Beverly and Qamanirjuaq Caribou Management Board

24 January 2011

Sophia Granchinho
Technical Advisor
Nunavut Impact Review Board
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Dear Ms. Granchinho:

NIRB 09MN003: Revised Draft Scope and Draft EIS Guidelines for Kiggavik Review

On behalf of the Beverly and Qamanirjuaq Caribou Management Board (BQCMB), I am responding to your request for comments on the NIRB's revised draft scope and draft EIS guidelines for AREVA's proposed Kiggavik mine and mill project. This is in accordance with the mandate of the BQCMB, which is to advise governments and caribou range communities on conservation and management of the Beverly and Qamanirjuaq caribou herds and their ranges.

As we have stated in previous submissions to the NIRB on this project proposal, the BQCMB believes that this proposed Project is precedent-setting[1] in many ways, and that a full and transparent review is necessary because:

- the proposed Project is likely to cause significant impacts, including impacts on caribou, caribou habitat and caribou harvesting activities;
- the potential effects of the Project on caribou are uncertain, and it is not known if they are mitigable with known technology; and
- the Project proposal has aroused significant concern from traditional caribou harvesters in Nunavut, the Northwest Territories, Saskatchewan and Manitoba.

General Comments

The revised draft scope and draft EIS guidelines are thorough, systematic and well-written. The BQCMB appreciates the efforts made by the NIRB to produce good products that will facilitate a transparent and detailed review. We have a few general recommendations for improving the EIS guidelines, and have attached our more detailed comments on both the draft scope and guidelines.

- We appreciate that the NIRB is attempting to ensure that this environmental review and the EIS that will form its basis are comprehensive. However, we find that the precedent-setting nature of this proposal, and the special EA requirements that result from this, are not reflected adequately in the scoping description or EIS guidelines.

  The EIS and Project review should be improved by including stronger direction to the Proponent concerning assessment of aspects of this Project related to its specific purpose,

[1] Precedent-setting aspects include: the first uranium mine and mill project in the Canadian arctic tundra, located in a region with continuous permafrost, in an era with uncertain effects resulting from climate change.

which is to extract uranium and transport yellowcake out of the region. Achieving this purpose requires a large and sustained undertaking by an international corporation to establish a major development that will include five mines, a mill, and a new transportation network. All stages of this development and its legacy will include risks inherent in working with uranium and its radioactive by-products. This proposed Project is therefore different from other mines proposed previously for Nunavut, and this should be reflected more clearly in the requirements for the EIS that are outlined in the NIRB's guidelines.

A key part of the EIS must be an in-depth assessment and explanation by the Proponent of the following aspects of their proposal for Nunavut's first uranium project:

- The ***extent of accumulation*** of environmental contaminants that will likely result from mining activities, including transportation and storage of ore and yellowcake, and the potential food-chain effects relevant to caribou and caribou harvesters.
- The ***risk of accidental release*** of contaminants, particularly those with radioactive properties, into the environment during all stages of operation (i.e., uranium ore extraction; transportation of ore to the mill; ore processing; transportation of yellowcake to southern Canada; and storage of waste rock, ore, and yellowcake.)
- The potential ***short-term and long-term impacts*** on the environment of any accidents involving environmental contaminants, including minor to major releases of radioactive materials; this should include impact assessment specifically for caribou, caribou habitat, and caribou harvesters.
- The ***limitations of mitigation*** of environmental contamination resulting from the proposed Project (including accumulation over time resulting from mining activities as well as accidental releases); this should include assessment of the effects of residual contamination on caribou habitat, caribou and caribou harvesters through food-chain effects.

The implications for the current and future well-being of caribou and Aboriginal and other caribou harvesters across the caribou ranges should be unambiguously assessed and clearly explained. The results of the various assessments required to address these major questions for caribou and caribou harvesters (related to impact assessment, risk management, hazardous materials management, mitigation and residual impacts) should be presented together and easily located in the EIS. They should not be scattered throughout the report or buried in the enormous amount of detail that will be produced for the EIS and its numerous supporting documents.

- As we have stated previously, the BQCMB believes that the NIRB's review of this Project proposal should take into account the range-wide, trans-boundary eco-systemic and socio-economic cumulative effects of past, present and reasonably foreseeable future exploration and development on caribou that use and migrate through the Kiggavik-Sissons area, and should assess the impacts of the additional effects that this proposed Project would create for caribou and caribou habitat. In addition to describing potential Project effects on Inuit and other residents of Nunavut, the review should also consider the potential adverse socio-economic effects that could extend to traditional harvesters and other users of caribou across the caribou ranges in the Northwest Territories, Saskatchewan, and Manitoba.

Thank-you for the opportunity to participate in the Kiggavik review process. We look forward to continuing to work with the NIRB to safeguard the sustainability of caribou populations and traditional Aboriginal lifestyles that include subsistence caribou harvesting.

Please contact BQCMB contract biologist Leslie Wakelyn (wakelyn@theedge.ca) or Secretary-Treasurer Ross Thompson (rossthompson@mymts.net) if you have any questions about these comments from the BQCMB.

Sincerely,

Albert Thorassie
BQCMB Chairperson

Attachments (4)

cc. David Vetra, BQCMB member (representing the Government of Nunavut, Arviat)
Thomas Elytook, BQCMB member (representing the Kivalliq Wildlife Board, Baker Lake HTO)
Laurent Angalik, BQCMB member (representing the Kivalliq Wildlife Board, Arviat HTO)

Attachment A. BQCMB Comments on the Revised Draft Scope for the Kiggavik Review

Following are a few comments on the NIRB document "*Revised Draft* Scope of the NIRB's Assessment of the Kiggavik Project Proposal", November 2010.

The *Revised Draft Scope* (p. 1) states that the scope of NIRB's project assessment is based on requirements of the Nunavut land claim agreement, NIRB's standard EIS requirements, and AREVA's Project proposal. The NIRB's 58-page report on the spring 2010 public scoping meetings (p. 4) indicates that "Issues raised at these public scoping meetings . . . will contribute to a complete and comprehensive project scope".

- One of the concerns raised over and over again at the community meetings was "radiation". People asked questions about: radiation from mine tailings and from waste rock; uranium by-products, including radon gas; the risks from radiation for human health and for the land, water and wildlife; long-term hazards and the responsibility for radioactive waste after mine decommissioning; what happens to stored waste if the permafrost melts; and the potential for spills and accidents at uranium mines and during transport of yellowcake.

  However, the *Revised Draft Scope* fails to address these concerns and issues adequately, as it does not highlight radiation as a key issue that needs to be addressed in the EIS, and in fact fails to list radiation or contaminants related to uranium mining generally.

  The scope and the guidelines should include radiation as a separate "environmental and socio-economic factor" that needs to be fully addressed by the Proponent in the EIS. The guidelines should include instructions to the Proponent to clearly explain the extent to which radiation and related issues will need to be dealt with during development, operation, and the legacy of the proposed Project. This should include a full accounting of the radioactive content/emissions resulting from mining and transporting uranium, management requirements, risks, and mitigation associated with all radiation-related aspects of the Project. This should include descriptions related to caribou, caribou habitat, and caribou harvesters.

- Although most of the issues raised during community meetings may be included in the list of "environmental and socio-economic factors" provided on pages 5-6 of the *Revised Draft Scope*, this list does not indicate the level of concern or the priority of these factors as expressed by community residents.

  For example, an issue raised repeatedly is that of Project impacts on caribou, yet caribou are not specified in the list of factors, but are included only generally under "Terrestrial Wildlife and Wildlife Habitat" and "Cumulative Effects" (as per the request of INAC Minister Strahl in Feb/10). This is surprising considering the frequency people at community meetings raised concerns specifically about caribou.

  The BQCMB does, of course, consider caribou to be a key environmental factor for the review of this proposed Project, with associated socio-economic implications.

Attachment B. BQCMB Comments on the Draft EIS Guidelines for the Kiggavik Project

Following are suggestions for improving the NIRB document "*Draft* Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc's Kiggavik Project (NIRB File No. 09MN003), November 2010". Our comments are organized under the section headings used for the draft guidelines.

Note: Throughout our comments, references to "harvesters across the caribou ranges, including those in the NWT, Saskatchewan and Manitoba", or "residents of caribou-range communities in the NWT, Saskatchewan and Manitoba", relate to the historic and current year-round ranges of caribou herds that occupy and migrate through the Kiggavik-Sissons area. These are ranges of any caribou herds that interact with the proposed project area. Therefore they include, but may not be limited to, historic and current ranges of the Beverly and possibly Qamanirjuaq herds.

We have attached a map of the historic year-round ranges of these two herds based on survey data up to 1994 (Attachment D). Information about more recent range use by these herds, and by other herds which may use the Kiggavik-Sissons area (such as the northeast mainland caribou herds), should be obtained by the NIRB and the Proponent from the governments of Nunavut and the NWT.

GLOSSARY

In addition to definitions of terms "provided for the Proponent's greater certainty" (p. v), the glossary should provide definitions that improve the ability of review participants to understand technical terms used during the review. These should include definitions for key terms related to:

- uranium mining (e.g., radon, radiation, yellowcake, clean waste, special waste, subeconomic mineralized waste)
- mining (e.g., tailings, leaching, reagent, fugitive dust, subsidence)
- wildlife (e.g., biodiversity, raptors, marine biota, benthic, phytoplankton)
- environmental assessment topics (e.g., eco-systemic, transboundary effects, significant effects or impacts, mitigation, residual impacts, sustainability)

2.0 Guiding Principles

- The BQCMB supports basing the review on an ecosystem-based approach. This approach is essential for fully assessing the effects of mining uranium specifically. The Proponent should be directed to include an in-depth assessment of the food chain effect that would result from their proposed Project, including eco-systemic effects of dust dispersal to lichen-caribou-wolves and people. This assessment should occur over a suitable time frame that relates to the long-term persistence of uranium mining contamination in the environment.
- The BQCMB supports including consideration of transboundary effects for Project effects that would result outside Nunavut. An assessment of bio-physical and socio-economic effects across the ranges of the caribou herds is required. This should include an assessment of the transboundary effects on caribou and caribou harvesters that may result from aerial dispersal of radioactive dust.

2.2 Public Engagement

- The Proponent should be required to engage residents and organizations from across the caribou ranges during development of the EIS. This should include residents of caribou-range communities in the NWT, Saskatchewan, and Manitoba.

2.3 Precautionary Principle and 2.4 Sustainable Development

- The requirement for risk assessment and dealing with different aspects of uncertainty needs to be strengthened. The proponent should be directed to conduct thorough assessments specifically for

radiation-related risks generally, and for risks to sustainability of caribou herds and to present and future generations of subsistence and other caribou harvesters across the caribou ranges.

Assessing risk requires describing incomplete information and its influence on EA decisions. Uncertainty arises from process variability (natural variation among individuals and environmental variation, which is unpredictable); observational errors (measurement errors including those from inaccuracy or inadequate sampling design); and model errors (computer models are incomplete pictures of the complexity of biological systems).

2.5 Traditional Knowledge

- The BQCMB agrees that traditional knowledge should be incorporated into the EIS, and that it should include "local and community based knowledge, ecological knowledge (both traditional and contemporary)".
- The NIRB should provide more specific direction to the Proponent regarding how it expects them to "incorporate" TK into the EIS. Compiling traditional knowledge is only the first step in applying it into environmental assessment. Analysis, interpretation and synthesis are also necessary. TK should also be used to design monitoring programs and mitigation measures.
- Given the likelihood of transboundary effects, use of traditional knowledge must include knowledge and values of Aboriginal peoples from across the caribou ranges in NWT, Saskatchewan and Manitoba, as well as Inuit knowledge and values.

2.6 Study Strategy and Methodology

The Proponent should be required to identify all significant environmental effects from a perspective that acknowledges several key characteristics of their proposed Project, including its:

- precedent-setting nature (first uranium mine in tundra environment in Nunavut)
- exceptional environmental concerns (radiation and extremely long-term contamination)
- immense scale (5 separate mines with additional minesites possible in future)
- multi-faceted character (mines, mill, transportation system)
- region-opening potential, particularly with an all-weather road (likely making other developments feasible)
- potential impacts at all levels (air, land, freshwater and marine)
- risk of accidents, both relatively minor and major
- irreversibility of some residual effects, and extremely long time-frame for others

It is these characteristics that cause the BQCMB to be concerned about the potential impacts of this Project on caribou, caribou habitat, and caribou harvesters.

2.7 Use of Existing Information

The Proponent and the NIRB should ensure that all supporting documents, including those supporting the Project proposal, EIS, and other documents the Proponent has produced and referenced, are readily available on the NIRB Public Registry. Other documents should include previous assessments of AREVA's projects elsewhere, such as Saskatchewan's experience with AREVA's projects, including reports by governments and monitoring agencies.

3.2 Scope of NIRB's Assessment

The NIRB's document "*Revised Draft* Scope of the NIRB's Assessment of the Kiggavik Project Proposal" should be included in the EIS guidelines as Appendix B.

4.1 Presentation, 4.3 Length, 4.5 Data Presentation

The Proponent and the NIRB should ensure that the EIS and its supporting documents are all posted on the NIRB Public Registry in a manner that is manageable for reviewers, communities and the general public. Specifically, the Proponent should be instructed to:

- avoid large digital file sizes by breaking the EIS into several sections[2], and use file names that clearly identify their contents
- avoid excessive background detail on maps, which can significantly increase file size for documents
- provide a master list of all supporting documents that comprise the full EIS, including technical reports, appendices, and maps.

5.1 Proponent Information

The Proponent should be instructed to describe specific lessons learned from open pit and underground mining and road construction on the arctic tundra, especially lessons from NWT diamond mines, given that AREVA has not built or operated a mine on the tundra. They should describe project design and planning considerations to address conditions such as continuous permafrost, winter blizzards, and summer winds during all phases of the Project, in addition to safeguards it will put in place to compensate for its lack of experience in this region.

5.4 Assessment Boundaries

- The appropriate scale for caribou spatial and temporal boundaries is the annual range over decades. This time period is required to capture at least a full caribou cycle. Caribou numbers follow cycles of about 40-60 years, and as the numbers rise and fall, the distribution of caribou expands and contracts. This timescale of decades and changes in distribution has implications for identifying baseline, for impact predictions, and for monitoring and mitigation planning. Determining the area included in the long-term annual range is possible using Aboriginal knowledge and technical approaches (including dendrochronology and archaeology).
- The assessment boundaries should reflect both Aboriginal (including but not limited to Inuit) land use and occupancy and specific wildlife information in defining spatial and temporal boundaries. From the BQCMB's perspective, subsistence and other caribou harvesters and land users will be affected over a large area due to proposed project activities affecting caribou herds. This area extends outside Nunavut and will involve other Aboriginal peoples in addition to Inuit. As we have said previously, "the spatial boundaries of the maximum area potentially affected by the Project" will be at least as large as the caribou ranges.
- Dust fall also has to be considered in determining assessment boundaries as on the tundra, strong winds disperse over 10s of km and further for the very fine particles. This is especially important to consider for uranium mining, as some dust could be radioactive. The food chain effect could be significant where radioactive dust falls on lichens and other tundra vegetation important in the caribou diet.

6.1 Alternatives

Alternatives for the Kiggavik Project that the Proponent should be required to analyse concerning their risk of significant short-term and long-term adverse and cumulative effects on caribou, caribou habitat and caribou harvesters include:

- "No-go" for the Kiggavik Project
- No road development associated with the Project
- Alternatives for transport of the yellowcake from the Kiggavik site, including an alternative with no transport to Baker Lake via truck
- Alternatives for the routing and type of roads (winter vs. all-weather); use of roads after decommissioning
- Alternatives for air transport (size of aircraft, frequency of flights, especially low-level flights)

[2] For instance, in the *Terms of Reference for the Gahcho Kué Environmental Impact Statement,* MVEIRB requested individual files up to 5 MB in size and preferably less than 3 MB (using only low resolution images).

6.2 Project Design

General project design issues should also include description of how design, engineering, management and monitoring plans will minimize radiation exposure and contamination of the environment generally, and to caribou specifically. Description of how potential impacts to wildlife have influenced the design of the Project should specify how project planning has taken into account the need to minimize disturbance to caribou and caribou harvesters.

7.3 Methodology

As well as providing details about acquisition of data, the Proponent should describe:

- methods of data archiving used, at least for metadata
- availability of data for assessment and monitoring, including when the Proponent has funded a third party (such as consultants or government) to collect data
- limitations on data availability and their causes
- issues related to analysing data from various sources, such as statistical issues with data collected by different parties using different methods (re: comparability)

7.7 Impact Prediction

- The Proponent should predict impacts on caribou and caribou harvesting that include:
  - direct, indirect, short-term, long-term and cumulative impacts
  - impacts associated with each Project phase
  - impacts resulting from accidental effects and malfunctions.

  The degree of uncertainty and the anticipated response of caribou to predicted impacts should be explained and justified.
- The Proponent should also be required to provide details on the size or extent of the predicted effects and the statistical power of the predictions.

7.8 Cumulative Effects Assessment

The guidelines should provide more detail on the spatial and temporal boundaries, as well as on which past, present and reasonably foreseeable projects to include in the CEA. This should include the following:

- As we have said under “5.4 Assessment Boundaries”, the appropriate scale for assessment of effects on caribou is the annual range over decades, so the temporal scale for CEA for caribou should be several decades at a minimum.
- For assessing cumulative effects on caribou, consideration should be given to interaction of impacts including:
  - disturbance from human land use activities across the ranges of the herds, including mineral exploration and mining on the caribou range in the NWT, Saskatchewan and Manitoba,
  - past, present, planned, and likely future mining activities on the caribou range, including the legacy of uranium mining in northern Saskatchewan and past and recent uranium exploration across the Athabasca and Thelon geological basins
  - loss of winter range due to wildfires in the NWT, Saskatchewan and Manitoba
  - increased access to caribou range resulting from new roads and airstrips
  - accumulation of contaminants on caribou habitat and in caribou from all sources, including airborne dust
  - climate change effects across the caribou range.

Evaluating the significance of cumulative effects should include predicting the direct, indirect and residual impacts on caribou at both the individual and herd level, as well as the effects on availability of caribou to subsistence and other harvesters across the caribou ranges. Some of the aspects that should be considered are outlined in Attachment C.

7.9 Transboundary Impacts

- Most effects of the Project on caribou will have transboundary impacts if they affect the health of individual animals or the productivity of the herd. These impacts will affect availability of caribou for traditional subsistence and other harvesters in the NWT, Saskatchewan and Manitoba. The EIS should include an assessment of these types of transboundary impacts.
- Interactions between the effects of the Project on caribou in the NSA and the effects of projects on caribou outside Nunavut, should be assessed in the EIS. Because caribou migrate long distances every year, there are many potential transboundary effects of this nature. Assessment of these transboundary effects on caribou should take into account the long-term effects of uranium mines in Saskatchewan and other mineral exploration and mining activities across the caribou ranges in NWT, Saskatchewan and Manitoba.

8.1.2. Air Quality, 8.1.10 Freshwater Aquatic Environment

- The guidelines should instruct the Proponent to provide information about predictions for emission sources and rates, specifically for dust, including extremely fine particulate dust, radioactive dust and radon.
- Assessment of potential impacts on caribou, caribou habitat and caribou harvesters should involve airborne dust and any other sources of contaminants that will be deposited on lichen and other vegetation important in the diet of caribou, as well as on water bodies likely to serve as drinking water for caribou.

8.1.13 Terrestrial Wildlife and Habitat

- In addition to baseline information outlined in the draft guidelines, the Proponent should be instructed to provide details regarding available information of relevance to caribou on:
    - potential impacts to wildlife associated with roads, including habitat loss, disruption of movements, mortality and injury, disturbance, dust, and increased human access to the area.
    - potential impacts to caribou associated with contaminants, including radioactive materials, and related food-chain effects.
- The instructions for assessing impacts of Project activities on terrestrial wildlife and wildlife habitat are fairly detailed and comprehensive, and should all be applied by the Proponent for assessing direct, indirect, and cumulative impacts of the Project on caribou and caribou habitat. Aspects of particular importance to the assessment of Project impacts on caribou will include: habitat loss (direct and indirect) and modification; disturbance from ground and air traffic, especially low level flights; disturbance from mining activities and construction and operation of infrastructure, including roads; short- and long-term contamination of air, land and water; and greater hunting pressure and other disturbances resulting from increased access to the area for an increasing human population.
- Assessment of impacts on caribou should describe potential impacts associated with each proposed road option. This should assess the effects of potential habitat loss, disruption of movements, mortality and injury, disturbance, dust, and increased human access to the area. Cumulative impacts should be assessed for roads proposed for this Project in combination with existing roads on the caribou ranges, such the Meadowbank road and roads on the winter range in northern Saskatchewan, as well as any reasonably foreseeable roads, such as the proposed road from northern Manitoba to Baker Lake.
- Assessment of impacts of contaminants on caribou and caribou habitat should include analysis of contamination by airborne radioactive dust, and resulting food chain effects through the vegetation-caribou-predator/human harvester pathway.
- Assessment of food chain effects should include impacts potentially accumulating in individual caribou as they move across the caribou ranges and return to the same seasonal ranges year after year, including cumulative effects of ingesting contaminants at several different sites throughout each year (e.g., from feeding near minesites on the winter range and others on the summer range).

8.2 Socio-economic Environment

- The BQCMB supports inclusion of guidelines that address ways that impacts of the Project on caribou may affect food security, self-reliance, traditional land use, human health and cultural well-being. Guidelines for describing baseline information and assessing impacts should be applied by the Proponent as they relate to caribou and caribou harvesters as outlined in sections 8.2.3, 8.2.5, 8.2.8, 8.2.11, and 8.2.12.
- Aspects considered should include the importance of subsistence caribou harvesting, sustainable use of caribou, and the cultural and social activities associated with hunting caribou (such as community feasts and making arts and crafts) to maintenance of Aboriginal people's traditional way of life.
- Socio-economic assessments related to Impacts of the Project on caribou should be conducted not just for Inuit harvesters in Nunavut, but also for other Aboriginal traditional harvesters across the caribou ranges, including those in the NWT, Saskatchewan and Manitoba.

9.1 Environmental Management Plan
9.3 Monitoring and Mitigation Plans
9.4.15 Wildlife Mitigation and Monitoring Plan

- It is extremely important that the EIS include descriptions of:
    - how results from monitoring will be used to modify mitigation measures or identify other actions required when actual impacts differ from those that were predicted
    - thresholds and monitoring indicators that will trigger decisions or actions, including mitigation measures
    - means for assessing the effectiveness of mitigation measures
    - a mechanism for adaptive management.
- The guidelines should direct the Proponent to describe the statistical power of their analyses to detect changes, including effects size and levels of significance.
- The management and monitoring plans should include annual reporting requirements and a plan for access to monitoring data and data archiving.
- The EIS should include a Caribou Mitigation and Monitoring Plan that addresses each of the issues and actions outlined in the EIS guidelines, and aims to mitigate potential negative impacts of the Project on caribou, caribou habitat, and caribou harvesters across the caribou ranges. It should also include descriptions of:
    - areas where scientific uncertainty exists for the prediction of adverse effects and their significance.
    - the likely effectiveness of mitigation measures, and an evaluation of the significance of residual impacts.
    - thresholds and monitoring indicators that will be used to identify required actions.
    - proposed mitigation measures and anticipated residual effects for impacts of all road alternatives, including a scenario with no road from Kiggavik to Baker Lake.

9.5 Socio-Economic Environmental Management Plans

In this section of the EIS, the Proponent should describe what compensation measures will be established for adverse socio-economic impacts respecting caribou, including compensation of traditional caribou harvesters for loss of food security and traditional way of life as a result of potential changes to caribou accessibility or increased levels of contaminants.

9.8 Significance of Residual Impacts

- Significance of residual impacts specifically for caribou, caribou habitat and caribou harvesters should be provided as part of the assessment of impacts of the Project on caribou.
- A summary that describes all mitigation measures the Proponent commits to apply should be provided and cross-referenced to appropriate sections of the EIS. This should be provided in a format that will assist with reviewing the summary table of effects before and after mitigation.

- The time frame considered should be indicated for significance of residual impacts, with terms clearly defined (e.g., short-term, long-term, cumulative over specific time period).
- Conclusions about significance of residual impacts should be justified with full explanation and references.

Attachment C. Cumulative Effects and Caribou

Following is a preliminary list of information required to allow a meaningful assessment of cumulative effects on barren-ground caribou. This list is not exhaustive, but is provided for consideration by parties responsible for cumulative impact assessment.

1) At individual level

- How individual caribou are affected by mineral exploration activities (energetic costs of responses to drilling noise or other human activities, restricted access to key water crossings or feeding areas; exposure to contaminants; loss of habitat).
- How development impacts accumulate in caribou through annual movements across range, in a single year and over many years
  (for the Beverly herd, this includes exploration and mining on SK winter range; exploration on NWT spring migration range; exploration on NU calving ground, post-calving areas and summer range)
- How development impacts interact with other impacts
  (loss of winter range from fires, climate change impacts).
- What level of accumulated impacts affects caribou health
  (health of migrating pregnant female caribou, calf survival, chance of pregnancy).

Each of these will vary with changes in:

- Relative status of pregnant female caribou on spring migration
  (relatively healthy and strong vs. undernourished and extremely stressed).
- Ability of individual caribou to adjust to all environmental influences, including human activities.

2) At herd level

- What level of accumulated impacts on individual caribou results in effects at the herd level (such as lower pregnancy rates, lower calf survival, decreasing population, reduced herd health)

- How well caribou herds can adjust to all environmental influences, including human activities.

These will vary with factors such as:

  - Population size and trend (increasing, stable, decreasing)
  - Overall herd health.
  - Seasonal distribution and movements.
  - Harvest levels
  - Effects of environmental conditions on caribou.

3) At level of caribou-human system

- What level of accumulated impacts on caribou herds results in reduced availability of caribou to communities
  (reduced herd size, changes in migration patterns)
- How well communities can adjust to reduced availability of caribou
  (dependence on caribou, availability of alternatives)
- What is the economic loss to communities and outfitters that will occur if caribou are not available for harvest.
- How well can governments respond to economic pressures resulting from loss of availability of caribou for communities.

Attachment D. Map of year-round range of the Beverly and Qamanirjuaq caribou herds based on government surveys between 1940 and 1995.