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10. ASSESSMENT METHODS AND PRESENTATION

10.1 INTRODUCTION

This section describes the environmental effects assessment approach that was used within both the Key Lines of Inquiry (KLOI) and Subjects of Note (SON) provided by the Terms of Reference (TOR) for the Taltson Hydroelectric Expansion Project (MVEIRB 2008). According to the Environmental Effects Assessment Guidelines (MVEIRB 2004), the Developer's Assessment Report (DAR) must contain sections on issue identification, mitigation, effect prediction, the developer's determination of significance, and a cumulative effects assessment. This section describes the approach used to meet these requirements. In some cases, it was necessary to deviate from the assessment approach outlined here. In these cases, a rationale and description of the changes was provided in the respective KLOI or SON sections.

The structure of this DAR for the Taltson Hydroelectric Expansion Project (the Project) is different from previous environmental assessments conducted in the Northwest Territories and Canada. This is due to the Key Lines of Inquiry approach adopted by the MVEIRB. This approach was first used by the MVEIRB for the Gahcho Kué Project (MVEIRB 2007). The following presents the two key features of the approach.

- The MVEIRB has not only identified issues, but prioritized the issues. The three Key Lines of Inquiry presented by the MVEIRB are "areas of the greatest concern that require the most attention during the environmental assessment and the most rigorous analysis and detail in the DAR" (MVEIRB 2008). Subjects of Note "require a thorough analysis, including a cumulative effects assessment, but do not require the same level of detail as Key Lines of Inquiry". Through this approach, the MVEIRB has identified a two-tiered approach to issues, and this is reflected in the level of detail in the DAR.
- Most of the KLOI and SON are multi-disciplinary. For example, the KLOI for Water Fluctuations in the Taltson River Watershed must include an analysis of how changes to hydrology may affect aquatic life, fish habitat, contaminant levels, riparian vegetation and wildlife, and access. In previous environmental assessments, this information would be distributed among several discipline-specific sections. However, for this assessment, the response to each KLOI and SON is stand-alone, with comprehensive analyses and minimal cross-referencing outside of the KLOI or SON.

Another unique aspect of this DAR was the approach to cumulative effects assessment. Cumulative effects are defined as changes to the environment caused by projects or activities in combination with other past, present and reasonably foreseeable projects or activities (CEAA 1999). It requires the consideration of effects due to projects other than the one being assessed. The cumulative effects to the valued component (VC) include not only the Project-specific effects but the entire effect to VCs from all past, present and foreseeable future projects. Valued components are the environmental elements of an ecosystem that are identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance (see Section 10.3 below).

The effects assessment includes the Project-specific (or incremental) effects relative to the present-day existing environment, and the cumulative effects to VCs from all overlapping historic, current and future projects and activities. The assessment of cumulative effects would have a greater degree of uncertainty (a fact acknowledged in MVEIRB 2004) due to limited baseline data or assumed environmental conditions prior to human activity. However, it does lead to a better description of the overall human-caused effects to VCs relative to pristine conditions. For example, a Project-related incremental effects assessment to caribou includes the incremental Project effects relative to existing conditions. A cumulative effects assessment includes historic developments, current developments, and the proposed Project. In this DAR, both the incremental and cumulative effects would be described and classified, followed by significance determination. The effects of possible future projects were considered a source of uncertainty, and were considered but not classified.

10.1.1 Approach Summary

In order to address each of the KLOI and SON, all likely Project effects were identified, and this was followed by a process of elimination directed towards finding the most important effects. The remaining potential effects were then quantified and classified. In this way, the DAR remained focused, and placed the greatest emphasis and effort on areas of greatest concern. The key steps of this approach were as follows:

- describe the existing environment, focusing on those areas where effects are expected,
- identify and justify the VCs,
- develop assessment endpoints for each VC, which would identify the particular aspects of the VC that should be protected or preserved,
- determine spatial and temporal assessment boundaries that are meaningful for each VC,
- describe the pathways through which each Project component may affect the VCs,
- list the proposed mitigation, describe how mitigation affects the pathways, and determine which pathways remain Valid after mitigation,
- conduct an effects assessment of the Valid pathways to determine the Project-specific (incremental) effects,
- describe the effects from other overlapping projects and human activities, both past and present, to describe the cumulative effects to each VC,
- classify both the incremental and cumulative effects using criteria such as direction, magnitude, geographic extent, duration, frequency likelihood, and reversibility,
- use the incremental and cumulative effects classification for each pathway to determine the overall significance of effects to the assessment endpoints for each VC, and
- document areas of uncertainty in the assessment, the reasonably foreseeable future developments, and plans for monitoring.

10.2 EXISTING ENVIRONMENT

A description of the existing environment is required in order for the MVEIRB to assess the potential direct, indirect and cumulative effects of the proposed development. The level of detail provided for each component of the existing environment should correspond to the predicted level of interaction between the Project and that component (MVEIRB 2008), and should contain all available information to support effects analysis and conclusions.

For each KLOI and SON, the description of the existing environment concentrated on describing the most recent conditions or up-to-date information, such as currently existing developments, land use, climate conditions, and wildlife populations. Where necessary, historical information was also presented (i.e., historical water levels within the Taltson Basin).

In general, where existing environment information is relative to all Project components, broad geographic areas, or regional descriptions, that information is presented in Chapter 9 – Existing Environment. Where the existing environment information is localized, or related to a specific Project component, detailed area of interest, or a specific SON, that information is contained with the related KLOI or SON.

The existing environment was described using a range of information sources. Baseline information collected by the Proponent was supplemented with information and data from regional studies, published and unpublished scientific literature, discussions with experts, and Traditional Knowledge.

10.3 VALUED COMPONENTS

Valued components are used to focus the environmental assessment on the areas of greatest concern (MVEIRB 2008). A valued ecosystem component is defined by the Canadian Environmental Assessment Agency (CEAA 2006) as the environmental element of an ecosystem that is identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance. Valued ecosystem components that have the potential to interact with Project components should be included in the assessment of environmental effects (CEAA 2006). However, because the term “effects on the environment” is defined by the Mackenzie Valley Resource Management Act broadly to include social and cultural components, the term valued components is preferred by the MVEIRB to include, and replace, the narrower terms such as valued ecosystem components and valued social components (MVEIRB 2004).

A VC may represent a physical attribute (such as air quality), a population (such as the Bathurst caribou herd), a species at risk (such as peregrine falcons), or community (such as songbirds) that is considered to be ecologically, culturally, socially or economically important. Valued components may also include physical and biological processes such as wildlife migration, feeding behaviour, calving periods, changes in vegetation communities (succession) or predator-prey relationships. Valued components may be found at the beginning or end of pathways (such as noise or the resulting effect of noise on caribou distribution), and at the top or bottom of trophic levels (from plankton to lake trout).

10.3.1 Valued Component Selection

A range of representative VCs was selected for each of the KLOI and SON. Factors considered when selecting VCs included the following (Salmo 2006):

- public concern;
- required by or compatible with regulatory requirements and existing initiatives;
- easily understood and known to be important to residents, managers, and regulators;
- when taken together, reflect overall environmental and social conditions;
- can be easily measured or described with one or more practical indicators (measurement endpoints); and
- allow cumulative effects pathways to be considered.

An important aspect of the VC selection process is that it reflects the values of concerned people, which were presented during public hearings. Concerns raised by government agencies, aboriginal organizations, environmental organizations, and other stakeholders were considered in the VC selection process. The VC selection process also drew upon scientific principles, the major effect pathways, important ecosystem processes, the presence of species at risk, and the availability of adequate information.

Valued components were specific to each of the KLOI and SON. In some cases the KLOI or SON required a wide range of VCs, such as those required for the KLOI for Water Fluctuations in the Taltson River Watershed. The VCs for this KLOI may include fish, mammals, aquatic resources, and wetland extent. In other cases, the scope of VC selection was narrowly defined, such as the KLOI for Barren-ground Caribou, where caribou is the VC.

10.3.2 Assessment Endpoints

Assessment endpoints represent the key properties of the VC that should be protected for use by future human generations. For this DAR, the assessment endpoints served two purposes:

- to identify the key features of the VC that should be protected, and
- to illustrate how the various pathways may affect each VC.

Examples of assessment endpoints include the persistence of fish habitat, persistence of caribou abundance and distribution, continued opportunities for harvesting caribou, and persistence of wilderness character (Table 10.1). Assessment endpoints were developed for each VC, and the pathways (or the means by which the Project may affect the VC) were grouped by these assessment endpoints. Table 10.1 presents an example of the possible VCs, assessment endpoints, and pathways. Assessment endpoints for each VC were defined at the beginning of each KLOI and SON.

Table 10.1 — Example of Possible Valued Components and Assessment Endpoints

Key Line of Inquiry or Subject of Note	Valued Component	Assessment Endpoints
Water fluctuations in the Taltson River watershed	Beaver	Persistence of beaver abundance and distributions Continued opportunities for beaver harvesting
Water fluctuations in the Taltson River watershed	Fish	Persistence of fish populations
Key furbearing species and ungulates	Marten	Persistence of marten abundance and distribution Continued opportunities for beaver harvesting
Barren-ground caribou	Barren-ground caribou	Persistence of the caribou abundance and distribution Continued opportunity for human use

10.4 SPATIAL AND TEMPORAL BOUNDARIES

Identifying the spatial and temporal scale for assessment is key to both measuring and estimating potential effects, and in making extrapolations from other studies to this Project. This is because individuals, populations, species and communities all perceive and react to the environment (and effects from the Project) at different spatial and temporal scales. For example, the movements of a wolf pack at the local scale might be related to the presence of lakes and eskers, while the movements of the same pack on a regional scale would be correlated to caribou migrations. The movements of a fish at a fine scale may be correlated to local bathymetry and collective movements of the school, while other processes (such as spawning, ice cover and water temperature) might define fish movements over a larger scale.

The ability to detect spatial and temporal patterns is a function of both extent and grain (Wiens 1989). Spatial extent refers to the overall area encompassed by a study (the study area), while grain refers to the size of the unit being observed (such as the size of the plots within the study area or the statistical sampling unit). Temporal extent and grain could refer to aspects of study design such as the sampling frequency of a study (grain), and the number of years over which the study is conducted (extent). Extent and grain define the upper and lower limits of resolution of a study, and are analogous to the mesh size and overall dimensions of a sieve. Johnson et al. (2005) state that:

- incorrect definition of scale may result in failure to detect relevant processes and response,
- small-scale processes may be averaged or large-scale processes missed if an inappropriate scale is used,
- measured responses at one scale may not extrapolate to other scales, and
- comparisons among organisms may be invalidated if scales are not calibrated.

The spatial and temporal boundaries of the assessment were determined for each VC according to the principles above.

10.4.1 Spatial Boundaries

Effects from the Project on the biophysical environment are likely stronger at the local scale, and larger-scale effects are more likely to result from other ecological factors and human activities. For example, most changes to soil quality at the local scale should be associated with direct disturbance from the Project (i.e., footprint, air and dust emissions), while some variation would be related to soil properties. At the regional scale, most of the variation in soil quality would be related to factors influencing decomposition rate, such as climate (Meentemeyer 1984).

Similarly, mining activities have been correlated with changes in the behaviour and distribution of caribou at the local and regional scales. In one study, the amount of time spent feeding by caribou was reduced when animals were within 5 km of an operating mine (BHPB 2004). Several studies have shown that direct and indirect effects may influence the distribution of animals within 10 km to 50 km around mineral developments (Boulanger et al. 2004; Johnson et al. 2005; De Beers 2008; Golder 2008). However, natural environmental factors, such as fire, snowfall, food abundance and quality likely have a greater influence on the seasonal distribution of caribou relative to local and regional effects from a project (Messier et al. 1988; Ferguson and Messier 2000; Kendrick et al. 2005).

For species with relatively small home ranges, any effects from the Project on a local population (or subpopulation) would likely not be transferred to other populations in the region. Depending on the species, an increase in distance among local populations can decrease effective dispersal and result in subpopulations that fluctuate independently (Schlosser 1995; Steen et al. 1996; Sutcliffe et al. 1996; Ranta et al. 1997; Bjørnstad et al. 1999). In other words, changes in the number of individuals within subpopulations over time are more related to local factors that influence reproduction and survival rates than the movement of individuals between populations.

The concept of distinct local populations is important for determining the incremental and cumulative effects from the Project on VCs. For two subpopulations that have little to no exchange of individuals between them, the effects from the Project on one population should not influence the other population (provided that the spatial extent of effects from the Project influences only one population). For example, effects from the Project on a local songbird population breeding near Nonacho Lake would have no measurable influence on the on the local population near Snap Lake.

For animals, such as caribou and wolverine, the distance traveled during an average daily walk to find food may be equivalent to the distance for a marten or robin to move between local populations. Similarly, large animals (i.e., caribou, grizzly bear, and wolf) that are influenced by the Project would likely encounter other developments in their daily and seasonal ranges. Consequently, effects from the Project can combine with influences from other developments in the animals' range, and result in cumulative effects to the population.

The purpose of the examples above is to emphasize the different levels of organization in natural systems, and the correspondent need to analyze and predict Project effects to VCs at the appropriate spatial boundaries. For the DAR, the spatial boundaries must be able to capture the scale-dependent processes and activities that influence the geographic distribution or movement patterns specific to each VC. Accordingly, the DAR has adopted this multi-scale approach for describing baseline conditions (existing environment) and predicting effects from the Project on VCs.

Generally, the spatial boundaries of the local assessment areas were based on the Project footprint and activities on the VCs through the different pathways (i.e., changes to water levels and water quality, physical disturbance to vegetation, soil admixing). Local assessment areas were also defined to assess small-scale indirect, or peripheral, effects from Project activities on VCs such as changes to vegetation and wildlife from fluctuations in the hydrologic regime. The boundaries for regional assessment areas were designed so that Project related effects beyond the Project footprint could be measured and predicted. Project-related effects at the regional scale include potential changes to VCs at a watershed scale, population or populations scale, physical barrier to movement and distribution, etc.

For some VCs in the DAR, local and regional assessment areas were sufficient for measuring and predicting effects from the Project. Examples include effects to soil and vegetation. For other VCs, the spatial assessment boundary for measuring and predicting Project effects was extended beyond the regional assessment area. For example, caribou and grizzly bears travel large distances during their daily and seasonal movements and can be affected by the Project, and several additional projects. Using the concepts presented in the preceding paragraphs, the spatial boundary for the assessment of effects was defined by the range of the population or the predicted dispersal distance for the species. As a result, the analysis not only includes the Project-specific (incremental) effects on the population, but also the cumulative effects from the Project and other developments that overlap with the distribution of the population.

10.4.2 Temporal Boundaries

In the DAR, temporal boundaries are linked to two concepts:

- The length of time that Project-related stressors would influence VCs during the different development phases of the Project (i.e., construction and operation).
- The predicted duration of effects from the Project on VCs, which may extend beyond operation.

The expected length of time that Project-related stressors would influence VCs during the construction phase is three years. Currently, the Project is expected to be in operation for 20 years to service the existing and proposed diamond mines. However, the infrastructure would have a lifespan of at least 40 years, and it is the intent of Dezé Energy to solicit new customers to extend the Project beyond 20 years. Subsequently, the expected length of time that Project-related stressors would influence VCs during the operation phase is assumed to be 40 years. Although Dezé Energy intends to operate the Project longer than 40 years if customers can be found, increasing the duration of the operation phase of the Project would increase the uncertainty in the effects predictions. For example, it is currently not known how much of the transmission line would be in operation after 40 years. Therefore, 40 years was defined as the longest reasonable duration of the operation phase for predicting and assessing effects from the Project.

The duration of some effects from the Project, such as changes to existing noise levels and dust deposition, are expected to stop soon after the end of construction. The transmission line, on the other hand, would generate stressors that would be present over a 40-year time span, and the duration of effects is expected to last beyond operations. An example of such an effect is the mortality of waterfowl caused by collisions with the transmission line. In this case, the assessment must predict if the effect on the populations during the 40 year operations phase is reversible. 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. 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.

10.5 PROJECT COMPONENTS

To simplify presentation and aid in scoping how the Project may affect the environment (i.e., the identification of pathways), the Project has been divided into discrete components. The main Project components include the Nonacho Lake control structure, canal, new powerhouse at Twin Gorges, winter roads, and the transmission line. Each component involves a range of activities and potential environmental effects. Components also vary in spatial and temporal extent and frequency. For example, winter roads would be active only in late winter during the three year construction phase of the Project. Activity levels would vary over this time. In contrast, the transmission line would lead to a large amount of activity during construction, but very little during operation. The nature of the activities taking place for each Project component would be used later in the pathways analysis to identify how each Project component could affect the environment, and for how long. Table 10.2 presents a summary of the activities, schedule, duration, and phase for Project components.

Table 10.2 — Table of Project Components and Their Nature

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
Nonacho Lake Control Structure	Lower the Nonacho Lake elevation (not a Project component, but retained as a pathway reminder)	None	Nonacho Lake	3rd Q 2010 – 1st Q 2011	9 months	Construction
	Intake canal Control structure & hydro generation plant	Mobilization and site preparation (clearing, levelling)	Facilities footprint + 100 m buffer	1st Q 2011-2nd Q 2011	6 months Continuous	Construction
		Terrestrial blasting & excavation Trucking Waste management Waste rock storage Riparian zone clearing	Facilities footprint + 100 m buffer	1st Q 2010-4th Q 2011	12 months Continuous	Construction
		Aggregate processing	As above	2nd Q 2011	4 months	Construction
		Terrestrial concrete works	As above	2nd Q 2011	3 months	Construction
		In-stream concrete works	Not required			
		In-stream blasting	As above	4th Q 2011	2 weeks	Construction
		Site reclamation	As above	4th Q 2011	2 weeks	Construction
	Dam modification	In-stream rock placement	As above	2nd -3rd Q 2011	2 months	Construction
	Spillway raise	In-stream concrete work (dry work as lake lowered)	As above	2nd Q 2011	1 month	Construction
	Mechanical and electrical	Transport and Installation of equipment	As above	1st Q 2011 – 1st Q 2012	15 months Q1 delivery, Q4/Q1 install	Construction

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
Nonacho Lake Control Structure	Construction camp & work zone	Mobilization; setup; Waste (sewage, refuse, metals, incineration, etc.) Demobilization & reclamation		1st Q 2011-2nd Q 2012	18 months	Construction
	Mechanical and electrical maintenance on control structure and hydrogen plant	Helicopter or plane access	Facilities footprint	Monthly Visits September maintenance	1 week	Operations
	Change to flow in channel (not a Project component, but retained as a pathway reminder)	Annual lake drawdown	Spillway channel between Nonacho and Taltson lake (~500m)	Typically February – May	Annual	Operations
South Valley Spillway	Minimum flow release structure	In-stream works depending on final design – fill placement and possibly minor blasting.	Facilities footprint + 200 m buffer	3rd ,4th Q 2010	4 months	Construction
	Dewatering of two side channels (not a Project component, but retained as a pathway reminder)	None	River channel from side channel spills to confluence of Trudel (~500m)	Continuous from 1st Q 2012	Continuous except for high flow periods	Operations
South Gorge Bypass Facility	Canal construction	Site preparation, blasting, trucking and waste management	Facility Footprint + 100 m buffer	2nd Q 2011 – 3rd Q 2011	5 months	Construction
	Concrete works and equipment installation	Terrestrial concrete placement	As above	4th Q 2011	2 months	Construction
		In-stream excavation	Canal Entrance	1st Q 2012	2 weeks	Construction
South Gorge Bypass Facility		Plant outage	As above	As required	Hours – days	Operations

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
Twin Gorges Facilities	Water conveyance canal construction (SON)	Mobilization and site preparation (vegetation clearing and levelling	Facilities footprint + 500 m buffer	1st Q 2010 – 3rd Q 2010	6 months	Construction
		Terrestrial blasting Trucking Waste management Riparian zone clearing	As above	3rd Q 2010 – 4th Q 2011	14 months	Construction
		Aggregate processing	As above	2nd Q 2010 – 4th Q 2011	18 months	Construction
		In-stream blasting	As above	4th Q 2011	2 months	Construction
	Powerhouse, excavation & penstocks	Terrestrial blasting Trucking	Powerhouse footprint	2nd Q 2010 – 3rd Q 2010	4 months	Construction
		Terrestrial concrete work & equipment	Powerhouse footprint	3rd Q 2010 – 2nd Q 2012	18 months	Construction
	Rock tailrace canal	In-stream blasting	See canal	4th Q 2011	1 month	Construction
	Switchyard	Installation	See canal	2nd Q 2011 – 4th Q 2011	5 months	Construction
	Waste rock stockpile	Earthmoving equipment Runoff	See above	2nd Q 2011 – 4th Q 2011	7 months	Construction
	Mechanical & electrical installation	Installation of equipment	See above	2nd Q 2011 – 1st Q 2012	9 months	Construction
	Transportation	Plane	Air Strip	1st Q 2010 – 2nd Q 2012	2/week	Construction
	Construction camp & work zone	Mobilization; setup; Waste (sewage, refuse, metals, incineration, etc.) Demobilization & reclamation	See canal	1st Q 2010 – 2nd Q 2012	30 months	Construction

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
TG Facilities	Powerhouse & switchyard	Maintenance	Facilities footprint	April annually	1 week	Operations
	Waste rock	Runoff	Nearest water body	Continuous	Continuous	Operations
	Camp		Facilities footprint	Continuous	Continuous	Operations
	Transportation	Plane	Air Strip	Continuous	2/wk	Operations
Staging Areas	Southern section staging areas and camps (operational summer and winter)	Vegetation clearing and site levelling Small generators, trailers Helicopter work (see t-line) Reclamation	Footprint	1st Q 2010 – 2nd Q 2012	6 months during southern transmission line construction	Construction
	Northern section staging areas and camps (winter prep and occupation)	Clearing and levelling, Delivery of line materials, assembly of line materials	Footprint	As above	6 months during northern transmission line construction	Construction
Roads	Ft. Smith to Twin Gorges winter road	Brushing out existing overland sections Traffic	15 m right-of-way	1st Q 2009, 1st Q 2010 – set up staging areas 1st Q 2011-material transport 1st Q 2012 - Decommission	Jan-March annually	Construction
	Twin Gorges to Nonacho winter road and spurs to Staging areas	Clearing portages Blasting at portages	See above	1st Q 2010 – set-up staging areas 1st Q 2011-material transport	Jan-March annually	Construction

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
				1st Q 2012 - Decommission		
Winter spur roads	Tibbitt to Contwoyto winter road spurs created for the Taltson Project	Ice road only to mine sites and staging areas, as per southern section – no portage clearing	See above	1st Q 2010 – set-up staging areas 1st Q 2010- material transport 1st Q 2012 - Decommission	Jan-March annually (two seasons max)	Construction
Transmission line	Transmission line from Twin Gorges to treeline	Helicopter construction Drilling at rock foundations Excavation in non-rock foundations Mechanized and hand clearing of transmission line right-of-way	Footprint of towers. Flying between staging areas and towers, 30 m wide transmission line right-of-way,	1st Q 2011 – 1st Q 2012	6 months Within caribou and other animal timing windows, as possible	Construction
	Transmission line from treeline to Snap Lake, Gahcho Kué, Ekati, and Diavik mine sites.	Helicopter and machine construction Drilling at rock no clearing, foundations Excavation in non-rock foundations	See above	1st Q 2010 – 1st Q 2012	2 periods of 6 months Within caribou and other animal timing windows, as possible	Construction
	Transmission line from Twin Gorges to treeline	Hand clearing Helicopter access	Transmission line right-of-way	1/10 years	2 months	Operations
	Transmission line	Maintenance: observations Helicopter	See above	Annually	2 days	Operations

Project Component	Sub-components	Associated Activities	Geographic Extent (of Project component)	Timing	Duration	Phase
Barge landing	2 Barge landing sites and staging areas	Vegetation clearing and levelling, camp facilities installation and operation Waste management	Footprint	3rd Q 2010 – 1st Q 2012	2 periods of 4 months Within caribou and other animal timing windows, as possible	Construction
Four new substations at mine sites	Installation	Maintenance	Footprint	2nd – 4th Q 2011	6 months	Construction
				Continuous		Operations

10.6 PATHWAY ANALYSIS

10.6.1 Identification of Pathways

A key component of the assessment process was to identify and focus on the areas where the Project may influence the physical and biological environment. This involved assessing how each of the Project components (i.e., Nonacho Lake control structure, canal, new powerhouse at Twin Gorges, winter roads, and the transmission line) may affect VCs (i.e., loss of vegetation, changes to caribou distribution, water quality). A linkage between a Project component and a VC is required to create a Valid pathway. For example, a transmission line may cause changes to furbearer distribution, but is unlikely to lead to furbearer mortality (and therefore mortality was not considered as a pathway). Potential pathways through which the Project could affect VCs were identified through:

- potential pathways identified in the Taltson Expansion Project Terms of Reference (MVEIRB 2008);
- pathways identified by regulatory agencies such as DFO and ENR;
- a review of the Project Description and scoping of potential effects by the environmental assessment and engineering teams for the Project; and
- consideration of potential effects identified by the public.

The pathways outlined in the Terms of Reference were in turn developed from a review of comments received during the MVEIRB public scoping sessions, held in Łutsel K'e, Fort Resolution, Fort Smith, Hay River, and Yellowknife in November and December 2007, and from the scoping process conducted by the MVLWB (which included the consultation of government, regulatory, and Aboriginal agencies). Further issues were also derived from Dezé Energy public information sessions held in Hay River, Fort Providence and Fort Smith in March 2004 (reported in Rescan 2004).

Pathways that did not lead to VCs were not considered further. For example, tree clearing in the transmission line right-of-way is a pathway that would affect red squirrels, and changes to red squirrel abundance is a pathway to marten. Although both species may be directly affected, marten is the VC, and red squirrel is a pathway to the VC. Only pathways to a VC were assessed.

The Subjects of Note Canal Construction, and Turbine and Conveyance refer to specific Project components. In these cases, the relevant section will only include pathways originating from that specific Project component. Table 10.3 provides an illustration of Project components and their associated pathways.

10.6.2 Mitigation

Mitigation refers to the measures used to eliminate or reduce environmental effects from Project pathways. Any effects remaining after mitigation are referred to as residual effects. Within this DAR, mitigation has been divided into two categories; mitigation practices and mitigation design features. Mitigation practices refer to any activity, strategy, or practice used to reduce or avoid a negative effect. Management plans and best management practices are typical mitigation practices. Mitigation design features refer to any Project component designed and/or incorporated into the

Project to eliminate or reduce a negative effect. A mitigation design feature commonly has an economic cost. Table 10.3 presents examples of potential mitigation practices and mitigation design for selected pathways.

Table 10.3 — Example of Proposed Mitigation to Reduce Effects to Marten

Project Component	Pathway	Pathway Duration	Proposed Mitigation	Pathway Validation
Transmission line right of way Twin Gorges to Nonacho Lake winter road Laydown areas Construction camps	Habitat loss leading to change in abundance	Construction and Operation	Adhere to the Vegetation Management Plan Compact layout of the surface facilities would limit the area disturbed at construction Wherever topography would allow, the transmission line would span over lowland areas, leaving them undisturbed. Adjustments to tower locations would be made during construction to avoid sensitive areas. Helicopter construction methods would limit effects to habitat between towers. Maximize the use of frozen lakes and rivers for the winter road Winter road access would make use of existing winter roads and alignments wherever possible Remove topsoil during site preparation and stockpile for later use	Valid. The vegetation clearing required for these Project components would lead to the loss of marten habitat.

Mitigation should not be confused with adaptive management, which refers to the systematic process of continually improving management practices and policies by learning from the outcome of existing programs. Adaptive management occurs in response to new challenges as they arise.

10.6.3 Pathway Validation

Project environmental effects occur when there is a pathway between a Project component or activity and a VC. Effects from some pathways may be reduced or eliminated through mitigation. Pathway validation is the process of screening each pathway to assess its expected contribution to the overall Project residual effects to VCs after mitigation.

In the pathway validation step, knowledge of the mitigation design and practices are applied to the pathways to assess how each pathway is affected by mitigation. Some pathways may not be affected by mitigation, but others may be reduced or eliminated completely. For example, clearing of vegetation could cause the destruction of migratory bird nests, but this pathway is eliminated if clearing only occurs before or after the migratory bird nesting season.

Each potential pathway was evaluated to determine if it could lead to a change in various components of the environment that could affect a VC. Each potential pathway is evaluated and characterized as follows:

- Invalid – The pathway does not exist, is removed by mitigation, or mitigation results in no detectable (measurable) change or residual effect relative to baseline or guideline values.
- Minor – The pathway exists but has a negligible residual effect on the population (e.g., the loss of a small amount of wildlife habitat, or a short-duration stressor such as blasting noise).
- Valid – The pathway likely contributes to residual effects to a VC.

Invalid and Minor pathways were not carried forward into the effects assessment. An example of pathway analysis summary is provided in Table 10.3. In the KLOI or SON chapters, each of the Minor or Invalid pathways is justified with supporting information. Valid pathways would undergo a more rigorous analysis in the residual effects analysis section that follows pathway validation.

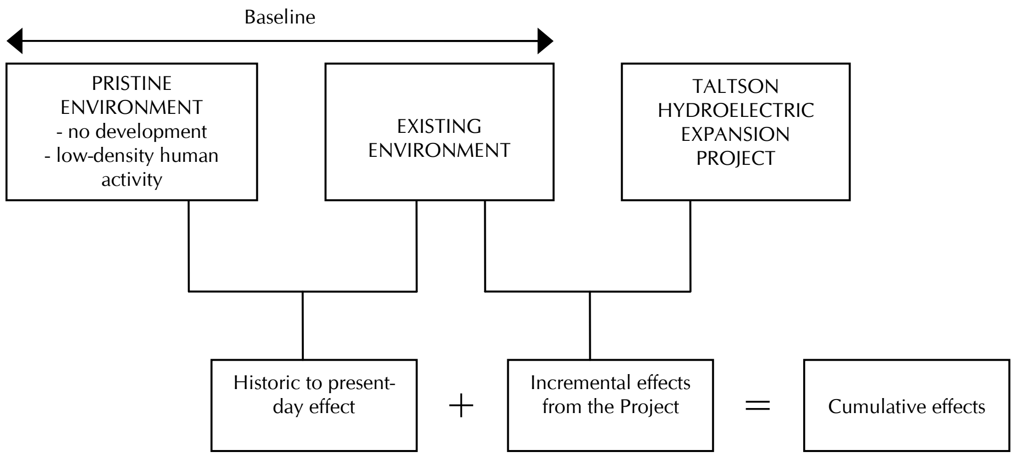
For each KLOI and SON a pathway diagram is presented to illustrate the link between the assessment endpoint of the valued component and the Project activities that have the potential to cause an effect. Where pathway diagrams could easily portray all pathways (Valid, Minor and Invalid) then all were shown. In some cases, however, a multitude of pathways exist. For reader clarity, in these assessments only the Valid pathways are shown in the pathway diagram.

10.7 RESIDUAL EFFECTS ANALYSIS

The effects analysis was used to quantify the Project incremental effects on the current (existing) environment and the overall cumulative effects to VCs resulting from the Project and other projects (see Figure 10.1). Incremental effects represent the Project-specific changes relative to the existing environment in 2008. These incremental effects occur at the local scale (i.e., habitat loss due to the Project footprint) and regional scale (i.e., combined habitat loss, dust, noise, and sensory disturbance from Project activities [i.e., maximum predicted zone of influence]).

Cumulative effects are the sum of all changes which have occurred from a pristine environment through to the existing environment, and application of the Project. Cumulative effects were measured when there were overlapping effects from the Project and other surrounding projects and activities. Cumulative effects may result from both spatial and temporal overlap of projects and activities. For example, noise from two adjacent mines may have spatial overlap, creating a cumulative effect. Further, noise from two isolated mines may also create a cumulative effect if caribou interact with each project during their seasonal movements.

Figure 10.1 — The Relationship Between Baseline Environment, Incremental and Cumulative Effects



10.7.1 Incremental Effects

Where possible and appropriate, the analyses were quantitative, and included data from field studies, scientific literature, government publications, effects monitoring reports, and personal communications. Where available, Traditional Knowledge and community information were incorporated into the analysis. The expected effects to each VC from each Valid pathway were analyzed using quantitative measurements where possible. This included quantitative measures such as direct and indirect habitat loss, and/or qualitative measurements, such as the predicted magnitude of changes to traditional and non-traditional land use activities.

The analysis and information presented in the effects analysis was expressed in terms of direction, magnitude, geographic extent, duration, frequency, reversibility and likelihood and ecological extent. For example, the effect of direct habitat alteration to furbearers might be presented in terms of years until vegetation re-growth (duration), area that habitat that would be disturbed (geographic extent), the number of times the habitat would be disturbed (frequency), and the change (percent or absolute) in population from change in the amount of habitat available (magnitude).

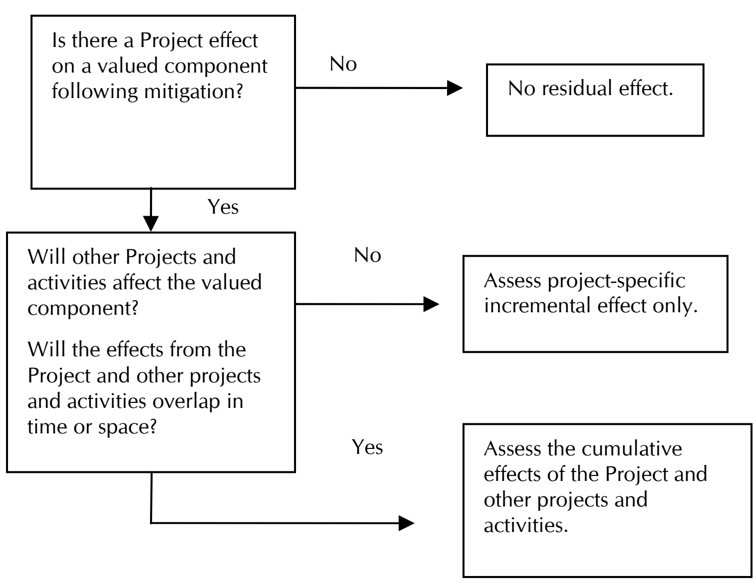
Effects were assessed based on the "sustainability" or "preservation" of the VC in question. For example, effects of waterfowl mortalities due to transmission line collisions are irreversible at the individual level, but likely reversible at the population level. The magnitude and reversibility of the effect on the population is related to the number of individuals that are influenced through direct mortality, habitat loss, and changes in behaviour and movement. Thus, the effect on individuals is considered in the analysis, but the assessment of significance is determined based on the sustainability of the VC (i.e., assessment endpoint: preservation of the population [Section 10.3.2]).

10.7.2 Cumulative Effects

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, cultural, and economic properties of the social-ecological system within a period of time and space. Where an effect to a VC was identified, overlapping effects from other development and activities were also considered. Effects may overlap spatially and temporally. Figure 10.2 illustrates the cases in which cumulative effects were included. Where sufficient information exists on pristine conditions, the final determination of significance would not be limited to the incremental effects of the Project on the VC, but include the cumulative effects from all previous and existing projects and activities on the VC, including the Project. 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 VCs relative to pristine conditions. If the Project takes place in a relatively pristine environment, then cumulative effects would be negligible, and only the Project-related incremental effects would be considered. Figure 10.1 outlines the cases in which incremental and cumulative effects should be assessed.

Stressors to a VC may be human-related, or natural (such as floods, predation, and forest fires). Both may contribute to cumulative effects. In a pristine system, populations and ecosystems are driven by natural factors. Only anthropogenic effects were described in detail and included in the effects assessment. Key natural stressors were identified, and professional judgement was used to predict the relative importance of anthropogenic and natural stressors on changes to a VC.

Figure 10.2 — Incremental and Cumulative Effects Assessment Flow Chart



10.7.2.1 PREVIOUS AND EXISTING DEVELOPMENTS

To estimate the cumulative effects, an understanding of the previous and existing projects and activities in the effects study area was required. The extent of other projects and activities in the effects study area was estimated by the number, type, and location of previous and existing developments on the landscape. This information was obtained using the following sources:

- Mackenzie Valley Land and Water Board (MVLWB): permitted and licensed activities within the NWT;
- Indian and Northern Affairs Canada (INAC): permitted and licensed activities within the NWT and Nunavut;
- 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 VCs;
- company websites; and
- knowledge of the area and Project status.

The information was used to generate a development layer within a geographical information system (GIS) platform. Other data sources were added to this layer either by merging it into the GIS software or digitizing the location of the development. The file was examined for duplication of information (i.e., mineral exploration camps and the associated airstrips are often permitted separately). The development layer was then applied to the spatial boundary (effects study area) for applicable VCs. Some projects are seasonal (such as winter roads), and this was incorporated where possible.

Several assumptions were made concerning the temporal and spatial extent of effects from the different types of development, particularly with respect to estimating the cumulative effects on wildlife. The development layer database does not contain information on the duration of activities associated with land use permits. For example, although the land use permit for mineral exploration may be active for five years, there are no data on the actual frequency and length of time that exploration activities occurred during that period. Subsequently, to estimate the temporal extent of the zone of influence from exploration sites, the analysis assumed that approved land use permits were active for five years. The assumption likely overestimates the effect from exploration activities as exploration typically occurs during the non-winter period. For the cumulative effects analysis, the assumption was made that all land use permits issued more than five years ago (i.e., 2003) are now inactive, and may receive less weighting when considering cumulative effects from the Project. Land use permits are typically valid for five years, unless an extension is obtained. However, as many of the permitted activities do not use all five years of their permit (such as spur roads from the Tibbitt to Contwoyto winter road, and many exploration camps), this likely overestimates the actual level of activity.

In addition, the database contains no information on the size of the physical footprint of the development. For communities and closed and operating mines, the footprint was digitized from Landsat 7 Imagery from the Government of Canada (CanImage 2008). For all other developments, the physical area of the footprint was estimated using a number of assumptions. For example, estimated footprints for linear developments (all roads, seismic lines) were based on a 200 m corridor, while the area of the footprint for outfitting camps, wood operations, and staging areas was based on a 200 m radius (12.6 hectares [ha]). A 1,000 m radius was used to estimate the area of the footprint for exploration sites and power plants (314 ha). For all closed mines and inactive land use permits, the physical footprint was carried through the entire assessment as it was assumed that direct impacts to the landscape had not yet been reversed.

10.8 RESIDUAL EFFECTS CLASSIFICATION

The purpose of the residual effects classification is to describe the effects of the Project using a scale consisting of common words (rather than quantitative numbers or percentages used in the effects analysis) according to the criteria in the Terms of Reference (MVEIRB 2008). Eight effect classification criteria, provided in the Terms of Reference, were used to classify the effects, and included:

- direction
- magnitude
- geographic extent
- duration
- reversibility
- frequency
- likelihood
- ecological context

In this DAR, the assessment and classification of residual effects (i.e., after mitigation) was based on both the predicted incremental and cumulative changes from the Project where sufficient information was available to adequately quantify cumulative effects.

Where information was available, cumulative effects were both quantified and qualified. For example, if habitat loss for a VC has been 10%, and the Project is predicted to result in an additional loss of 1%, then the incremental loss of 1% is classified as well as the cumulative habitat loss of 11%. However, if only a general understanding of pristine conditions was available, then a general discussion of cumulative effects was presented.

10.8.1 Criteria Definitions

This section provides a generic definition for each of the residual effect criteria.

Direction indicates whether the effect on the environment would be adverse (i.e., less favourable), positive (i.e., beneficial), or neutral (i.e., no change). While the main focus of the effects review is to assess whether the Project is likely to cause significant adverse effects on the environment or be cause for public concern, the positive changes associated with the Project are also reported. The MVEIRB must consider both the positive and negative effects when evaluating the overall effect of the development.

Magnitude is a measure of the intensity or severity of an effect. Magnitude can relate to a percentage change (i.e., change from baseline), or to absolute changes that are above or below guidelines or thresholds. Magnitude is classified into four scales as negligible, low, moderate, and high. The definitions of these terms are specific to each VC (i.e., water quality, wildlife). Because there is an element of professional judgment needed to assign the scales, the definitions of each scale are provided for each VC. This makes the classification process transparent and reviewers can see exactly what is meant by words such as low or high.

Geographic extent refers to the area or distance from the Project that is affected, and is categorized into three scales: local, regional, and beyond regional. Local-scale effects mostly represent changes that are directly related to the Project footprint and activities, but may also include small-scale indirect effects. For example, the geographic extent for noise is the distance from the noise source at which noise levels drop down to background levels (typically local in geographic extent). Changes at the regional scale are largely associated with indirect effects from the Project, and represent the maximum predicted spatial extent of effects from the Project (i.e., maximum zone of influence). Effects beyond the regional scale are associated with VCs that have large spatial distributions and are influenced by cumulative effects from other projects such as caribou, traditional land users, and socio-economics. The definitions of geographic extent may change according to the VC. For example, the geographic extent of effects to wildlife is often expressed in terms of distance from the Project, while the geographic extent of effects to water quality may be expressed in terms of river confluences, reaches, or watersheds.

Duration is defined as the amount of time from the beginning of an effect to when the effect on a VC is reversed. Thus, duration is a function of the length of time that the VC is exposed to Project activities, and reversibility. Duration is related to Project stressors during construction and operation, but in many cases the effect outlasts the stressor. For example, removal of trees during construction would cause effects that last until the trees regenerate, and the duration of the effect considers the time required for regeneration. Short-term duration is assigned to effects that are expected to last no more than one year (including time for the effect to be reversed), medium-term is assigned to effects which may last throughout construction (three years), and long-term is assigned to effects which would last up to or beyond 40 years (i.e., assumed time length of operation).

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. Many effects are reversible, and the expected time frame for reversal would be provided where appropriate (i.e., duration). By definition, short, medium, and long-term effects are reversible. For effects that are permanent or the duration is unknown, the effect is considered to be irreversible.

Frequency refers to how often an effect would occur and is expressed as isolated, periodic or continuous. For example, the frequency of habitat disturbance from erecting transmission towers occurs once during construction, while migratory bird strikes on the transmission line may occur periodically throughout the assessment period. Frequency should, where applicable, include a description of the length of time between occurrences.

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

Ecological Context refers to the intrinsic value or perceived importance of the VC. For example, an effect causing mosquito mortalities may be viewed differently from an effect causing caribou mortalities. Even if the direction, magnitude, frequency and duration of the effects to mosquitoes and caribou are the same, the overall effect would be much greater for caribou.

Ecological context has been largely assigned through the issue prioritization presented in the KLOI and SON approach. The MVEIRB, through public and stakeholder consultation, has adequately identified the issues and VCs of greatest intrinsic value or perceived importance. Specifically, the issues of greatest concern were defined as Key Lines of Inquiry, while issues with a lower level of concern were defined as Subjects of Note. Thus, ecological context was not presented in the KLOI and SON residual effects classification tables.

10.8.2 Definitions of Scales for Criteria

The residual effects are classified using each of the criteria described in Section 10.8.1, and assigning a scale such as high, medium and low (magnitude) or short-term and long-term (duration). Generic criteria definitions are presented in Table 10.4, but these may be modified as required for each KLOI and SON.

Table 10.4 — Definitions of Terms Used in the Residual Effect Classification

Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Likelihood
Neutral: no residual effect **Adverse:** a less favourable change relative to baseline values or conditions **Beneficial:** an improvement over baseline values or conditions	**Negligible:** no predicted detectable change from baseline values **Low:** effect is predicted to be within the range of baseline values **Moderate:** effect is predicted to be at or slightly exceeds the limits of baseline values **High:** effect is predicted to be beyond the upper or lower limit of baseline values so that there is likely a change of state from baseline conditions	**Local:** small-scale direct and indirect effect from the Project (i.e., footprint, physical hazards, single river reach, single lake, and dust deposition) **Regional:** the predicted spatial extent of combined direct and indirect effects from the Project that exceed local-scale effects (can include cumulative direct and indirect effects from the Project and other developments at the regional scale) **Beyond Regional:** cumulative local and regional effects from the Project and other developments extend beyond the regional scale	**Short-term:** effect is reversible at end of one year **Medium-term:** effect is reversible at with the construction phase **Long-term:** effect is reversible after the assumed 40-year operation period **Indefinite:** the duration of the effect is indefinite beyond the assumed 40-year operation period	**Reversible:** effect would not result in a permanent change of state of the population compared to "similar" [1] environments not influenced by the Project **Irreversible:** effect is not reversible (i.e., duration of effect is indefinite or permanent)	**Isolated:** confined to a specific discrete period **Periodic:** occurs intermittently but repeatedly over the 40-year assessment period **Continuous:** occurs continually over the 40-year assessment period	**Unlikely:** effect is likely to occur less than once in 100 years **Possible:** effect is possible within a year; or at least one chance of occurring in the next 100 years **Likely:** effect is probable within a year; or at least one chance of occurring in the next 10 years **Highly Likely:** effect is very probable (100% chance) within a year

[1] "similar" implies an environment of the same type, region, and time period

10.8.3 Residual Effects Classification

Residual effects are classified using the criteria and categories above, for both the incremental and cumulative (if applicable) effects from the Project on the VC. An example of how the effect classification criteria may be used to describe the effects to marten is provided in Table 10.5. An effects classification was completed for each Valid pathway. Cumulative effects to the VC, if any were identified, (see Figure 10.2) were classified using identical methods, except that the classification of effects included the sum of all effects to a VC from previous and existing projects within the effects assessment area. For example, the incremental effect of population changes from habitat loss predicts independent effects from the Project on habitat and thus the population, while the cumulative effect on the population from habitat loss predicts the effect from the Project and all other previous and existing projects.

Essentially, the only difference in the outcome of effects criteria between cumulative and incremental changes from the Project is in the magnitude and geographic extent of effects. The magnitude for cumulative effects involves changes from reference conditions through application of the Project, while incremental effects are based on changes from the Project relative to 2008 baseline values. Cumulative effects from the Project and other developments influence the entire spatial boundary of the effects assessment area. In contrast, the geographic extent of incremental effects from the Project may have a local or regional influence on the range of the population (i.e., determined by the zone of influence from the Project).

The effects pathways created during the construction and operations phases of the Project can be different. For example, effects from pathways such as noise and dust are anticipated to occur during construction. In contrast, pathways that lead to changes in hydrology regime, riparian vegetation, and bird collisions with the transmission line would predominantly occur during the operations phase. Subsequently, pathways that can be assigned to either construction or operation are classified for each Project phase. Project phases were combined for pathways that generate effects through construction and operation (i.e., habitat loss from erecting transmission towers) (Table 10.5; Table 10.6).

For some KLOI and SON, an overall rating of the residual effect was included in the residual effect classification table. The overall residual effect rating considered all the assessment criteria rankings and was used to assist in the determination of significance; see Section 10.9.

Table 10.5 — Example of Effect Classification Summary for Pathways to Incremental and Cumulative Effects on Population Size and Distribution of Marten

Pathway	Project Phase	Direction	MAGNITUDE		GEOGRAPHIC EXTENT		Duration	Reversibility	Frequency	Likelihood
			Incremental	Cumulative	Incremental	Cumulative				
Habitat loss from tower instalment leading to change in abundance	Construction and Operations	Adverse	Low	Moderate	Local	Regional	Long-term	Reversible	Continuous	Highly likely
Winter road hauling activity and disturbance changes distribution	Construction	Adverse	Low	Low	Local	Local[1]	Short-term	Reversible	Isolated	Highly likely
Construction activity and disturbance leading to change in distribution	Construction	Adverse	Low	Low	Local	Regional	Short-term	Reversible	Isolated	Highly likely

[1] There are no other winter roads within the study area, so the cumulative effect is the same as the incremental geographic extent.

Table 10.6 — Example of Effect Classification Summary for Pathways to Incremental and Cumulative Effects on Continued Opportunities for Harvesting Marten

Pathway	Project Phase	Direction	MAGNITUDE		GEOGRAPHIC EXTENT		Duration	Reversibility	Frequency	Likelihood
			Incremental	Cumulative	Incremental	Cumulative				
Effects to population size and distribution changes the availability of animals	Construction and Operations	Adverse	Low	Low	Local	Regional	Long-term	Reversible	Continuous	Possible

10.9 SIGNIFICANCE DETERMINATION

The classification of residual effects on Valid pathways for a VC (Table 10.5; Table 10.6) provides the foundation for determining significance from the Project on assessment endpoints. In this hypothetical example, three pathways affect marten population size and distribution during construction and one pathway influences marten during construction and operation (Table 10.5). All pathways are linked to the assessment endpoint called persistence of marten abundance and distribution. In reality, there would likely be more than two pathways for the construction phase and more than one pathway for the combined construction and operation phase, and the pathways may differ from these examples. Persistence of marten abundance and distribution is associated with the continued opportunity for harvesting marten (Table 10.6).

In the DAR, determining significance considers the entire set of pathways that influence a particular assessment endpoint. Significance is only determined for assessment endpoints, and not individual effects. Assessment endpoints represent the ultimate ecological properties and services of the VC that should be protected for use by future human generations (Section 10.3.1). To determine significance, either the overall residual effect rating or simply magnitude, geographic extent, and duration (which includes reversibility) were used to predict significance. For the latter, the other criteria (frequency, likelihood) were used as modifiers (where applicable) in the determination of significance.

Using the example above, the significance of the incremental effects during the construction phase of the Project on the persistence of marten population and distribution would consider the three pathways (Table 10.5). The relative contribution of each pathway is then used to predict the significance of effects (Table 10.7). 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 effect 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 significance.

Where sufficient information was available, determination of significance was completed for both the incremental and cumulative effects of each assessment endpoint and for construction and operation phases, independently (where effects may differ between construction and operation). In summary, the following information was used in the determination of the significance of effects from the Project on VCs:

- results from the residual effect classification of Valid pathways;
- application of professional judgment and ecological principals, such as resilience, to predict the duration and associated reversibility of effects; and
- application of additional adaptive management and mitigation measures that may increase resilience and decrease the significance of effects.

Table 10.7 — Example of the Summary Information Used in the Determination of Significance to Marten and Use of Marten by People

Assessment Endpoint	Project Phase	Pathways	MAGNITUDE		GEOGRAPHIC EXTENT		Duration	Significance of Incremental Effects
			Incremental	Cumulative	Incremental	Cumulative		
Persistence of marten population and distribution	Construction	Construction activity and disturbance leading to change in distribution Winter road hauling activity and disturbance changes distribution	Low	Low	Local	Regional	Short-term	Not Significant
Persistence of marten population and distribution	Construction and Operations	Habitat loss leading to change in abundance	Low	Moderate	Local	Regional	Short-term	Not Significant
Continued opportunity of harvesting marten	Construction and operations	Effects to population size and distribution changes the availability of animals	Low	Low	Local	Regional	Long-term	Not Significant

10.10 UNCERTAINTY

Uncertainty refers to the level of confidence in the effect prediction. The purpose of this section is to highlight areas of low certainty, and to discuss how uncertainty has been addressed to increase the level of confidence that effects would not be worse than predicted. Confidence in effects analyses can be related to many elements, including the following:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Project (i.e., extent of future developments, climate change, catastrophic events);
- model inputs (i.e., limited data set for long-term hydrological modeling);
- incomplete understanding or simplified representation of a system being modelled either physically (i.e., cross-sections along a river for hydraulic modelling), numerically (i.e., period of record of hydrologic data set), or conceptually (i.e., ecosystem response to a stressor);
- understanding of Project-related effects on complex ecosystems that contain interactions across different scales of time and space (i.e., how and why the Project would influence caribou); and
- knowledge of the effectiveness of the mitigation for reducing or removing effects (i.e., restricted public access on temporary winter roads).

Uncertainty in these elements can result in uncertainty in the prediction of significance. Where possible, a strong attempt was made to reduce uncertainty in the DAR to increase the level of confidence in effects predictions, through implementing a conservative approach when information is limited so that effects are typically overestimated. Each KLOI and SON would include a discussion of how uncertainty has been addressed and provide a qualitative evaluation of the resulting level of confidence in the effects analyses and determination of significance.

10.10.1 Reasonably Foreseeable Projects

Cumulative effects assessment should include all other human activities that may substantially affect the VC, including past, present and reasonably foreseeable future projects (MVEIRB 2004). Like all predictions, this does introduce a measure of uncertainty (MVEIRB 2004). Reasonably foreseeable projects included in the cumulative effects assessment were projects or activities that:

- are currently undergoing regulatory review,
- are about to be submitted for review,
- have been officially announced by a proponent,
- are directly associated with the Project under review, or
- would be induced by the Project if the Project is approved.

Potential future developments of varying numbers, sizes, and types in the Project area could contribute to cumulative effects to VCs. The following proposed projects have been selected as a suite of major developments that may occur in the reasonably foreseeable future, and a description of the key components of each is provided below. Other reasonably foreseeable future projects may be included within each Key Line of Inquiry and Subject of Note.

- the Gahcho Kué Project (which would, for the purposes of this DAR, be considered an existing project);
- a small-scale diamond mine in the Lac de Gras region owned by Peregrine Diamonds Ltd., which hauls ore to Ekati for processing;
- the Tyhee NWT Corporation Yellowknife Gold Project;
- the Bathurst Inlet Port and Road Project (BIPR); and
- the East Arm National Park

Peregrine Diamonds Ltd.'s WO property is located in the Lac De Gras region, near the proposed transmission line route. This property contains two kimberlite pipes, DO-27 and DO-18, which have shown results that are favourable in regards to further expansion of the site (Peregrine Diamonds 2008). A possible scenario for this Project is the development of a small-scale underground mine and construction of an all-season haul road for the transportation of ore to the Ekati mine site for processing. The viability of the Peregrine Diamonds property would improve with the presence of the Taltson transmission line, providing an example of the development which may be induced by the Taltson Project.

The Yellowknife Gold Project proposed by Tyhee NWT Corporation anticipates a combination open pit and underground mining operation with a lifespan of 8 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 2008). 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. Although this property could not be easily serviced by the Taltson Project, it also lies within the range of the Bathurst caribou herd.

The proposed BIPR Project provides access to the Arctic Ocean for projects located within the interior of the Northwest Territories and Nunavut. The proposed 211 km all-weather road, which would begin at a planned port facility south of the community of Bathurst Inlet, Nunavut, would connect with the existing ice road on Contwoyto Lake (BIRP 2008). It is expected that this would reduce the fuel and supply costs for northern communities and any developments that are along the proposed route. Employment would peak during construction and opportunities would be staffed mainly by Nunavut residents. The BIPR Project could lead to cumulative effects to wildlife with the Taltson Project and other developments in the Slave Geological Province.

The study area for the proposed East Arm National Park intersects the proposed Project corridor near Reliance. Depending upon the length of time for the park feasibility study to be completed and the time to negotiate the remaining stages of the park planning process, the proposed East Arm National Park may not be created until the Taltson Project is well into the operations phase. There is also ambiguity in predicting the status of the existing fishing, hunting lodges, and camps in the proposed park area. This assessment assumes that existing lodges would no longer allow hunting, but would remain as tourist lodges. Overall, the proposed East Arm National Park would likely be beneficial to the environment, but was considered because of the changes to the natural and socio-economic environment which it may induce.

Table 10.8 scopes the major pathways in which each of the reasonably foreseeable future projects may lead to cumulative effects with the Taltson Expansion Project, and provides a summary of the validity of the pathways.

Table 10.8 — Pathways from Reasonably Foreseeable Future Projects

Project	PATHWAYS				
	Loss of caribou habitat and changes to caribou abundance and distribution	Changes to hydrology within the Taltson River	Improvements to access within the Taltson watershed, leading to changes in land use patterns	Changes to water quality within the Taltson watershed	Changes to the socio-economic environment in the South Slave Region and Yellowknife
Effects from Taltson Project	The Taltson Project overlaps with the Bathurst caribou herd during all their seasonal ranges.	The Taltson Project would affect hydrology within the Taltson River.	Without mitigation, the Taltson Project may improve access in the South Slave Taltson watershed region	The Taltson Project may affect water quality in the Taltson River	The Taltson Project is expected to provide income and employment for the South Slave region, and may reduce the amount of transportation to the Diamond mines through Yellowknife
Peregrine Diamonds Ltd. WO Property	Valid Pathway The Peregrine Diamonds property is located within the spring and post-calving ranges of the Bathurst caribou herd	Invalid Pathway Peregrine's WO property is in a different watershed.	Invalid Pathway Peregrine's WO property would not influence access in the South Slave region.	Invalid Pathway Peregrine's WO property is located within a different watershed system.	Valid Pathway Peregrine's WO property could affect the socio-economic environment of Yellowknife
Tyhee NWT Corp Yellowknife Gold Project	Valid Pathway The Yellowknife Gold Project is located within the Bathurst caribou winter range	Invalid Pathway Tyhee's proposed project is in a different watershed.	Invalid Pathway Tyhee's proposed project would not influence access in the South Slave region.	Invalid Pathway Tyhee's proposed project is located within a different watershed system.	Valid Pathway Could affect the socio-economic environment of Yellowknife
BIPR Project	Valid Pathway The BIPR project is located within the spring and post-calving ranges of the Bathurst caribou herd	Invalid Pathway The BIPR project is in a different watershed.	Invalid Pathway The BIPR project would not directly influence access in the South Slave region.	Invalid Pathway The BIPR project is located within a different watershed system	Valid Pathway Could affect the socio-economic environment of Yellowknife

Project	PATHWAYS				
	Loss of caribou habitat and changes to caribou abundance and distribution	Changes to hydrology within the Taltson River	Improvements to access within the Taltson watershed, leading to changes in land use patterns	Changes to water quality within the Taltson watershed	Changes to the socio-economic environment in the South Slave Region and Yellowknife
Proposed East Arm National Park	Valid Pathway The proposed park lies within the Bathurst caribou range, particularly the winter range.	Invalid Pathway The proposed park would not contribute to changes in the hydrology, and is not within the Taltson watershed.	Invalid Pathway The proposed park would not create increased access within the Taltson Watershed.	Invalid Pathway The proposed park would not affect water quality, and is not within the Taltson watershed	Valid Pathway The proposed park may affect tourism and change resource development in the South Slave and North Slave regions

10.11 MONITORING

In the DAR, proposed monitoring programs would be identified based on the effects predictions and environmental design features. The focus would be on measurement endpoints for VCs. In general, monitoring would be used to test effects predictions and determine the effectiveness of environmental design features. Monitoring would be used also to identify unanticipated effects. To meet the Terms of Reference, each KLOI and SON would distinguish between the following types of monitoring that may be applied during the development of the Project:

- Compliance inspection: monitoring the activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval and company commitments.
- Environmental monitoring: monitoring to track conditions or issues during the development lifespan, and subsequent adaptation of Project management.
- Follow-up: programs designed to verify the accuracy of effect predictions, to reduce uncertainty, and to determine the effectiveness of mitigation.

These programs would form part of the environmental management system (EMS) for the Project. If monitoring or follow-up detects effects beyond those predicted, unanticipated effects, or the need for improved or modified design features, then adaptive management would be implemented. This may include increased monitoring, changes in monitoring plans, or additional mitigation.