GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

SECTION 13

CUMULATIVE EFFECTS

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13.1 INTRODUCTION

13.1.1 Context

This section summarizes the cumulative effects approach, methods, and results from the key lines of inquiry and subjects of note for the biophysical and socio-economic components of the Gahcho Kué Project (Project) Environmental Impact Statement (EIS). It outlines, in general, the overall approach to the cumulative impact assessment and significance determination that was used in the key lines of inquiry and subjects of note. Details that are specific to each key line of inquiry and subject of note are provided in their respective sections and sub-sections.

13.1.2 Purpose and Scope

The *Terms of Reference for the Gahcho Kué Enviornmental Impact Statement* (Terms of Reference) (Gahcho Kué Panel 2007) require that each key line of inquiry and subject of note be a stand-alone assessment, and must address cumulative effects from past, present, and reasonably foreseeable future developments. The Terms of Reference also require a stand-alone assessment of the cumulative effects from the proposed development. The cumulative effects section must provide sufficient information to allow the Panel and parties to evaluate the significance of the proposed development's cumulative effects, without having to refer to other sections extensively (Gahcho Kué Panel 2007).

To analyze and classify cumulative effects for each key line of inquiry and subject of note, the approach and methods described below are applied to information from the existing environment and the Project Description (Section 3). For many biological and socio-economic components, information from traditional knowledge was used to help assess effects.

13.1.3 Definition of Cumulative Effects

Cumulative effects are those effects that result from a combination of the Project with other past, present, and reasonably foreseeable future developments (MVEIRB 2004). They may be biophysical, socio-cultural or economic in nature (MVEIRB 2004). Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, social, cultural, and economic components of the environment through time and across space (Section 6.6.2).

Some changes may be human-related, such as increasing mineral development or implementing new policy, and some changes may be associated with natural phenomena such as extreme rainfall events, and periodic harsh and mild winters. It is the goal of the cumulative effects assessment to estimate the contribution of these types of effects, in addition to Project effects, to the amount of change in the valued components of the biophysical, socio-economic, and cultural environments.

Not every valued component (VC) requires an analysis of cumulative effects. The key is to determine if the effects from the Project and one or more additional developments/activities overlap (or interact) with the temporal and spatial distribution of the VC. For some VCs, there is little or no potential for cumulative effects because there is little or no overlap with other projects (e.g., components of the aquatic environment). For other VCs that are distributed or travel over large areas and can be influenced by a number of developments (e.g., caribou and socio-economics), the analysis of cumulative effects can be necessary and important.

A cumulative effects assessment should use the following steps (from MVEIRB 2004):

- identify the VCs for the proposed project,
- determine what other past, present, and reasonably foreseeable future developments could affect the VCs,
- predict the effects of the proposed project in combination with these other developments, and
- identify ways to manage the combined effects.

In this EIS, cumulative effects are identified, analyzed, and assessed in the section on the VC where applicable, and follow the approach used for the Project-specific effects analysis (Section 6.6.1), and impact classification and determination of significance (Section 6.7). To meet the requirements in the Terms of Reference, this section provides a summary of cumulative effects for all all components of the biophysical and socio-econonmic environments (i.e., for components influenced and not influenced by cumulative effects).

13.2 APPROACH TO CUMULATIVE EFFECTS ASSESSMENT

13.2.1 Spatial Boundaries

For the EIS, spatial boundaries are typically established at the local, regional, and beyond regional scales (Section 6.4.1). The spatial boundaries of the local study areas were designed to measure baseline environmental conditions and then predict direct effects from the Project footprint and activities on the VCs and associated measurement endpoints. Examples of local Project effects include loss of fish habitat from Kennady Lake, physical disturbance to vegetation, soil admixing, and mortality of individual animals. Local study areas were also defined to assess small-scale indirect effects from Project activities on VCs such as changes to soil and vegetation from dust and airl emissions.

The boundaries for regional study areas were designed to quantify baseline conditions at a scale that was large enough to assess the maximum predicted geographic extent (i.e., zone of influence) of direct and indirect effects from the Project on VCs and measurement endpoints. Project-related effects at the regional scale include potential changes to downstream water quality and quantity, vegetation communities, wildlife habitat quality, wildlife and fish, and people that use these ecosystem services. Cumulative effects are typically assessed at a regional spatial scale and, where relevant, may consider influences that extend beyond the regional study area.

Effects that occur beyond the regional scale concern wildlife populations with large home ranges such as caribou, grizzly bear, wolverine, and wolf. Individuals within these populations (or VCs) travel large distances during their daily and seasonal movements and can be affected by the Project, and one or more additional projects (Section 6.4.1). For these species, the spatial boundary was defined by the seasonal or annual range of the population. Similarly, cumulative effects from multiple developments influence traditional and non-traditional land use practices, and socio-economic properties beyond the regional scale. The rationale for the spatial boundaries is provided in the introductions to each key line of inquiry and subject of note.

13.2.2 Temporal Boundaries

The approach used to determine the temporal boundaries of effects from natural and human-related disturbances on VCs is similar to the approach used to define spatial boundaries (Section 6.4.2). In the EIS, temporal boundaries are linked to two concepts:

- the development phases of the Project, which includes;
  - construction (2 years);
  - operations (11 years); and
  - closure (8 years).
- the predicted duration of effects from the Project on a VC, which may extend beyond closure.

Thus, the temporal boundary for a VC is defined as the amount of time between the start and end of a relevant project activity or stressor (which is related to development phases), plus the duration required for the effect to be reversed. After removal of the stressor, reversibility is the likelihood and time required for a VC or system to return to a state that is similar to the state of systems of the same type, area, and time that are not affected by the Project but does not necessarily imply returning to environmental conditions prior to development of the Project (Section 6.4.2). For example, ecological and socio-economic systems continually evolve through time (Chapin et al. 2004; Folke 2006) and the physical, biological, social, and economic properties of social-ecological system at closure likely will be different than the current observed patterns, independent of Project effects. Return or recovery to pre-Project conditions may not be possible or even desirable.

The temporal boundaries of key line of inquiry for aquatic VCs are defined by the Terms of Reference, and the development phases of the Project. For example, the temporal boundary for effects to Water Quality and Fish in Kennady Lake is associated with lake dewatering, which occurs during construction and part of operation. Similarly, the timeframe for Downstream Water Effects is also associated with the Project schedule for lake dewatering; however, the duration of effects may extend beyond operation. The temporal scale for Long-term Biophysical Effects and Closure Issues considers all phases of development, and the duration of effects to VCs. For all biological and human VCs, the duration of effects is presented in the context of the life history of species (e.g., number of life spans, number of generations [Section 6.7.2]).

13.2.3 Assessment Cases

For VCs that can be influenced by the Project and one or more additional developments (i.e., require a cumulative effects analysis), the concept of assessment cases is applied to the associated spatial boundary (effects study area) to estimate the incremental and cumulative effects from the Project and other developments (Table 13.2-1). The approach incorporates the temporal boundary for analyzing the effects from previous, existing, and reasonably foreseeable developments before, during, and after the anticipated life of the Project (Section 6.6.2).

Table 13.2-1 Contents of Each Assessment Case

Baseline Case	Application Case	Future Case
Range of conditions from little or no development to all previous and existing projects[a] prior to the Gahcho Kué Project	Baseline Case plus the Gahcho Kué Project	Application case plus reasonably foreseeable projects

[a] Includes approved projects.

The baseline case represents a range of conditions over time within the effects study area prior to application of the Project, and not a single point in time. Thus, the baseline case includes conditions on the landscape prior to industrial development (reference conditions). Baseline conditions also include all previous and existing developments (i.e., from reference to 2010 baseline conditions) in the VC effects study area prior to application of the Project. Analyzing the temporal changes to the landscape is fundamental to predicting the cumulative effects from development on VCs that move over large areas such as caribou, grizzly bears, and traditional land users.

The temporal boundary of the application case begins with the anticipated first year of construction of the Project, and continues until the predicted effects are reversed (Section 6.4.2). For several VCs, the temporal extent of some effects likely will be longer than the lifespan of the Project because the effects will not be reversed until after closure. For other VCs, the effects may be determined to be irreversible within the temporal boundary of assessment. Such effects may be permanent, or the duration of the effect may not be known, except that it is expected to be extremely long (possibly more than 100 years past closure).

The future case includes the predicted duration of residual effects from the Project, plus other previous, existing, and reasonably foreseeable projects and activities. Thus, the minimum temporal boundary for the application and future case is the expected lifespan of the Project, which like the baseline case, includes a range of conditions over time. The difference between the application and future case is that the application case considers the incremental effect from the Project in isolation of potential future activities.

Analyses of the effects for the baseline and application cases are largely quantitative. Alternately, effects analyses for the future case are more qualitative due the large degree and number of uncertainties. There are uncertainties associated with the timing, rate, type, and location of developments in the study areas for each VC. There are also uncertainties in the direction, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of Project effects.

13.3 IMPACT ASSESSMENT METHODS

13.3.1 Application of Residual Impact Classification

In the EIS, the term "effect" used in the effects analyses and residual effects summary (Section 6.6.1) is regarded as an "impact" in the residual impact classification. An effect represents an unclassified change in a VC. The term "impact" is only used during the classification process. Therefore, in the residual impact classification, all residual effects are discussed and classified in terms of impacts to VCs.

Quantitative and qualitative descriptions of the direction, magnitude, geographic extent, and duration of changes to measurement endpoints for all VCs with primary pathways are provided in the residual effects summary for each key line of inquiry and subject of note (as described in Section 6.6.1). Frequency and likelihood of effects also are described where applicable. Results from the residual impact classification are then used to determine the environmental significance from the Project on assessment endpoints.

The purpose of the residual impact classification is to describe the residual incremental and cumulative (if applicable) effects from the Project on VCs using a scale of common words (rather than numbers and units). The use of common words or criteria is a requirement in the Terms of Reference for the Project (MVEIRB 2007). Criteria and associated generic definitions are provided below.

Direction: Direction indicates whether the impact on the environment is negative (i.e., less favourable), positive (i.e., beneficial), or neutral (i.e., no change). While the main focus of the impact assessment is to predict whether the development is likely to cause significant adverse impacts on the environment or cause public concern, the positive changes associated with the Project are also reported. Neutral changes are not assessed.

Magnitude: Magnitude is a measure of the intensity of an impact, or the degree of change caused by the Project relative to baseline conditions or a guideline value. Magnitude is classified as negligible, low, moderate, and high. For each VC, the scale of magnitude is defined (i.e., the meaning of the terms negligible, low, moderate, and high is defined). Magnitude can relate to relative (percentage) or absolute changes that are above or below baseline, guidelines, or threshold values. Where possible, magnitude is reported in absolute and in relative terms.

Geographical extent: Geographic extent refers to the area affected, and is categorized as local, regional, and beyond regional. Local-scale impacts mostly represent changes that are directly related to the Project footprint and activities, but may also include small-scale indirect effects. Changes at the regional scale are largely associated with indirect impacts from the Project, and represent the maximum predicted spatial extent of direct and indirect effects from the Project (zone of influence). Impacts beyond the regional scale are mostly associated with VCs that have large spatial distributions and are influenced by cumulative effects such as caribou. Cumulative effects generally occur at the regional or beyond regional scales.

Using aquatics as an example, local is the Kennady Lake watershed, regional is the watershed from Kennady Lake to Aylmer Lake, and beyond regional is the Lockhart River watershed. In using this criterion, local intensities will be considered as well (i.e., where an impact may affect various areas to differing degrees, separate analyses would be provided). For example, downstream impacts would be separated into several geographic areas of high, medium, and low magnitude.

Duration: Duration is defined as the amount of time (usually in years) from the beginning of an impact to when the impact on a VC is reversed, and is expressed relative to Project phases (Section 6.4.2). Both the duration of individual events (e.g., waste water discharges) and the overall time frame during which the impact may occur (e.g., phases of a Project during construction, operation, and closure) are considered.

For those VCs in which the duration of the impact extends past closure (i.e., long-term impacts), the estimated duration is discussed in the context of life spans (e.g., fish and wildlife) or generation times (i.e., humans), and reversibility. Some impacts may be reversible soon after the effect has ceased, while other impacts may take longer to be reversed. By definition, impacts that are short-term, medium-term, or long-term in duration are reversible.

In some cases, available scientific information and professional judgement may predict that the impact is irreversible. Alternately, the duration of the impact may not be known, except that it is expected to be extremely long (say more than 100 years), and any number of factors could cause the VC and system to never return to a state that is unaffected by the Project. In other words, science and logic predict that the likelihood of reversibility is so low that the impact is irreversible (i.e., permanent).

Reversibility: After removal of the stressor, reversibility is the likelihood and time required for a VC or system to return to a state that is similar to the state of systems of the same type, region and time period that are not affected by the Project. Each discipline defines what constitutes a system and what the "same" type is (e.g., lake, stream). This term usually has only one alternative: reversible or irreversible. The time frame is provided for reversibility (i.e., duration) if an effect is reversible. Permanent impacts are considered irreversible. In terms of the socio-economic environment, the manageability of impacts is considered rather than their reversibility. Where appropriate, the evaluation identifies the resources that may be used to facilitate recovery.

Frequency: Frequency refers to how often an impact will occur and is expressed as isolated (confined to a discrete period), periodic (occurs intermittently, but repeatedly over the assessment period), or continuous (occurs continuously over the assessment period). Frequency is explained more fully by identifying when it occurs (e.g., once at the beginning of the Project). If the frequency is periodic, then the length of time between occurrences, and the seasonality of occurrences (if present) is discussed.

Likelihood: Likelihood is the probability of an impact occurring and is described in parallel with uncertainty. Four categories are used: unlikely (impact is expected to occur less than once in 100 years); possible (impact is expected to occur at least once in 100 years); likely (impact is expected to occur at least once in 10 years); and highly likely (impact has 100% chance of occurring within a year).

Ecological context: The nature of effect refers to the type of the impact (e.g., loss of habitat) as well as the nature of the affected valued component (e.g., caribou).

13.3.2 Residual Impact Classification and Determination of Significance

As explained in Section 6.6.1, effects statements are used to focus the analysis of effects to VCs that are associated with one or more primary pathways. The effects associated with each pathway are then classified using categorical scales for each impact criterion (e.g., low magnitude, regional geographic extent, long-term duration, high likelihood).

The classification of residual impacts on primary pathways provides the foundation for determining environmental significance from the Project on assessment endpoints. Magnitude, geographic extent, and duration are the principal criteria used to predict significance (FEARO 1994, internet site). Other criteria, such as frequency, ecological context, and likelihood are used as modifiers (where applicable) in the determination of significance.

The evaluation of significance for biophysical VCs considers the entire set of primary pathways that influence a particular assessment endpoint, but significance is not explicitly assigned to each pathway (Section 6.7.4). Rather, the relative contribution of each pathway is used to determine the significance of the Project on assessment endpoints, which represents a weight of evidence approach. For example, a pathway with a high magnitude, large geographic extent, and long-term duration would be given more weight in determining significance relative to pathways with smaller scale effects. The relative impact from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes to assessment endpoints would also be assumed to contribute the most to the determination of environmental significance.

Alternately, the determination of significance for the socio-economic environment is completed on a subset of VCs (e.g., quality of life, employment, income, education and training, and infrastructure), and typically, each VC is directly associated with an individual pathway. Each pathway can result in different levels of effects on individuals, communities, and the region. Consequently, it is more practical to independently classify and predict the significance of the impact from each pathway on a socio-economic VC than to classify the entire combined set of pathways. However, after evaluating the significance of each pathway, the overall significance of the Project on the assessment endpoint for the socio-economic environment is provided.

The following is an example of definitions for assessing the significance of impacts on the persistence of the wildlife VCs, and the associated continued opportunity for traditional and non-traditional use of wildlife.

Not significant – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population persistence.

Significant – impacts are measurable at the population level and likely to decrease resilience and increase the risk to population persistence. A number of high magnitude and irreversible impacts at the population level would likley be significant.

13.4 DEVELOPMENT DATABASE

13.4.1 Previous and Existing Developments

To assess the cumulative effects from development, a database containing the type and location of previous, existing, and reasonably foreseeable projects was compiled from the following sources:

- Mackenzie Valley Land and Water Board (MVLWB): permitted and licensed activities within the Northwest Territories (NWT);
- Indian and Northern Affairs Canada (INAC): permitted and licensed activities within the NWT and Nunavut;
- INAC: contaminated sites database;
- Natural Resources Canada (NRCAN): obtained a Geographical Information System (GIS) file of community locations from NRCAN's GeoGratis website;
- Government of the Northwest Territories (GNWT): Location of parks within the NWT;
- provincial governments (Saskatchewan, Manitoba, Alberta): information related to location of mines and other developments that may occur within the spatial boundaries for caribou herds;
- individual operators for project-specific information such as component footprints or routes;
- company websites; and
- knowledge of the area and project status.

Data for previous and existing permitted and licensed activities were obtained in spreadsheet format. Some temporal data were available prior to 1996, but most of the known start and end dates of land use permits for developments were available from 1996 through 2010. The file was reviewed to eliminate duplication of information (e.g., a water license and a land use permit for the same development). The information was used to generate a spatially and temporally-explicit development layer within a GIS platform.

13.4.2 Reasonably Foreseeable Projects

It is the standard practice, and the specific request of the Gahcho Kué Panel (2007), to include reasonably foreseeable future developments in the cumulative effects analysis. This section describes the potential future projects included in the assessment and how they were selected. The reasonably foreseeable projects included in the assessment were projects or activities that:

- have been proposed and scoped to a reasonable level of detail;
- may be induced by the Project, and
- have the potential to change the Project or the impact predictions.

For the purposes of this assessment, it is assumed that each of the reasonably foreseeable projects are carried forward to full development, and that their effects have both spatial and temporal overlap with the Project. Using these criteria, the following proposed projects have been selected as a suite of major developments that may occur in the reasonably foreseeable future:

- the Yellowknife Gold Project;
- the Nechalacho Project;
- the Damoti Lake Gold Project;
- the NICO Project;
- the Taltson Hydroelectric Expansion Project; and
- the East Arm National Park.

The Yellowknife Gold Project

The Yellowknife Gold Project proposed by Tyhee NWT Corporation anticipates a combination open pit and underground mining operation 230 kilometres (km) west of the Project with a lifespan of eight to 13 years depending on production rates. It is expected that approximately 190 people would be employed at the site when in full operation (Tyhee 2010, internet site). The property is located 90 km north of the City of Yellowknife on the former Discovery Mine site, an existing contaminated area. Access would be via an existing winter road route and by air. Currently, there is no operations start date, and further work needs to be done to demonstrate economic viability.

The Nechalacho Project

The Nechalacho Project is a rare earth elements deposit, owned by Avalon Rare Metals Inc. The property is located approximately 100 km southeast of the City of Yellowknife and 240 km southwest of the Project near Hearne Channel on the East Arm of Great Slave Lake. Rare earth elements such as cerium, lanthanum, and neodymium along with associated zirconium, niobium and tantalum will be mined underground from the Nechalacho deposit. Production would peak at 2,000 tonnes per day, mining approximately 12 million tonnes over a period of approximately 18 years of operations, with construction beginning in 2013 and operations in 2015 (Avalon 2010, intenet site).

The Nechalacho Mine infrastructure will include a 150 person camp, airstrip, diesel power generation and concentrate loading and storage areas. Concentrates will be loaded into bulk transport containers, hauled to the seasonal dock facility along the north shore of Great Slave Lake and barged during the summer to a purpose-built hydrometallurgical plant, possibly located near the site of the old Pine Point mine on the south shore of Great Slave Lake (Avalon 2010, internet site).

Damoti Lake Gold Project

The Damoti Lake Gold Project is a gold deposit owned by Merc International Minerals Inc. The property is located approximately 20 km south of the Colomac Mine and approximately 270 km west of the Project, and accessed via the winter road to Colomac and Wekweeti. A bulk sample was conducted in 1996 by previous owners, and Merc has conducted drill programs since then to expand known resources (Merc 2010, internet site). As the Project is currently in exploration stage and a mine plan has not yet been developed, there is uncertainty regarding the size and duration of the Project.

The NICO Project

The NICO Project is cobalt, gold and bismuth deposit located in the Tlicho region, approximately 50 km northwest from the community of Whati and 370 km west of the Project. Fortune Minerals Ltd. proposes to mine the deposit using open-pit and underground methods. The Project is located in the Marian River basin, draining into the East Arm of Great Slave Lake. The NICO Project would require an all-season road connection to Highway 3 near Bechoko. The NICO reserves will support a minimum 15-year mine life at 4,000 tonnes per day (Fortune 2010, internet site). Gold would be extracted from the ore at the NICO site, but cobalt and bismuth concentrate would be trucked to a purpose-built smelter in Saskatchewan (Fortune 2010). The NICO Project is currently undergoing an environmental assessment by the Mackenzie Valley Environmental Impact Review Board.

The Taltson Hydroelectric Expansion Project

The Taltson Hydroelctric Expansion Project is proposed by Dezé Energy Corporation to enhance existing power generating facilities at the Taltson hydroelectric station near Fort Smith and the construction of a new power transmission line to the Project, then branching to the Snap Lake, Diavik and Ekati mines (Dezé 2010, internet site). The proposed project would offset the diesel-generated electricity at the existing mines and at the Project. This would lead to some environmental benefits, such as reduced greenhouse gas emissions and fewer haul trucks on the Tibbitt-to-Contwoyto Winter Road. The Taltson Hydroelectric Expansion Project would not cause any new flooding in the Taltson River basin. However, it would require a new winter road from Fort Smith to Nonacho Lake and new spur roads from the Tibbitt-to-Contwoyto Winter Road during the three-year construction period (likely 2012 to 2015). Further, approximately 690 km of new transmission line would be required to link the Taltson generating station to the existing diamond mines and the Project (Dezé 2010). Full operations of the expansion are anticipated in 2013. The Taltson Hydroelectric Expansion Project was included as an existing development for the purposes of cumulative effects analysis.

The East Arm National Park

The proposed East Arm National Park would include McLeod Bay, Reliance, Pike Portage, the Lockhart River and Artillery Lake at the East Arm of Great Slave Lake. In 1970, an area of 7,407 square kilometres (km^2) in the East Arm of Great Slave Lake was permanently withdrawn or set aside from further development and land disposition to allow a national park proposal to proceed (the East Arm National Park Land Withdrawal area). Over the next three decades, lack of progress in resolving Aboriginal land, resources and governance issues meant that there was not a suitable context to advance the park proposal (Environment Canada 2010, internet site).

In 2005, the Łutselk’e Dene First Nation delineated an area it calls 'Thaidene Nene', a part of its traditional territory that it proposes to protect through the establishment of a national park and other conservation measures (Environment Canada 2010, internet site). This, in part, prompted Parks Canada to reassess the boundaries of the 1970 East Arm National Park proposal, proposing a new study area of 33,525 km^2 (the Study Area for the East Arm National Park area).

There remains ambiguity in the status of the existing fishing, hunting lodges, and camps in the proposed park area. Overall, the proposed East Arm National Park would be beneficial to the environment, and may lead to local jobs (Environment Canada 2010, internet site). It is not clear when this Park would be fully established, but the existing permanent land withdrawal has already removed the core area from further development.

Linkages between the Project and these reasonably foreseeable developments are summarized in Table 13.4-1. Cumulative effects are assessed for potential future projects that are linked to residual effects from the Project.

Table 13.4-1 Linkages (interactions) Between the Project and Reasonably Foreseeable Future Projects

Project	Terrestrial Environment	Aquatic Environment	Socio-Economic Environment
Gahcho Kué Project	Effects to vegetation and wildlife populations that occur within the RSA. Project is located in the seasonal ranges of Bathurst and Ahiak caribou herds, grizzly bear, wolverine, and wolf populations	Effects to water quality and quantity, sediment, lower trophic levels, and fish habitat and fish populations in the LSA	Effects to economic, social, and cultural attributes in the LSA and RSA
The Damoti Lake Gold Project	linkage located in the seasonal ranges of Bathurst caribou herd and wolf population	no linkage different watershed	linkage located in the LSA and RSA
The Yellowknife Gold Project	linkage located in the seasonal ranges of Bathurst caribou herd and wolf population	no linkage different watershed	linkage located in the LSA and RSA
The NICO Project	linkage located in the seasonal ranges of Bathurst caribou herd and wolf population	no linkage different watershed	linkage located in the LSA and RSA inkage
Taltson Hydroelectric Expansion Project	linkage located within the RSA and seasonal ranges of Bathurst and Ahiak caribou herds, grizzly bear, wolverine, and wolf populations	linkage the transmission line would cross the Lockhart watershed in the LSA	linkage located in the LSA and RSA
Nechalacho Project	linkage located in the seasonal ranges of Bathurst caribou herd and wolf population	no linkage different watershed	linkage located in the LSA and RSA
East Arm National Park (all effects are positive)	linkage located within the RSA and seasonal ranges of Bathurst and Ahiak caribou herds, and grizzly bear, wolverine, and wolf populations	linkage The proposed Park would protect a large area of the Lockhart watershed	linkage located in the LSA and RSA

LSA = Local Study Area for the Project.

RSA = Regional Study Area for the Project.

13.5 CUMULATIVE EFFECTS TO VALUED COMPONENTS OF THE TERRESTRIAL ENVIRONMENT

Cumulative effects within the terrestrial environment were assessed by analyzing the changes from previous, existing, and reasonably foreseeable developments on habitat quantity and quality, and populations (VCs). Natural factors that influence populations were also included in the assessment. Assessment endpoints for VCs included:

- persistence of the population; and
- continued opportunities for traditional and non-traditional use of the VC.

Valued components assessed in the cumulative effects analysis included caribou, carnivores, other ungulates, and species at risk and birds. No cumulative effects analysis was completed for permafrost, geology, terrain and soils because the residual effects from the Project on these components of the terrestrial ecosystem were local in geographic extent. Subsequently, the incremental residual effects from the Project on these terrestrial components have little or no potential to overlap in time or space (i.e., interact) with residual effects from other developments. For vegetation ecosystems and listed and traditional plantss, the potential for cumulative effects was assessed through a fragmentation analysis of the Regional Study Area (RSA) and examined the changes to the quantity and configuration of broad ecosystem units (Section 11.7.4). The magnitude of cumulative impacts are negligible to low, and are predicted to not significantly affect the persistence of vegetation ecosystems, and listed and traditional plants within the RSA.

The following sections summarize the results of the cumulative effects analysis of primary pathways for caribou, carnivores, other unulates, and species at risk and birds. Details regarding incremental and cumulative effects analysis for each VC are available in their respective sections.

13.5.1 Caribou

Five primary pathways were evaluated for cumulative residual impacts from development on the population persistence of caribou (Section 7). These included direct habitat loss and fragmentation from development footprints (including winter roads), and indirect changes to habitat quality from sensory distubance effects such as people, vehicles, dust, and noise. These pathways were analyzed through the use of habitat, energetic, and population models. Two pathways related to changes in the availability of caribou for traditional and non-traditional use were also examined.

The duration of the impacts from the different pathways are expected to be reversible in the medium to long term. An exception is the incremental and cumulative direct disturbance impacts to populations from development footprints, which were assumed to be irreversible within the temporal boundaries of the assessment. Sensory disturbance impacts associated with influences of exploration and mining activities on caribou populations are anticipated to be reversible over the long term (27 to 32 years [two caribou lifespans or 1.5 human generations]). Impacts from winter roads on populations and traditional and non-traditional use of caribou are expected to be reversible in the medium term (5 years after initial closure). For all primary pathways influencing population size and distribution, cumulative impacts were determined to be beyond regional in geographic extent (i.e., impacts occur at the scale of the seasonal ranges).

The cumulative direct disturbance to the landscape from the Project and other previous, existing, and future developments is predicted to be less than or equal to 1.7 percent (%) of the Bathurst and Ahiak caribou herds seasonal ranges relative to reference conditions (low magnitude). The Project and other developments are predicted to result in habitat-specific cumulative changes to the number of patches and the distance between similar habitat patches and the magnitude ranges from 0% to 5% (low magnitude). These changes are expected to have a negligible influence on the carrying capacity of the seasonal ranges and the movement and distribution of caribou.

The cumulative direct impact of habitat fragmentation on caribou movement from the Winter Access Road and Tibbitt-to-Contwoyto Winter Road (from Tibbitt Lake to MacKay Lake) is predicted to be low in magnitude (i.e., within the range of baseline values). The magnitude of changes in the number of forest patches from reference to current conditions is predicted to be no more than 1.7% in either the Bathurst or Ahiak ranges. Also, the change in the mean distances to nearest neighbour for forest patches was no more than 1.3% in the analysis. Although the presence of the winter roads may represent a partial barrier to caribou and lead to some fragmentation of the population within the winter range, the roads are in operation for approximately eight to 12 weeks each year. Thus, the frequency of impact from winter roads on caribou population size and distribution is periodic.

The assessment also considered the cumulative effects from indirect changes to habitat quality (sensory disturbance zones of influence) associated with the Project and other developments on the availability of preferred habitats. Overall, the magnitude of cumulative declines in preferred habitat across seasonal ranges of the Bathurst and Ahiak caribou herds is predicted to be low (ranged from 1.1% to 7.3%). Sensitivity analyses also showed that a 10% reduction in carrying capacity (or loss of preferred habitat) had no statistical effect (*P*=0.24) on population abundance and persistence of caribou.

Population models predicted that the incremental impacts from the Project and the Taltson Hydroelectric Expansion Project had little influence on the persistence of the caribou herd relative to reference conditions. Specifically, the relative decrease in projected final abundance was 1.5% (low magnitude) in the model. Cumulative changes in habitat and fecundity from the Project and other developments resulted in a 12.2% (moderate magnitude) reduction in projected final herd abundance relative to reference conditions.

Energetic and population models also indicated that insect harassment and harvest levels had much stronger effects on caribou populations relative to the changes from the Project and other developments. Levels of human development on the landscape, measured as a percentage of seasonal ranges covered by zones of influence, peaked in 2006 at approximately 6% cover and have since declined. A recent review by Adamczewski et al. (2009) also indicates that effects from the mines are limited and unlikely a major contributing factor in the decline of the Bathurst caribou herd. Thus, the cumulative impacts from development should not have a significant adverse impact on the seasonal movements and distribution of caribou relative to reference conditions.

There are natural environmental factors that operate over large scales of space and time that likely have greater influences on seasonal distributions of caribou relative to the cumulative and incremental impacts from the Project. For example, some studies of caribou have shown that the historical cumulative effect of overgrazing on calving, summer or winter ranges can result in periodic range shifts and large population fluctuations (Messier et al. 1988; Ferguson and Messier 2000). Climate change can also influence the seasonal distribution of caribou by modifying insect levels, food abundance (primary productivity), snow depth and hardness, predator numbers (and alternative prey), and burns (Sharma et al. 2009; Vors and Boyce 2009). Traditional knowledge also contends that fire frequency and intensity affects caribou numbers and distribution (Kendrick et al. 2005).

The weight of evidence from the analysis of the primary pathways predicts that the incremental impacts from the Project and cumulative impacts from the Project and other developments will not have a significant negative influence on the resilience and persistence of caribou populations (Section 7.8). Most of the incremental and cumulative impacts were predicted to be negligible to low in magnitude and reversible. The persistence of caribou herds during large fluctuations in population size indicates that the species has the capability to adapt to different disturbances and environmental selection pressures. Migration routes, and survival and reproduction rates appear to have the flexibility to respond to changes through time and across the landscape. This resilience in caribou populations suggests that the impacts from the Project and other developments should be reversible and not significantly affect the future persistence of caribou populations. Subsequently, cumulative impacts from development also are not predicted to have a significant adverse effect on continued opportunities for use of caribou by people that value the animals as part of their culture and livelihood.

13.5.2 Carnivore Mortality

Three primary pathways were evaluated for cumulative residual impacts from development on the population persistence of grizzly bear, wolverine, and wolf (Section 11.10). These included direct habitat loss and fragmentation from development footprints (including winter roads), and indirect changes to habitat quality from sensory distubance effects such as people, vehicles, dust, and noise. The effect on grizzly bear and wolverine populations from direct mine-related mortality was assessed. A pathway related to changes in the availability of other ungulates for traditional and non-traditional use was also examined.

The duration of the impacts from the different pathways are expected to be reversible in the medium to long term for carnivores. An exception is the incremental and cumulative direct disturbance impacts to populations from development footprints, which are assumed to be irreversible within the temporal boundaries of the assessment. Sensory disturbance impacts associated with influences of exploration and mining activities on carnivore populations are anticipated to be reversible over the long term (27 to 32 years). Impacts from winter roads on populations and traditional and non-traditional use of carnivores are expected to be reversible in the medium term (five years after initial closure). For all primary pathways influencing population size and distribution, cumulative impacts were determined to be beyond regional in geographic extent (i.e., impacts occur at the scale of the seasonal ranges).

The magnitude for the primary pathways impacting grizzly bear, wolverine, and wolf populations ranged from low to moderate. The magnitude of the cumulative impact from direct habitat loss associated with the Project and previous, existing, and reasonably foreseeable future developments is expected to be about 1.4% to 2% relative to reference conditions. For impacts to habitat quality, the maximum change in preferred habitats is predicted to be 12.4% for grizzly bear, 11.1% for wolf, and 18.8% for wolverine. However, most of this decrease (10%) in the wolverine study area was due to the temporary disturbance from winter roads for eight to 12 weeks during the winter period. Incremental and cumulative changes to the behaviour and movement of carnivores from winter roads were expected to be within the range of baseline conditions (low magnitude).

Incremental and cumulative impacts from direct mine-related mortality on grizzly bear and wolverine were expected to be of negligible and low magnitude. Estimated direct mine-related grizzly bear and wolverine mortality rates among five operating mines averaged from 0.074 and 0.204 individuals per mine per year, respectively, from 1996 to 2009. These rates represent approximately 0.05% and 0.15% of estimated grizzly bear and wolverine populations, respectively.

The weight of evidence from the analysis of the primary pathways predicts that the incremental and cumulative impacts from the Project and other developments should not have a significant negative influence on the resilience and persistence of carnivore populations (Section 11.10.8). In addition, incremental impacts from the Project on carnivores should have a negligible influence on opportunities for hunting and trapping, and viewing grizzly bear, wolverine, and wolves in the region. Similarly, changes to traditional and non-traditional use of carnivores from the cumulative impacts of development and current harvesting are expected to be within the range of baseline conditions. Subsequently, cumulative impacts from development also are not predicted to have a significant adverse effect on continued opportunities for use of carnivores by people that value these animals as part of their culture and livelihood.

13.5.3 Other Ungulates

Four primary pathways were evaluated for cumulative residual impacts from development on the population persistence of muskoxen and moose (Section 11.11). These included direct habitat loss and fragmentation from development footprints (including winter roads), and indirect changes to habitat quality from sensory distubance effects such as people, vehicles, dust, and noise. A pathway related to changes in the availability of other ungulates for traditional and non-traditional use was also examined.

Overall, the duration of the impacts from the different pathways are expected to be reversible in the medium to long term for other ungulates. An exception is the incremental and cumulative direct disturbance impacts to populations from development footprints, which were assumed to be irreversible within the temporal boundaries of the assessment. Sensory disturbance impacts associated with influences of exploration and mining activities on muskoxen and moose populations are anticipated to be reversible over the long term (27 to 32 years). Impacts from winter roads on populations and traditional and non-traditional use of other ungulates are expected to be reversible in the medium term (five years after initial closure). For all primary pathways influencing population size and distribution, cumulative impacts were determined to be regional in geographic extent, which implies that at least some portion of the populations are affected.

The magnitude for the four primary pathways impacting other ungulates ranged from negligible to low. The magnitude of the cumulative impact from direct habitat loss associated with the Project and previous, existing, and reasonably foreseeable future developments is expected to be about 5% relative to reference conditions (no development). Cumulative indirect impacts to habitat from the Project and previous, existing, and reasonably foreseeable future developments was expected to reduce high quality muskoxen habitat by 8%, and good quality moose habitat by 2% (low magnitude). Indirect effects from the Project footprint will be continuous, while indirect effects from the Tibbitt-to-Contwoyto Winter Road and the Winter Access Road will be limited to the seasonal use of the roads (i.e., periodic frequency).

Overall, the weight of evidence from the analysis of the primary pathways predicts that the incremental and cumulative impacts from the Project and other developments should not have an adverse significant impact on the persistence of other ungulate populations (Section 11.11.8). Subsequently, cumulative impacts from development also are not predicted to have a significant adverse effect on continued opportunities for use of muskoxen and moose by people that value these animals as part of their culture and livelihood.

13.5.4 Species at Risk and Birds

Two primary pathways were evaluated for cumulative residual impacts from development on the population persistence of upland breeding birds, water birds, and raptors (Section 11.12). These included direct habitat loss and fragmentation from development footprints, and indirect changes to habitat quality from sensory distubance effects such as people, dust, and noise. A pathway related to changes in the availability of birds and associated species at risk for traditional and non-traditional use was also examined.

Results indicated that the cumulative impacts of direct habitat loss and fragmentation from the Project and other developments on population size and distribution are expected to be regional in geographic extent. The magnitude of the cumulative impact from direct habitat loss associated with the Project and other developments is predicted to be less than 5% of the RSA (low magnitude). Impacts from changes in habitat quantity and fragmentation (i.e., development footprints) predicted to be irreversible within the temporal boundary of the assessment.

Habitat modeling predicted that the maximum spatial extent of indirect changes to habitat quality (i.e., zone of influence) from the Project and other active developments in the RSA is 1 km. Habitat quality was reduced around each active project within 1 km from the edge of the footprint to estimate of potential effects from sensory disturbance on upland breeding birds, water birds, and raptors. The magnitude of the effect from changes to habitat quality, movement, and behaviour on birds and species at risk is predicted to be negligible to low. The cumulative decrease to high and good quality habitats ranged from 1% to 3% (low magnitude) among species groups. The impact from sensory disturbance is anticipated to be reversible within five to 10 years after final closure (i.e., after Kennady Lake is refilled).

It is predicted that the cumulative impacts from development should be reversible and not significantly affect the future persistence of bird and associated species at risk populations in the region (Section 11.12.9). Subsequently, cumulative impacts from development also are not predicted to have a significant adverse effect on continued opportunities for use of birds by people that value these animals as part of their culture and livelihood.

13.6 CUMULATIVE EFFECTS TO VALUED COMPONENTS OF THE AQUATIC ENVIRONMENT

The Project is located within the head waters of the Lockhart River watershed. Impacts to water quality and quantity, and fish and fish habitat are anticipated to be confined to the Local Study Area (LSA). Downstream Project effects to water quality are projected to occur between Kennday Lake and Lake 410 (Section 9.13.2), and the movement of radio-marked fish were less than 2 km (Section 8.3.8.2.9) within the LSA. The database of previous and existing developments indicated that there are no prior or active developments within the LSA. A power transmission line from the Taltson Hydroelectric Expansion Project is the only reasonably foreseeable future development anticipated to occur within the LSA (Table 13.4-1).

The Taltson Hydroelectric Expansion Project intends to deliver electricity through a power transmission line that connects hydro generation facilities at Twin Gorges in the Taltson watershed to the Project and the Diavik, Ekati and Snap Lake diamond mines (Dezé 2010, internet site). The proposed transmission line route crosses Kennady Lake, Kirk Lake and N watersheds within the LSA. A small winter road along the proposed transmission line route will be required for construction. Construction staff will be housed at the Project facilities and at a camp outside of the LSA near Back Lake. Fugitive dust or chemical spills related to transmission line construction could impact water quality and fish health or habitat, but the changes are expected to have negligible residual impacts on the system, and would be limited to the construction phase. In their report of assessment, the Mackenzie Valley Review Board (MVRB) did not raise any new concerns regarding the possible effect of the transmission line on aquatic systems (MVEIRB 2010).

The results from residual impact classification for the Project indicated that impacts to water quality and fish in Kennedy Lake would be negative, of low to high magnitude, local in geographic extent, reversible but not environmentally significant in terms of the entire Kennady Lake Watershed (Section 8). Downstream effects of the Project were not deemed environmentally significant (Section 9).

Incremental effects from construction of the Taltson Hydroelectric Expansion Project transmission line through the LSA are not anticipated result in a measurable change water quantity and quality, or fish habitat, abundance, and health. Thus, the cumulative effects from development of the Taltson Hydroelectric Expansion Project transmission line and the Project are not anticipated to be different than incremental effects predicted for the Project.

13.7 CUMULATIVE EFFECTS TO VALUED COMPONENTS OF THE SOCIO-ECONOMIC ENVIRONMENT

13.7.1 Screening of Residual Project Effects for Potential Cumulative Effects

An initial screening was completed to identify VCs of the socio-economic and cultural environments that have the potential to be influenced by cumulative effects from the Project and other developments (Table 13.7-1). All VCs, except inflation, have the potential to be influenced by cumulative effects. The previous mining operations did not contribute to inflation or other price changes in the NWT in the past decade. Rather, the rate of inflation lagged behind changes in the rest of Canada (Section 12.6). This is not unexpected because the economy of the NWT is small and “open” in that there is relatively little domestic production and the demand for most goods and services is filled by imports (i.e., goods are shipped into the NWT, not made in the NWT). The Project and reasonably foreseeable developments are expected to have little influence on inflation.

Table 13.7-1 Identification of Residual Project Effects that have Potential Cumulative Effects

Key Line of Inquiry or Subject of Note	Valued Component	Residual Project Effect	Potential Cumulative Effect Yes / No
Long-term social, cultural, and economic effects	production, employment, and income	more employment options	yes
	labour force	stable financial resources	yes
	inflation	little effect on inflation	no
	local business	more opportunities for local business	yes
	government revenues	increased government revenues	yes
Family and community cohesion	rotation	rotations will continue, although proximity of some projects to communities may offer flexible options	yes
	lifestyle choices	individuals with skills have more options	yes
	in-migration	some increase in in-migrations for jobs, but overall tendency to increased out-migration	yes
Social disparity between communities	education and skills up-grading	career development, which improves capacity of local labour force	yes
	social assistance	less reliance on social assistance (unemployment)	yes
	unemployment	less unemployment	yes
	inflation	little effect on inflation	no
Social disparity within communities	education and skills up-grading	career development, which improves capacity of local labour force	yes
	loss of skilled labour / volunteers	less time to participate in community activities, including volunteering for activities with children	yes
	employment access for women	greater opportunities for training and employment of women	yes
	inflation	little effect on inflation, although housing and goods and services costs remain high	no
Employment, training, and economic development	maximized direct employment	more jobs created	yes
	skills development	greater opportunities for training	yes
Demands on infrastructure	in-migration	continued in-migration, offset by higher out-migration	yes
	costs for infrastructure and services	use of existing infrastructure increases cost for maintenance, need for expansion	yes
	costs to monitor and regulate	increased costs to the government to upgrade infrastructure and to monitor and regulate developments	yes

Table 13.9-1 Identification of Residual Project Effects that have Potential Cumulative Effects (continued)

Key Line of Inquiry or Subject of Note	Valued Component	Residual Project Effect	Potential Cumulative Effect Yes / No
	volunteerism	less time to participate in community activities, including volunteering for activities with children	yes
Tourism potential and wilderness character	tourist potential	additional tourism opportunities created	yes
	wilderness character	infrastructure by some projects may affect visual aesthetics	yes
Proposed national park	wildlife population and distribution	some changes to wildlife movement and behaviour are expected	yes
	vegetation	dust from traffic on gravel roads and blasting may affect vegetation	yes
	visual aesthetics	viewsheds may be affected	yes
	noise	increased noise from mobile and stationary mining equipment, blasting, aircraft and trucks	yes
	access	new road and use of airport may increase park access	yes
Culture, heritage, and archaeology	Aboriginal language use	continued but varied loss of Aboriginal language	yes
	changes to cultural landscape	altered or removed cultural landscape feature	yes
	effects on archaeological sites	new / additional cultural knowledge	yes

13.7.2 Assessment of Cumulative Effects to the Economic Environment

Valued components of the economic environment include government revenues (economic growth), labour force and employment, and demands on infrastructure. The economic effects were estimated using the NWT Economic Impact Model (Impact Economics), public information from the project proponents, and past experience in forecasting effects from other mining and construction projects in the NWT. This section concludes with a brief discussion of the end of economic benefits in relation to the closure and post closure of many of the existing and future mines.

13.7.2.1 Economic Growth

All of the reasonably foreseeable mining projects will include expenditures on labour and capital for the production and processing of the resource, operation of camp facilities, building roads, running power generators, and other standard mine operation requirements (Section 12.6). These projects are anticipated to have positive and significant cumulative effects on the following pathways for economic growth, including revenues and diversification:

- Workforce and procurement requirements for the projects will cumulatively increase economic activity (gross domestic product) in the LSA and NWT.
- The projects will cumulatively increase the tax base for the NWT during construction and operation.

13.7.2.2 Labour Force and Employment

The capacity within the local labour force and business community has grown over the past decade (Section 12.8). Investments by government and mining companies on training and skills development are improving the quality of labour and competitiveness of local businesses. This growth should continue given an expectation that both the private and public sector intend to pursue these investments further.

This schedule for the projects predicts strong demand for NWT labour for the next 15 to 20 years. That means 15 to 20 more years of work experience, skills development, business development, and wealth creation. These projects also create an economic environment in the NWT whereby labour can withstand the closure of Ekati and Diavik diamond mines, which are the largest employers in the NWT mining sector. Moreover, the diversity of projects offers NWT labour some degree of choice. This is important because it maintains an element of competition between employers and adds some assurance that the current standards of employment will be upheld into the future.

All of the existing and proposed future mining projects assessed in this section include expenditures on labour for the production and processing of the resource, operation of camp facilities, building roads, running power generators, and other standard mine operation requirements. Likewise, the Taltson Hydroelectric Expansion Project will require labour. These projects are anticipated to have positive and significant cumulative effects on the following pathway for the VC labour force and employment:

- Workforce and procurement requirements during construction and operation of the Project will cumulatively increase employment for Aboriginal and northern residents in the LSA communities and NWT.

13.7.2.3 Infrastructure

Infrastructure and services are essential to economic growth, health and well-being, education, and employment, particularly in the smaller communities. Community infrastructure includes a wide range of services and facilities such as schools, roads, airports, communication networks, utilities, and public housing. These are developed, funded, and maintained by the GNWT.

The NWT continues to expand and improve infrastructure and services, including roads and airports, to meet the demand of expanded economic development (Section 12.8). Very moderate demographic growth is also driving the need for infrastructure. The Taltson Hydroelectric Expansion Project, if constructed, will increase power supply in the LSA. These projects are anticipated to have mainly positive and significant cumulative effects on the following pathway for infrastructure:

- The projects may increase demand for LSA and NWT infrastructure (mainly airports and roads) for the transport of material and people to the project sites.

13.7.2.4 End of Economic Benefits

Cumulative effects on migration suggests the projects will combine to preserve the population base already established in the Territory for an extended period of time (Section 12.8). The extent to which this translates into more transfers from the federal government depends on future fiscal arrangements and the level and extent to which out-migration is mitigated by these additional projects. The Economic Impact Report (Appendix 12.II) demonstrates that the current transfer (for the 2010-2011 fiscal-year) equals approximately $21,000 per person. It also includes calculations that show with the Project, NICO, and Prairie Creek projects added to the economy (a scenario whereby no new projects are added and the existing diamond mines eventually close), the NWT's population would exceed that of the current estimate by over 1,000 people. The addition of Nechalacho, Yellowknife Gold, and Damoti Gold projects would further preserve the population base. This would result in higher federal transfers.

In summary, the cumulative effects of closure and post closure of the mines will have negative economic effects on the economy of the NWT, including labour and income. There is no mitigation except for sequenced development so that the NWT can take full advantage of the benefits.

13.7.3 Assessment of Cumulative Effects to the Social Environment

Valued components of the social environment include lifestyle choices, education and skills up-grading, and social disparity. The cumulative effect of the additional projects will be positive for increased lifestyle choices (Section 12.8). Major changes are not expected to the typical rotational schedule for mining projects. These rotations, while not without their downsides, appear to offer the best alternative for community members in the LSA who are already working or desire to work in mining. In contrast, migration patterns will continue to change as a result of the additional projects. The expectation is that these projects will not have a large effect on in-migration, though certainly some people will move to the Territory as a result of the developments. These projects are anticipated to have positive and significant cumulative effects on the following pathway for lifestyle choices:

- The projects may increase lifestyle choices, including greater mobility, as a result of the incomes associated with employment.

Mining is known to require a highly trained and skilled workforce. A human resource needs assessment completed across the NWT mining industry in 2008 identified the need for as many as 5,000 new semi-skilled, skilled, and professional workers over the next five years (Mining Training Society 2009). This number reflects turnover and retirements as well as growth, and is almost double to previous forecast of 2,700 (Mining Training Society 2008; 2009).

The Terms of Reference states as a concern that communities may not benefit from the Project and that there are groups in the population who are left behind but must contend with an increased cost of living, coupled with a decrease in their standard of living or quality of life. Changes to income, income support assistance, unemployment rates, and inflation have been tracked since before the first diamond mine. The trends in the data suggest incremental and cumulative effects from existing projects, and provide an indication of what may occur with the addition of the potential future projects.

Some people will disbenefit from the Project and other developments. Increased access to money has also aggravated addictions and strained family structures. Income-earners must often work outside their communities for employment in resource extraction. The rapid development in the LSA has also been accompanied by an increase in housing prices and rents, which contributes to housing insecurity among those not benefiting during periods of high economic growth. Continued upward pressure on prices is difficult to cope with for people on fixed incomes. According to the data and reports, construction and operations of the existing mines have not brought about inflation because they have yet to create demand for goods and services in the NWT.

Increases in social disparities and decreased social cohesion have been occurring prior to the onset of diamond mining. Effects on social cohesion and disparities can be mitigated to some degree by government policies and programs, and specific support mechanisms that are provided by project proponents as an integral part of development applications or on a voluntary basis.

The cumulative social effects of the existing and potential future projects are not able to be predicted with high certainty due to the influence of many overlapping factors, both positive and negative. In the LSA, however, it is likely that the cumulative positive and negative effects of social disparity will continue, although the effect will likely be low and not significant. A growing inequality of incomes and education will perhaps occur in the short term, but in the long term the breadth of opportunities should encourage more local training and skills transfer. Over time, the uptake of jobs should improve for local communities, income gaps should narrow, and fewer people should require social assistance.

The cumulative effects of closure and post closure of the mines may also increase social problems (Section 12.8). This is because there will be decreased economic and employment inputs after the mines are closed. The solution to these negative aspects is to focus efforts on sustainability long before closure begins. Long-term economic growth is linked to social and cultural well-being.

13.7.4 Assessment of Cumulative Effects to the Cultural Environment

A number of issues raised can be viewed as “cultural” insofar as they relate to the changing social fabric and life ways of the communities in the LSA. Research on subsistence issues such as harvesting, an important subject in the North, suggests important intergenerational connections regarding the continuity of ecological and traditional knowledge. What is understood to be cultural change has a good deal to do with changing patterns of subsistence and resulting changes in relationships and roles. “Changing roles” is not easily tracked as an indicator of cultural change. Aboriginal language use and harvesting activity can be used as indicators to track some aspects of cultural change.

Traditional activities have been on the decline for many years. Wage labour and consumption of mass produced goods are daily realities for Aboriginal people living in NWT communities. The challenge for many appears to be how to earn the money needed to hunt while still having the time to go out and do it. Studies suggest that having the financial means to hunt is important to the continuation of the activity; it is not carried out in a "traditional" fashion. Overall, a cumulative effect on harvesting is anticipated; more people will have the financial resources to hunt but people will likely hunt closer to home.

13.7.4.1 Language

The baseline study and other statistics suggest a "resurgence" in Aboriginal language use, or at the very least a slower decline than was anticipated when mining began at the end of the 1990s (Section 12.8). Aboriginal language use as a second language may actually be slightly increasing in some LSA communities. This suggests that those individuals exposed to an Aboriginal language as a child may be retaining it into adulthood and that other language learning opportunities outside the home may be promoting retention as well. This is possibly a reaction to imposed policy and cultural changes, or a collective desire to maintain and expand traditional language use. Yet, there has been a noticeable and statistical decline in some languages. This decline is not attributed to mining or employment but, rather, on English media and mobility. Specifically, people will leave a community for economic opportunity in places where the dominant language is English.

13.7.4.2 Cultural Landscape

Cultural landscapes embody various values: cultural, social, economic, psychological, spiritual, historical, and ecological (Section 12.8). For Aboriginal people, cultural, natural, and spiritual aspects form part of a single landscape. The connections within a cultural landscape are important, rather than just a series of parts or places (NWT Cultural Places 2007). Landscapes are constantly changing; change is something we should always expect. Continual and unpredictable changes happen because of the social, economic, environmental, and even political changes occurring in any cultural landscape. These changes and events create patterns that help us understand what has been going on and why.

The cumulative effect of changes to the cultural landscape is of overall concern in the LSA communities. With the limited information available, it is difficult to predict what the cumulative effects may be to the cultural landscape of the LSA. The eventual development of the East Arm National Park is a positive change to the landscape since it will help to protect both cultural and ecological values. People will not frequently see the reasonably foreseeable future projects due to their remote location, but will be aware of them, and this may cause changes to people's sense of place.

Archaeological site numbers are increasing as a result of the inventory completed in recent years (Section 12.8). Provided that appropriate mitigation or management continue to be completed in advance of development, the impact of sites may be prevented by avoidance or compensated for by detailed archaeological investigations in advance of ground disturbing activities. The mitigation of sites through surface collection and excavation contributes to the archaeological database and is both a negative effect (site is disturbed or destroyed) and a positive effect (data are collected).

Cultural landscapes embody cultural, social, economic, psychological, spiritual and historical values in addition to having ecological importance (Evans et al. 2001; Parks Canada 2004; Collignon 2006). Cultural identity for many people is at the core of community life. When new features (e.g., mines, cabins, airstrips, and communities) are added to the landscape, the retelling of the cultural story on the landscape is affected.

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13.9 ACRONYMS AND GLOSSARY

13.9.1 Acronyms and Abbreviations

%	percent
De Beers	De Beers Canada Inc.
EA	environmental assessment
EIS	environmental impact statement
GIS	geographical information system
GNWT	Government of the Northwest Territories
INAC	Indian and Northern Affairs Canada
LSA	Local Study Aarea
MVLWB	Mackenzie Valley Land and Water Board
NRCAN	Natural Resources Canada
NWT	Northwest Territories

Project	Gahcho Kué Project
RSA	Regional Study Area for the Project
Terms of Reference	*Terms of Reference for the Gahcho Kué Environmental Impact Statement*
VC	valued component

13.9.2 Units of Measure

%	percent
m	metre
km	kilometre
km^2	square kilometre