lag is expected between the implementation of offset measures and achievement of the target condition? What margin of error surrounds these time estimates?***
24. ***Based on the above, what multiplier is most representative of the total risk and time lags and most likely to mitigate them?***

Long-Term Management

25. ***Is ownership of the offset project (including land and all other assets) clear and legally secured?***
26. ***Is authority and accountability for the long-term management of the project clearly defined? Is it secured through necessary legal arrangements and clarity around decision-making, etc?***

27. ***Does the long-term management system take into account a variety of interests? Is the structure satisfactory to achieve this, if desired?***
28. ***Is there sufficient funding secured to cover all costs of long-term management and monitoring?***
29. ***What are the monitoring requirements of the offset project? Are their clear monitoring protocols and defined time intervals? How is data reported and to whom?***

Social Aspects

30. ***Does the offset project respect all legal and traditional rights?***
31. ***Has consultation with affected communities and stakeholders been adequate to understand their values and concerns?***
32. ***Is traditional knowledge being adequately considered in impact mitigation and offset design?***
33. ***Are there questions of equity between communities or stakeholder groups as a result of the offset? Has that been adequately addressed?***
34. ***Is the offset project creating new opportunities for involvement, education, or employment?***

Appendix II: Canadian Biodiversity Offset Pilots, Programs and Policies

	Nature of Loss	Stated Objective	Explicit Consideration of Non-Offsettability	Nature of Gain/Offset	Systematic Equivalency Analysis?	Delivery Mechanism(s) (Direct, Banking, In-	Multiplier?	Monitoring	Governance & Engagement
Ad Hoc and Pilot Projects and Programs									
Boreal Caribou Focus									
Algar (Alberta - Boreal)	Oil sands landscape impacts	Test of restoration techniques	No	Restoration of prior linear disturbance	N/A	Direct	N/A	Yes	Multi-company with active stakeholder engagement
Cenovus LiDea (Alberta - Boreal)	Oil sands landscape impacts	Test of restoration techniques	No	Restoration of prior linear disturbance	N/A	Direct	N/A	Yes	Active First Nations and stakeholder engagement
Peace Northern Caribou Plan (BC)	Mine impacts to caribou habitat	Maintenance and recovery of caribou	No	Habitat protection and restoration; population augmentation	No	Direct (protection); ILF	Yes	Unknown	Regulatory compliance; Third party administration of In-lieu funds
NGTL	Pipeline habitat impacts	Regulatory compliance	No	Restoration of prior	Yes	Direct	Custom	Yes	Regulatory

		: no net loss		linear disturbance					
Other Focuses									
Skeena Moose Program (BC)	Moose mortality from mining road traffic	Regulatory compliance	No	Unknown	Variety of recovery plan measures	ILF	Unknown	In future	Proponent-Government relationship
TransMountan Legacy Fund (Jasper NP & Mount Robson PP)	Pipeline Expansion	Net gain in ecological integrity	No	Aquatic restoration plus portion to be used at each park's discretiion	No	Payment into special purpose fund	N/A	Yes	Custom-built multi-stakeholder committee
Hydro One Bruce to Milton Biodiversity Initiative	Transmission line impacts to woodland habitat	No net loss/ net gain where practicable	No	Habitat restoration	Yes	Direct	No	Yes	Proponent-delivered, but extensive involvement of First Nations, stakeholders, communities
BC Hydro Fish and Widlife Compensation Program	Hydro facility impacts to fish, wildlife,	Compensation	No	Variety	No	ILF	No	Yes	Independent board and liberal engagement of experts

	and habitat								
SE Alberta Conservation Offset Pilot	Industrial impacts on native prairie	Offset (pilot)	No	Planting of native perrenials	No	Direct, ILF	No	Yes	Government-run with active expert and stakeholder engagement
Offset Policy Programs									
Federal Fisheries	"Serious harm to fish"	Sustainability and ongoing productivity of fisheries	No	Fish habitat restoration or enhancement	Loose	Direct, some limited self-banking	Custom	Prescribed but compliance uncertain	Regulatory oversight
Federal Wetlands	Loss of wetland functions	No net loss of wetland functions	No	Rehabilitation of former wetlands and enhancements of existng healthy wetlands	Loose	Direct	Custom	Yes	Regulatory oversight
Federal Species at Risk (draft policy 2016)	Impact of activity affecting a listed widlife species	Negate jeopardy to species survival or recovery	Yes	Activities of benefit othe species or its habitat				Yes	Regulatory overisght

BC Environmental Mitigation Policy	Impacts on environmental values	Offset impacts	No, but avoidance and high multipliers apply strictly to high priority sites	Customized	Under development	Direct; ILF under consideration	Recommended	Yes	Policy direction, recommends active engagement with stakeholders
BC Spotted Owl Compensation	Loss of owl habitat	Recover owl populations	No	Variety - mainly captive breeding, control of competitive species	No	ILF	No	Yes	Regulatory compliance
BC Oregon Spotted Frog Compensation	Impacts to frog population	Recover frog population	Unknown				No	Yes	Regulatory compliance
Alberta Wetlands	Permanent loss of wetland functiion	Sustain wetland benefits	No	Wetland restoration, creation, enhancement or protection.	Yes	Direct, ILF	Standard	Yes	Regulatory compliance
Manitoba	Highway impacts to wetlands	Compensation							
Ontario Endangered Species Act	Harm to listed species or	"Overall benefit"	Yes	Customized	Unknown	Direct	Customized	Customized	Regulatory compliance

	damage to habitat								
Quebec Wetlands									
New Brunswick Wetlands	Loss of wetland function	No net loss of wetland function in non-provincially significant wetlands	Yes - Provincially Significant Wetlands	Wetland restoration, creation, enhancement or protection.	Unknown	Direct, ILF	Standard	Yes	Regulatory compliance
PEI Wetlands	Impacts of wetland alteration	No net loss of wetlands and wetland function	Yes	Unknown	Unknown	ILF	Unknown	Unknown	Regulatory compliance
Nova Scotia Wetlands	Loss of wetlands	Prevent net loss of wetland	Yes - Wetlands of Special Significance	Wetland restoration, creation, enhancement (protection only in conjunction with one of other three)	Loose	Direct	Standard	Yes	Regulatory compliance