Technical Submission

A Review of the Environmental Impact Statement (EIS) for Construction of the Inuvik to Tuktoyaktuk Highway, NWT

Submitted to

The EIRB

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By

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Executive Summary

A review of the Environmental Impact Statement (EIS) for the construction of the Inuvik to Tuktoyaktuk Highway, NWT was conducted for the Wildlife Management Advisory Council (NWT). A systems type approach was taken, which emphasized the cumulative effects assessment (CEA) of the proposed road upon key VECs/VSCs especially caribou, grizzly bear, the Husky Lakes, and the associated Inuvialuit wildlife harvest. A number of critical errors and/or omissions were found within the assessment, each further compounding the others, and leading to a total underestimate of overall potential impacts. Most fundamentally flawed was the choice of spatial and temporal boundaries for the CEA, both of which were lacking in scope and detail for a project of this magnitude. By delimiting these, the Proponent's assessment of potential impacts on VECs such as caribou, grizzly bear, and the Husky Lakes were grossly underestimated. As a result, the mitigation and/or remediation of these impacts and the proposed Worst Case Scenario (WCS) are erroneous. A more realistic WCS is offered which involves the severe disruption and/or loss of caribou harvest within the Inuvialuit Settlement Region (ISR). As the avoidance behavior of caribou associated with linear corridors cannot be mitigated, remediation through long-term compensation may be the only alternative. The errors and/or omissions in the EIS are further compounded by the lack of an integrated, cumulative effects monitoring plan specific to the Project within the context of other past, imminent, and likely future projects within the ISR.

Introduction

The Wildlife Management Advisory Council (NWT), hereafter WMAC, commissioned Environmental Systems Assessment Canada (ESAC) Ltd. to conduct an impartial and independent review of the Environmental Impact Statement (EIS) for Construction of the Inuvik to Tuktoyaktuk Highway, NWT (Hamlet of Tuktoyaktuk et al. 2011). ESAC was asked to address key Terms of Reference that fall within, or directly impact upon, the mandate of WMAC in order to determine the adequacy of the EIS in its response to the Environmental Impact Review Board's Terms of Reference of November 3, 2010 (EIRB 2010). In particular, ESAC was asked to consider whether the EIS provides adequate information and analysis to address the following questions in relation to EIRB's Terms of Reference:

- What is the impact, immediate and cumulative, of the project on key Valued Ecosystem Components (VECs) and Valued Social Components (VSCs)?
- What will be required to mitigate the immediate and cumulative impacts on key VECs and VSCs?
- What will be required to remediate immediate and cumulative impacts on key VECs and VSCs that cannot be mitigated?
- What is an accurate and realistic Worst Case Scenario?
- What is the required monitoring to ensure the necessary information required for the immediate and long-term mitigation and remediation of key VECs and VSCs?
- What will be the impact of the project on wildlife harvesting and the socio-economic effects of any impact on wildlife harvesting with respect to providing sufficient basis for wildlife compensation?

The Reviewer

Environmental Systems Assessment Canada (ESAC) Ltd. is a private consulting company located in Saskatchewan, and formed in 2008 to conduct business in the areas of strategic environmental science, policy, and legislation, among others. ESAC is committed to finding win-win solutions to environmental issues and conflicts by seeking the most sustainable options, as measured by both environmental and socio-economic outcomes. To this end, the two principal partners of ESAC, Dr. Paul James and Dennis Sherratt, have more than 55 years' combined experience in strategic environmental science and policy in both private and government sectors, including the Saskatchewan Ministry of Environment, the Saskatchewan Wetland Conservation Corporation, Wildlife Habitat Canada, the Nature Conservancy of Canada, and others. Experience gained during that time relevant to this review includes:

- Administration and/or application of Saskatchewan legislation including The Wildlife Act, Fisheries Act, Parks Act, Environmental Assessment Act, Environmental Management and Protection Act, Lands Act, Wildlife Habitat Protection Act, Conservation Easements Act, Forest Ecosystem Management Act, Ecological Reserves Act, Indian and Native Affairs Act, Metis Act, and Northern Affairs Act
- Integration with federal legislation and processes including The Species at Risk Act, Fisheries Act, Canadian Environmental Assessment Act, and Indian Act, among others
- Familiarity with First Nations, Metis, and private landowner rights, Treaty Land Entitlements, First Nations and Metis Consultation Policy
- Creation of Saskatchewan's Representative Areas Network
- Renewal of Saskatchewan's Prairie Conservation Action Plan
- GIS modeling of climate change cumulative effects on wildlife habitats
- GIS modeling of woodland caribou habitat in relation to the cumulative effects of forest fires over 60 years
- GIS modeling of wildlife habitat landscape connectivity
- Game and species at risk management, legislation, and strategic policy, including the wintering Beverly and Qamanirjuaq caribou herds
- Game and species at risk research projects and habitat assessments
- Great Sand Hills regional environmental study and cumulative effects assessment
- 2005 and 2011 Saskatchewan State of the Environment Reports

Systems Review of the EIS

The Reviewer will conduct the review of the EIS from a ‘systems’ perspective. In other words, focused at the coarser, landscape level rather than at the site-specific level. There are two reasons for this: First, many of the site-specific issues in any development can be adequately addressed with our current state of knowledge in project mitigation and remediation (for example, stream crossings). Such things should be second nature in project development by now. More importantly, it is wrong to assume that the whole ecosystem is sufficiently conserved by only addressing its constituent parts. Many individual site assessments judged to be ‘non-significant’ in past EIS’s have collectively led to significant degradation of environmentally sensitive landscapes (Noble 2006), for example, over decades of gas development in the Great Sand Hills of southern Saskatchewan (GSHSAC 2007).

The review of the EIS will begin with the question of cumulative environmental effects, because much of the current conflict and confusion surrounding environmental issues can be traced to decisions that were never consciously made, but simply resulted from a series of small decisions (Odum 1982). This ‘tyranny of small decisions’ refers to a phenomenon first highlighted by an economist who described a situation where a number of decisions, individually small in size and time, cumulatively result in an outcome that is neither optimal nor desirable (Kahn 1966). It is a condition in which a series of small, individually rational decisions can negatively change the context of subsequent choices, even to the point where desired alternatives or results are irreversibly damaged or destroyed. There are many environmental examples and they include the conversion of native prairie for crop production, the drainage of prairie wetlands, acid precipitation, and human induced climate change. To address this issue, a holistic rather than a reductionist perspective is needed to avoid the undesirable, cumulative effects of such small decisions.

Cumulative Effects Assessment (CEA)

For context and completeness, the EIRB's (2010) Term of Reference (#11) for cumulative effects is first presented:

EIRB (2010) states that the cumulative effects of the proposed Project must be assessed. The cumulative effects assessment must demonstrate to the Review Board that any long-term cumulative effects are adequately considered and can be successfully mitigated. The analysis of the cumulative effects must enable the Review Board to gain an understanding of the incremental contribution of all projects or activities in the delineated Study Area(s), and of the Project alone, to the total cumulative effect on the VEC or VSC over the life of the Project. Cumulative impacts may occur when the impacts of one project or activity combine with the impacts of other past, present and future projects and activities.

The Developer must describe and discuss the different types of potential impacts and the EIS must include these different forms of effects, such as synergistic, additive, induced and spatial or temporal overlap. Impact pathways and trends should be included and discussed. The Developer may use linkage diagrams to help illustrate and explain impact pathways; however, this must be used as a tool to easily identify the impact pathway and not as the process for demonstrating whether impact pathways occur or not.

The Developer must identify and assess cumulative effects associated with the proposed Project and provide rationale for the process chosen to carry out the cumulative effects assessment. The approach and methods used to identify and assess cumulative effects must be explained. For all aspects of the Project under consideration, including alternative routes, the Developer will identify and justify the environmental and socio-economic elements (VECs or VSCs), including Inuvialuit harvesting, which will constitute the focus of the cumulative effects assessment. The Developer must provide rationale and justification for the elements assessed. The Developer must identify and assess the cumulative environmental and socio-economic effects of the project in combination with other past, present or reasonably foreseeable projects and/or activities within the Study Area(s).

The assessment of cumulative effects of the project must include the following, but may also address other items:

- *Identify the VECs and VSCs, or their indicators, on which the cumulative effects assessment is focused, including the rationale for their selection. Present spatial and temporal boundaries for the cumulative effect assessment for each VEC selected. Emphasize VECs with special environmental sensitivities or where significant risks could be involved.*
- *Identify the sources of potential cumulative effects. Specify other projects or activities that have been or will be carried out that could produce effects on each selected VEC or VSC within the*

boundaries defined, and whose effects would act in combination with the residual effects of the project.

- *Evaluate the likelihood of development by the Proponent or others that may appear feasible because of the proximity of the Project's infrastructure. Limit assessment to cumulative effects on the physical, biological, and human environments that are likely and for which measurable or detectable residual effects are predicted.*

A reasonable degree of certainty should exist that the proposed projects and activities will actually proceed for them to be included. Projects and activities that are conceptual in nature or limited as to available information may be insufficiently developed to contribute to this assessment in a meaningful manner. In either case, provide a rationale for inclusion or exclusion.

The Developer must describe the analysis of the total cumulative effect on a VEC or VSC over the lifespan of the Project, which requires knowledge of the incremental contribution of all projects and activities, in addition to that of the Project.

Potential effects on a VEC are not necessarily the result of one project. While a project-specific assessment of cumulative effects is not responsible for assessing all external effects, the effect assessment must consider how a project-specific effect, or suite of project-specific effects, would interact with these external factors.

The Cumulative Effects Assessment must make clear the contribution of the project to a total potential cumulative effect, and place potential cumulative project effects in an appropriate regional context, considering regional plans, community conservation plans, species recovery plans, management plans, objectives and/or guidelines in an integrated manner in order to understand the aspirations of people and communities in the region.

In assessing the cumulative environmental effects of this Project in combination with other projects and/or activities, the Developer shall identify any changes in the original environmental effects and significance predictions for the project. The Developer shall also discuss the effectiveness of the proposed mitigation and/or other restitution measures and the response to such changes, as well as the implications for monitoring and follow-up programs as described in Term 13.

The Developer shall address and/or provide rationale for the following in any cumulative effects assessment:

- *Geographic and temporal boundaries for the cumulative effects assessment.*

- *Loss of remoteness.*
- *Direct and indirect disturbance of land or land change outside of the direct footprint of the development as a result of the proposed Project.*
- *The approach of the assessment in the context of the IFA and updated CCPs.*

The Developer shall outline, in detail, the proposed management tool(s) for cumulative effects resulting from the proposed Project.

The Developer shall also provide a discussion of potential induced effects of future developments that could occur as a result of, or could occur and use, this highway (e.g., Mackenzie Gas project, other oil and gas activities). Include a discussion of long-term operation, maintenance and management of the highway.

Spatial Boundaries of the CEA

Determining the spatial boundaries for a CEA is critical to its success in effectively managing the cumulative impacts associated with development projects, because the boundaries in CEA delimit the spatial extent of the assessment and thus the ecosystems and VECs/VSCs that are considered. It is generally acknowledged that in order to assess cumulative effects effectively there is a need to extend the spatial boundaries of the assessment well beyond the actual project site (Noble 2006). However, if boundaries are too large, only a superficial assessment may be feasible and uncertainty will increase. In addition, the incremental additions of a single project may seem less and less significant – a small drop in a large bucket. Conversely, if the boundaries are too small, a more detailed assessment is possible but an understanding of the broader context may be lost. In addition, the incremental impacts of a single project may be exaggerated – a large drop in a small bucket (Noble 2006). Consequently, the choice of spatial boundaries for CEA can be to the proponent’s advantage or disadvantage.

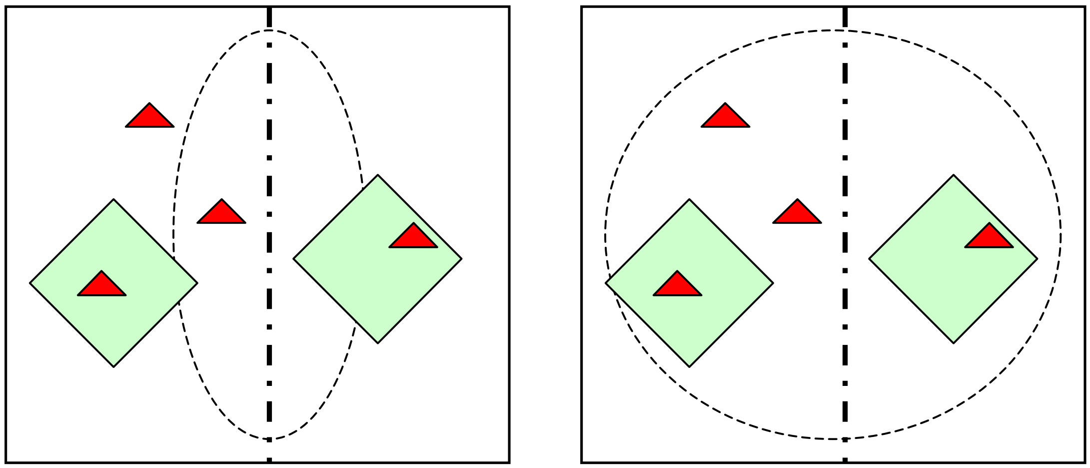
Based on the CEA literature, several guiding principles have emerged to assist both proponents and reviewers (Noble 2006):

- *Adequate scope*. Boundaries should be large enough to include relationships between the proposed project, other existing and proposed projects, and the

VECs/VSCs. This may mean crossing jurisdictional boundaries if necessary to account for interconnections across systems.

- *Natural boundaries*. Natural boundaries such as watersheds, airsheds, or other ecosystems likely best reflect the natural components of a system.
- *VEC/VSC differentiation*. Different VEC/VSC processes operate at different spatial scales and boundaries should reflect this variation.
- *Maximum zones of detectable influence*. Impacts related to project activities typically decrease with increasing distance from the project, thus boundaries should be established where impacts are no longer detectable.
- *Multi-scaled approach*. Multiple spatial scales, such as local and regional boundaries, should be assessed to allow for a more in-depth understanding of the scales at which VEC/VSC processes and impacts operate.
- *Flexibility*. CEA boundaries should be flexible to accommodate changing natural and human-induced environmental conditions.

Ideally then, the spatial boundary for CEA should be large enough to incorporate both previous and future developments and their likely interaction with the VECs of concern, especially if the VECs are wide-ranging. The figures below show a hypothetical road (thick dashed line), along with other developments (red triangles), and VECs (green squares). The left-hand figure's spatial boundary (thin dashed line) is insufficient because not all sources of impact are captured, and neither are the VECs of interest.



For the CEA, the Proponent somewhat vaguely defines the spatial boundaries as follows (page 627 of the EIS):

For purposes of this cumulative effects assessment (CEA), the spatial boundaries include the portion of the Mackenzie Delta and the Tuktoyaktuk Peninsula in the general vicinity of the proposed Inuvik to Tuktoyaktuk Highway corridor, extending between Inuvik and Tuktoyaktuk, including alternate alignments considered (as shown in Figure 4.3.8-1). The easterly boundary extends from the westerly shores of the Husky Lakes to the westerly boundary, which extends from the eastern side of the Mackenzie River. This general area encompasses the entire proposed Highway, the range of environments that could be impacted by the Highway, and the past, present and future projects that may have a potential to contribute to potential cumulative effects.

There is no CEA boundary line delineated in Figure 4.3.8-1 (page 600 of the EIS) or a calculated area provided in the EIS. By taking the western boundary of the Husky Lakes, this important feature is excluded from the CEA. Referring to the guiding principles for CEA above (Noble 2006), while existing and proposed projects are included in the CEA area, their relationships with VECs/VSCs are not. This is of particular concern with respect to wide ranging species such as caribou and grizzly bear in the Inuvialuit Settlement Region (ISR) and suggests that the CEA boundaries in the EIS are insufficient. Of 85 caribou studies reviewed by Vistnes and Nellemann (2007), 83% of the regional studies concluded that the impacts of human activity were significant, while only 13% of the local studies did the same. Hence the scale of the assessment is critical (Noble 2006, Therivel and Ross 2007). The Reviewer strongly recommends that these boundaries be clarified and/or expanded for the purposes of this CEA.

Temporal Boundaries of the CEA

At the core of CEA is the consideration of the influence of other past, proposed, or likely future activities – how far back in time and how far forward into the future (Noble 2006, Therivel and Ross 2007). The extent of temporal boundaries depends on the amounts of information desired and/or available, and what the assessment is trying to accomplish. Hegmann et al. (1999) outlines several options for deciding how far into the past a CEA should extent:

- Based only on the existing environmental conditions.
- When impacts associated with the proposed action first occurred.
- The time at which a certain land designation was made.
- The point in time at which effects similar to those of concern first occurred.
- A past point in time representative of desired environmental conditions or pre-disturbance conditions, especially if the CEA includes determining to what degree later actions have affected the environment.

CEA boundaries for future conditions are often based on (Hegmann et al. 1999):

- The end of operational life of the proposed project.
- The point of project abandonment and site reclamation.
- A time when VECs/VSCs are likely to be recovered, considering natural variations, to their pre-disturbance conditions.

Identifying potential future actions or activities to include in CEA can be more challenging (Noble 2006). To help with this, Hegmann et al. (1999) characterize such future actions into three types:

- *Certain actions*. The action will proceed or there is a high probability the action will proceed. This includes projects already approved or submitted for approval, or that have been proposed by the proponent.
- *Reasonably foreseeable actions*. The action may proceed, but there is some uncertainty about this conclusion. This might include some projects under review for which approval is likely to be conditional, activities identified in an approved or proposed development plan, or induced activities that may occur should the project proposed be approved.
- *Hypothetical actions*. There is considerable uncertainty whether the action will ever proceed. Such actions or activities include those discussed on only a conceptual basis or those speculated based on current information.

All of these actions lie on a continuum from most likely to least likely to occur. For each assessment, the reviewer will have to decide how far into the future the CEA should reach. Often, a major criterion is whether the future action(s) are likely to affect the same VECs/VSCs as the project under consideration (Noble 2006). Such is certainly the case here especially considering wide ranging species such as caribou and grizzly bear.

For the CEA, the Proponent defines the temporal boundaries as follows (page 627 of the EIS):

For purposes of this CEA, the temporal (time frame) for the assessment will be the next four (4) to ten (10) years, during which time construction of the proposed Highway is anticipated to be completed and the Highway will have been in operation for up to six (6) years. It remains unknown at this time whether construction of other proposed future projects, in particular, the Mackenzie Gas Project and the Tuktoyaktuk Harbour Project will have commenced or not within this 10 year time-frame.

For some reason, there is no temporal boundary established for past conditions, although several past and existing projects are considered (pages 628-633 of the EIS) and all dismissed as to their potential contributions to the cumulative effects of the Project. The Reviewer questions this decision as some of these past projects still have roads, trails, and rights of way associated with them (page 431 of the EIS), features that caribou avoid and that their predators (i.e. wolves) utilize to their advantage (Cameron and Whitten 1980, GNWT ENR ND, Jalkotzy et al. 1998, Nellemann and Cameron 1998, James and Stuart-Smith 2000, Wolfe et al. 2000, Dyer et al. 2001, Johnson and Boyce 2001, Nellemann et al. 2001, Dyer et al. 2002, Salmo Consulting Inc. 2004, Johnson et al. 2005, Vistnes and Nellemann 2008, Dahle et al. 2008, Sorensen et al. 2008, Stankowich 2008, Antoniuk et al. 2009, Polfus et al. 2011, Wasser et al. 2011, Whittington et al. 2011). Interestingly, traditional knowledge has also identified the avoidance behavior associated with roads (Parlee et al. 2005). The Proponent also considers several potential future projects and activities including the MacKenzie Gas Project and the Parson Lake Gas Field and Associated Infrastructure and Gathering Pipeline (pages 633-640 of the EIS). Again, all of these are dismissed as to their potential contributions to the cumulative effects of the Project, based mainly on the timing of these projects with respect to the short 10-year time frame of the EIS's temporal boundary. However, referring to Hegmann et al.'s (1999) criteria above, some of these should be included, especially the MacKenzie and Parson Lake projects, if this temporal boundary is extended, as it should be.

In addition to the brief 10-year temporal boundary stated above in the CEA, the Proponent defines the operational life of the project with the statement (page 97 of the EIS):

The Highway is intended for permanent long-term use.

These two definitions are quite at odds with one another, especially when one considers the history of road building in Canada. This country has over 900,000 km of roads, one-third of which is paved (Forman et al. 2003). The network of paved roads alone has grown from more than 100,000 km in 1959 to over 300,000 km in 2001, suggesting that few, if any roads are decommissioned once built. Such is likely to be the case here, so the Proponent's descriptor 'permanent' is quite appropriate. It therefore follows that the 10-year temporal boundary proposed for the CEA by the Proponent is totally insufficient, especially when one factors in the numerous and continuous ecological effects that existing roads have on wildlife, including caribou and grizzly bears (Noss 1995, Nietvelt et al. 2002, Forman et al. 2003, Yukon Fish and Wildlife Management Board 2003). The Reviewer strongly recommends that the future temporal boundary of the CEA be extended by several decades, perhaps up to 100 years. Projects like the MacKenzie and Parson Lakes would then be properly included within the CEA of the Project, as per Hegmann et al. (1999).

Cumulative Effects – Caribou and Caribou Habitat

The review will now consider the cumulative effects of the Project on caribou, arguably the most important VEC in the ISR, not only because of the important role that this animal plays in the lives and culture of the Inuvialuit, but also because of recent drastic population declines in both the Bluenose-West (a population decline from an estimated 98,900 in 1987 to an estimated 20,800 in 2005 – in 2009, herd size was estimated at 18,000) and Cape Bathurst (a population decline from an estimated 19,000 in 1992 to an estimated 1,800 in 2006 - in 2009, herd size was still estimated at 1,800) herds (Antoniuk et al. 2009, Gunn and Russell 2011). These declines have already resulted in significant management responses including reductions in caribou harvest levels within the ISR and elsewhere (Gunn and Russell 2011, page 422 of the EIS).

The Proponent carries forward only the adverse residual effects (effects remaining after the application of appropriate mitigation measures on the biophysical and socio-economic components of concern) on VECs/VSCs from the general impact assessment (page 456 of the EIS) into the CEA. One of these residual effects of the Project on caribou is described as follows (page 641 of the EIS):

Residual effects are anticipated to be negligible with the exception of potential vehicular impact and increased hunting. The effects of potential vehicular impact and increased hunting are predicted to be low magnitude effects with a moderate (vehicle collisions) to low (hunting) level of consequence based on duration.

To assess cumulative effects, the Proponent now employs a screening matrix (pages 644-645 of the EIS) that looks at what are the key anticipated effects and mitigation measures used to address those effects at local and regional scales. Following the application of these mitigation measures, the matrix includes determinations, based on the effects assessment and professional judgment, of the possible significance of an effect. The significance determination includes a ranking of Class 1, 2 or 3, which is used as a general guideline to rank effects. The Proponent defines these classes as follows (page 645 of the EIS):

Class 1 Effect: *The predicted trend in the measurable parameter under projected levels of development could threaten the sustainability of the VEC in the study area, and should be considered of management concern. Research, monitoring and/or recovery initiatives should be considered under an integrated resource management framework. Any negative change in VEC value of greater than 25% from benchmark is considered to be a Class 1 effect, regardless of VEC trend at the time of the assessment.*

Class 2 Effect: *The predicted trend in a measurable parameter under projected levels of development will likely result in a decline in the VEC to lower-than baseline but stable levels in the study area after Project closure and into the foreseeable future. Regional management actions such as research, monitoring and/or recovery initiatives may be required if additional land use activities are proposed for the study area before Project closure.*

Class 3 Effect: *The predicted trend in the measurable parameter under projected levels of development may result in a decline in the VEC in the study area during the life of the Project, but VEC levels should recover to baseline after Project closure. No immediate management initiatives, other than requirements for responsible industrial operational practices, are required.*

Based on this qualitative CEA, the Magnitude of Effect for caribou is rated as ‘Low’, the Class of Effect is rated as ‘Class 3’, and the Significance is rated at ‘Not Significant’ (page 644 of the EIS).

The Reviewer not only disagrees with this conclusion, but also questions how it was arrived at. Of particular concern in the residual effects assessment is the absence or under-estimation of indirect effects such as road avoidance, increased predation by wolves, and the increased harvest by humans over the permanent life of the Project. For example (page 526 of the EIS):

The amount of habitat lost to the Highway is estimated to be 383 ha, approximately 0.002% (217 ha) of the Bluenose-West Herd core winter range, approximately 0.019% (212 ha) of the Cape Bathurst Herd core winter range and approximately 0.0008% (32 ha) of suitable Boreal caribou habitat. In the context of both the LSA and RSA, this amount of habitat loss is considered low in magnitude, local in extent and lasting the life of the Project resulting in a consequence rating of low.

As stated before, caribou frequently avoid roads and other human infrastructure. This avoidance can be as great as 15 km and can impact many thousands of hectares of habitat (Oberg et al. 2000, Wolfe et al. 2000, Dyer et al. 2001, Johnson and Boyce 2001, Schindler et al. 2007, Stankowich 2008, Vistnes and Nellemann 2008, Flanders et al. 2009). Avoided caribou habitat is as ecologically non-functional as the direct habitat lost to development and is therefore additive in nature. For the 140 km or so of the proposed Highway, this translates into approximately 410,000 additional hectares of potentially lost habitat. Note that this estimate does not include the network of other roads associated with the numerous borrow pits along the Highway, and also assumes every hectare of terrestrial habitat in the region is suitable for caribou at any one time, which it is not (Manly et al. 2002, Rettie and Messier 2000). The Proponent's estimate of caribou habitat lost to the Project is therefore probably grossly underestimated.

Notwithstanding this error, the caribou's residual effect is considered within the Proponent's CEA screening matrix, which concludes that any cumulative effects on caribou are not significant (pages 644-645 of the EIS). However, if the temporal boundary of the CEA is extended as argued above, other important projects, such as the MacKenzie Gas and Parson Lakes also need to be accounted for. The length of the MacKenzie Gas Project within the EIS area is estimated at 68 km and the length of the Parson Lake connecting pipeline to this is estimated at 18 km from Figure 4.3.8-2 (page 601 of the EIS). Using the 15 km caribou avoidance value, this translates into an additional 258,000 hectares of habitat lost. Again, this does not take into account any infrastructure associated with these developments. In total then, the proposed Highway and linear corridors associated with the MacKenzie and Parson Lake gas pipelines could impact as much as 668,000 additional hectares of caribou habitat beyond that suggested by the Proponent, not including the effects from the network of roads to borrow pits. The precise number is not important; however, the Reviewer believes that the impact has been underestimated by several orders of magnitude by the Proponent. If the two caribou herds in question cross into adjacent jurisdictions, then the impacts of developments there also need to be factored in.

In addition to direct caribou habitat loss from the Highway, there are important indirect effects that are also insufficiently accounted for in the Proponent's CEA. These include:

- Increased wolf predation on caribou as a result of wolves utilizing the Highway and other linear corridors to gain easier access to their prey (Seip 1992, James and Stuart-Smith 2000, Wittmer et al. 2005, Wasser et al. 2011, Whittington et al. 2005, Whittington et al. 2011).
- The role of wildfires, their potential to increase over the permanent life of the Highway, and their contribution to the amount and quality of caribou habitat (i.e. lichens) over time and space (Klein 1982, Schaefer and Pruitt 1991, Thomas et al. 1996, Arseneault et al. 1997, Thomas and Kiliaan 1998, Joly et al. 2003, Dunford et al. 2006, Sorensen et al. 2008).
- Increased disturbance to caribou from escalated human access, including hunting. (Wolfe et al. 2001). While caribou hunting restrictions are currently in place, the potential long-term role that the Highway and other developments (MacKenzie, Parsons Lake, etc.) will play in caribou population recovery should be fully assessed.

Cumulative Effects – Grizzly Bear and Grizzly Bear Habitat

The grizzly bear is another very important VEC in the ISR. Again, notwithstanding the inadequate consideration given for CEA spatial and temporal boundaries, the residual effect of the Project on grizzly bears is considered within the Proponent's CEA screening matrix (pages 644-645 of the EIS). Like caribou, grizzly bears are highly sensitive to human development, infrastructure, and disturbance as highlighted by the Proponent (page 485 of the EIS):

Grizzly bears have shown avoidance and altered behaviour in response to road presence, seismic blasting and other industrial activities (Harding and Nagy 1980, Archibald et al. 1987, McLellan and Shackleton 1988, Mace et al. 1996, Mueller 2001, Gibeau et al. 2002, Wielgus et al. 2002). Follmann and Hechtel (1990) indicated that grizzly bears can habituate to noise disturbance, citing examples of bears that habituate to human developments if there are energetic benefits. Grizzlies typically select den sites >1 km from human activities; dens are abandoned or habitat not selected when closer than 1 km (Harding and Nagy 1978).

As for caribou, the Proponent only estimates the habitat lost to the immediate footprint of the Project (page 530 of the EIS):

Overall, approximately 21.3 ha of wetland habitat, 80.3 ha of riparian habitat and 135.0 hectares of berry-producing habitat will be lost. The amount of overall habitat loss within the RSA is small (0.20%) compared to the amount of similar habitat available (120,012 ha).

Again, the Reviewer believes this is grossly underestimated when one factors in the avoidance behaviour of grizzly bears (Johnson and Boyce 2001, Edwards et al. 2005, Edwards et al. 2008, Johnson et al. 2005). As with caribou, avoided habitat is lost, or non-functional habitat and can contribute to population declines (Johnson and Boyce 2001). In addition, as with caribou, not all the available habitat within the home range of a grizzly bear is equally utilized (McLoughlin et al. 2002, Edwards et al. 2009, Nielsen et al. 2010) so the actual proportional impact on high quality habitat may be higher.

The Proponent describes the residual effect of the Project on the grizzly bear as follows (page 641 of the EIS):

The net habitat and disturbance effects from the proposed development are expected to be limited to the local grizzly populations and are therefore low in consequence at the local population level. The overall impacts of the proposed Highway and operational activities are considered to be low to moderate within the LSA, and negligible within the RSA.

As with caribou, the qualitative CEA assesses the Magnitude of Effect for grizzly bear as 'Low', the Class of Effect is rated as 'Class 3', and the Significance is rated at 'Not Significant' (page 644 of the EIS). As for caribou, the Reviewer believes this to be an erroneous conclusion. In addition to direct grizzly bear habitat loss from the Highway and its avoidance, there are important indirect effects that are also insufficiently accounted for in the Proponent's CEA. Of particular concern is the elevated disturbance to bears from increased human access, including hunting and mortalities associated with increased habituation and resulting human-bear conflicts (Mattson 1992, Gibeau 1998, Chruszcz et al. 2003, Proctor et al. 2005). While grizzly bear hunting restrictions are currently in place, the potential long-term role that the Highway and other developments (MacKenzie, Parsons Lake) will play in bear population maintenance and recovery should be more properly assessed. This is particularly important for a long-lived species with large home range requirements and low reproductive rates, where even minor increases in mortality can translate into significant population effects (Wielgus et al. 1994).

Cumulative Effects – The Husky Lakes

The Husky Lakes area is considered by the residents of both Tuktoyaktuk and Inuvik to be very important for year-round hunting, trapping, fishing, recreation, and seasonal berry picking (page 426, 595 of the EIS). For example, both the Tuktoyaktuk and Inuvik Community Conservation Plans (Community of Inuvik et al. 2008, Community of Tuktoyaktuk et al. 2008) identify the Husky Lakes as a specially designated area with a Management Category of 'D' – 'Lands and waters where cultural or renewable resources are of particular significance and sensitivity throughout the year. As with Category C, these areas shall be managed so as to eliminate, to the greatest extent possible, potential damage and disruption.' The proposed Highway is also identified as an issue of concern in both documents.

The Husky Lakes lie immediately to the east of the proposed Highway, which will clearly increase year-round human access to the area and subsequently pressure on the natural resources found there. Despite this, Husky Lakes are not within the defined spatial boundary of the Proponent's CEA (page 627 of the EIS), which the Reviewer believes is a significant omission given the importance of the area to local people and the fact that the area is well within the 15 km avoidance distance for caribou established above. The main feeding and migration areas for caribou are along the shores of Husky Lakes (pages

437, 603 of the EIS) and the increased human presence resulting from the Highway will adversely affect these animals and their habitat in the manner already outlined above. The 1 km setback from the area proposed by the Proponent (pages 596, 605 of the EIS) is thus clearly inadequate.

The Husky Lakes are considered within the Proponent's screening matrix for cumulative effects, although as with caribou and grizzly bears, the qualitative CEA assesses the Magnitude of Effect for Husky Lakes as 'Low', the Class of Effect is rated as 'Class 3', and the Significance is rated at 'Not Significant' (page 645 of the EIS). As with caribou and grizzly bear, the Reviewer believes that with appropriate spatial and temporal boundaries assigned to the CEA, this benign conclusion would change significantly.

Worst Case Scenario

This section of EIRB (2010) provides direction to the Proponent for providing a 'worst case scenario' for negative impacts to wildlife, wildlife habitat and wildlife harvesting for the proposed Highway development. The Proponent describes its worst case scenario as follows (page 614 of the EIS):

To estimate the potential liability of the developer for impacts of the Highway development, a worst case scenario was identified. Based on consultation and regulatory feedback, it is evident that a worst case scenario would involve environmental damage to the Husky Lakes and effects to traditional activities and harvesting. Therefore, the worst case scenario for the Project would likely be one in which a fuel supply truck crashes on the Highway, in a location nearest the Husky Lakes (e.g., KM 80) and causes a fuel spill of greater than 10,000 L into an open watercourse, which is a direct tributary to the Husky Lakes.

The worst case scenario was further defined to assume that:

- *The fuel supply truck crash occurs during spring freshet when water levels, discharge and velocity are at their yearly peak and the potential for the greatest number of available pathways for conveyance downstream to the Husky Lakes is present*
- *The spill of diesel fuel into a fish-bearing watercourse and ultimately into Husky Lakes would result in residents avoiding consumption of fish because of the perception that the fuel would taint the fish*

- *The fish harvest season from Husky Lakes for that particular year would be lost as a result of the diesel fuel input to Husky Lakes*
- *The fouling of fishing gear would result in replacement costs.*

While the Reviewer agrees that such an incident would be a serious matter (and perhaps another reason for the road to not encroach anywhere near the Husky Lakes), the inclusion of appropriate spatial and temporal boundaries in the CEA could result in a quite different worst case scenario - the total loss of caribou harvesting over a long period of time, perhaps forever.

At first this may seem somewhat exaggerated until one considers the following:

1. Past experience elsewhere has shown that caribou populations are not resilient to long-term human development and disturbance.

2. The Cape Bathurst and Bluenose-West caribou herds are already under pressure - their populations are at all-time recorded lows.

3. The caribou harvest is already under pressure - caribou harvesting is currently restricted in the ISR.

4. The combined direct impact of past projects, the Highway, other imminent development projects and their associated road networks could affect hundreds of thousands of hectares of caribou habitat.

5. Such large losses of functional habitat could lead to population declines, or serve as permanent blocks to population recovery, and/or could affect seasonal movement patterns.

6. These demographic factors could be further exacerbated by indirect effects, such as increased wildfires, increased predation by wolves, and/or increased disturbance by humans, through their utilization of the linear corridors.

7. These demographic factors could be further affected by other planned future developments in the ISR (e.g. Holroyd and Retzer 2005).

8. These demographic factors could be further influenced by climate change (Brotton and Wall 1997, ACIA 2004, Joly et al. 2007).

Caribou and other land resources are of primary importance to the Inuvialuit, and are used for cultural, traditional, and subsistence purposes (page 367 of the EIS). The importance of these resources is shown by the number of people involved in traditional activities and by the proportion of people who consume country foods - 70% of households with children in the ISR have an active hunter, and fresh or dried caribou meat is the most commonly consumed country food (Egeland 2010). The long-term loss of caribou hunting could therefore have serious socio-economic repercussions. For example, the total net annual value of the harvest from the Beverly and Qamanirjuaq caribou herds has been recently estimated at almost $20 million (InterGroup Consultants Ltd. 2008), so compensation for the long-term loss and/or disruption of caribou hunting in the ISR could be potentially very significant, especially at a time when the human population of the ISR is increasing (StatsCan 2010).

Mitigation and Remediation

EIRB (2010) states that mitigation and remedial measures are generally limited in their intended application to those harvested species in the ISR that may be affected by development. Certain species which are not likely to be harvested, but are deemed 'important' in an ecological, or other social context, are also included. Federal or territorial designated species at risk are an example of this latter category.

Sustainable development is the overriding principle guiding the preparation of the mitigation and remedial measures. Sustainable development is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development 1987).

All land uses shall be conducted in keeping with the policy of sustainable development in order to protect the opportunities for wildlife harvesting (EIRB 2010).

There is a recognized sequence to the application of these measures (EIRB 2010):

Mitigation **-** *A priori (looking at causes) efforts to prevent or lessen potential adverse environmental effects that may occur.*
Remediation **-** *A posteriori (looking at effects) efforts to correct or compensate for any adverse environmental effects that have occurred, and to prevent, lessen, or compensate for any adverse environmental effects that may occur in the future as a result of the environmental damage.*

Mitigation measures would include the design, location, operational processes, timing and the preparation of contingency plans (including countermeasure plans), while remedial measures would include the implementation of contingency plans, restoration of wildlife and wildlife habitat, and compensation (EIRB 2010).

The Proponent provides a summary of mitigation strategies for identified valued components including caribou, grizzly bear, and the Husky Lakes on pages 647-650 of the EIS. All are local and/or site specific in nature. No mitigation strategies are identified for broader cumulative effects, although 'effects management' is included in the screening matrix for cumulative effects to VECs/VSCs at local and regional levels on pages 644-645 of the EIS. At the regional level, the Proponent's cumulative effects management for caribou, grizzly bear, and the Husky Lakes is only to:

Participate in ISR cumulative effects initiatives

This is clearly inadequate given the revised analysis outlined above, but understandable given the erroneous conclusion by the Proponent that no cumulative effects are significant. The Reviewer could find no descriptions of remediation strategies in the EIS, again presumably because the Proponent believes that they are not required under their benign effects conclusions. As outlined above, remediation through compensation may need to happen if the caribou herds fail to recover as a result of the cumulative effects of this and other imminent and future projects in the ISR.

Follow-Up and Monitoring

Follow-up, as defined in EIRB (2010), means a program for verifying the accuracy of the environmental assessment of a project, and determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project. The Proponent shall (EIRB 2010):

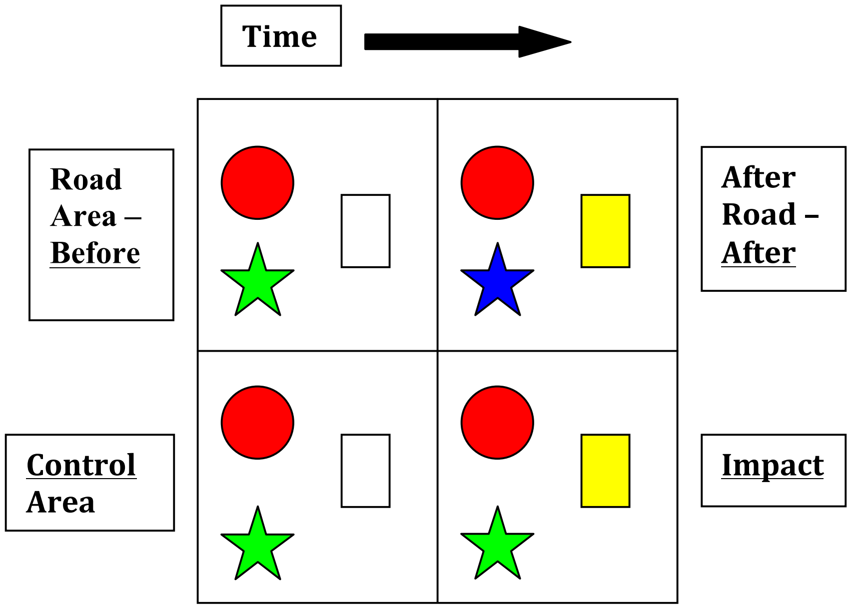
- *Clearly describe the regulatory and non-regulatory monitoring requirements for the life of the project.*
- *Provide a description of the purpose of each program, responsibilities for data collection, analysis and dissemination, and how results will be used in an adaptive management process.*
- *Describe how project-specific monitoring will be compatible with the NWT Cumulative Impact Monitoring Program or other regional monitoring and research programs.*

Natural resource management cannot operate effectively without reliable information on changes in the physical and biological environment and on the likely causes of those changes. Ecological monitoring represents an important source of such information, especially prior to and following human developments (Noble 2006). However, many operational monitoring programs are not very useful for decision-making (Vos et al. 2000). The design of a monitoring program usually consists of choices concerning monitoring objectives, variables (VECs, indicators) to be monitored, the sampling strategy and design to minimize statistical pitfalls, data collection, and finally data management and reporting (Vos et al. 2000, Moller et al. 2004, Spellerberg 2005). The requirements for effective monitoring include (Noble 2006):

- The early identification of objectives and priorities
- A targeted approach to data collection
- Hypothesis-based or threshold-based approaches to detection
- Control sites for comparison purposes (see below)
- Continuity in data collection and management

- Adaptability, flexibility, and timeliness
- An approach that is inclusive of socio-economic and cultural impacts

According to the Proponent, the Northwest Territories Cumulative Impact Monitoring Program (CIMP) focuses only on the biophysical environment while the Project EIS has both VECs and VSCs. However, the Reviewer notes that CIMP identifies both VECs and VSCs that are required to be monitored regularly (AAND 2010). In any event, the Proponent lists CIMP VCs on page 654 of the EIS alongside the Project VECs, and notes that there is a partial overlap between the two lists. More importantly, according to the CIMP strategic plan (AAND 2010), CIMP is not due to begin collecting baseline information for several more years, by which time the Project could be complete. Unless the monitoring protocols of CIMP and the Project are the same (which they are not), it will not be possible to begin measuring the potential impact of the road on any of the VECs or VSCs. Without the ability to measure these effects, it will not be possible to inform the direction that future adaptive resource management should take. Instead of relying on something not due to begin for several years, the Proponent needs to describe an appropriate integrated, cumulative effects monitoring plan for the life of the Project that includes a Before-After-Control-Impact (BACI) design (Stewart-Oaten et al. 1986, see figure below).



Such a monitoring design enables the partitioning of two potential reasons why a particular VEC is changing. The figure above shows three VECs (discs, rectangles, and stars). The upper half of the figure shows the traditional approach to ecological monitoring - before and after the road is built, for example. Two of the VECs change over time (rectangles, stars), but why? Is it because of a road impact, or is it due to natural fluctuation? One way to discriminate between the two is to have a matching control area away from the influence of the road (bottom left of the figure). In this control area, only the rectangle VEC has changed over time and not the star VEC. We can therefore conclude that the change in the rectangle VEC has something to do with the road and is not due to natural variation. We can then more confidently focus our efforts on understanding the VEC change due to the road.

Conclusions

By adopting a 'systems', cumulative effects approach to the EIS, the Reviewer has identified a number of critical errors within the assessment, each further compounded by the other. Of fundamental importance is the choice of spatial and temporal boundaries for the CEA, both of which are lacking in scope and detail. By strongly limiting these, the Proponent's assessment of potential impacts on VECs such as caribou, grizzly bear, and the Husky Lakes are grossly underestimated. As a result, the mitigation and/or remediation of these impacts and the proposed Worst Case Scenario (WCS) are erroneous. A more realistic WCS is presented which involves the severe disruption and/or loss of caribou harvest within the ISR. As the avoidance behavior of caribou cannot be mitigated, remediation through long-term compensation may have to occur. The errors in the EIS are further compounded by the lack of an integrated, cumulative effects monitoring plan specific to the Project within the context of other past, imminent, and likely future projects within the ISR. Without such a plan, it will not be possible to discern, for example, why caribou numbers are not increasing when they should be. As a result, the future management decisions involving the important natural resources of the Inuvialuit may not be properly served in that the decisions will become more reactive and less proactive over time.

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