# WUSKWATIM GENERATION PROJECT

# ENVIRONMENTAL IMPACT STATEMENT

**Manitoba Hydro**
**and**
**Nisichawayasihk Cree Nation**

**April 2003**

**Volume 10**

**Cumulative Effects Assessment: Framework**

Nisichawayasihk Cree Nation

Manitoba Hydro

Available in accessible formats upon request.

# PREFACE

Volume 10 (Cumulative Effects Assessment: Framework) is one of a series of supporting technical volumes for Manitoba Hydro's and Nisichawayasihk Cree Nation's (NCN) application for environmental licensing of the Wuskwatim Generation Project (the Project) which is entitled Wuskwatim Generation Project Environmental Impact Statement, Volume 1 (April 2003). Volume 10 has been prepared by independent discipline specialists who are members of the environmental study team retained to assist in the environmental assessment of the proposed Project and provides a framework for the cumulative effects assessment for the Project. The supporting volumes have contributed to the preparation of the summary Environmental Impact Statement (Volume 1) and also provide additional technical and professional supporting information to assist in the technical review of the EIS. The supporting documents have been reviewed by Manitoba Hydro and NCN and are technically consistent with the EIS. They have not been edited for consistency in format, style, or wording with either the Summary EIS (Volume 1) or other supporting volumes.

The Wuskwatim Generation Project EIS is comprised of the following:

- Volume 1 – Wuskwatim Generation Project: Environmental Impact Statement
- Volume 2 – Public Consultation and Involvement
- Volume 3 – Project Description and Evaluation of Alternatives
- Volume 4 – Physical Environment
- Volume 5 – Aquatic Environment
- Volume 6 – Terrestrial Environment
- Volume 7 – Resource Use
- Volume 8 – Socio-Economic Environment
- Volume 9 – Heritage Resources
- Volume 10 – Cumulative Effects Assessment: Framework

Volume 10 was prepared by North/South Consultants Inc. with the assistance of Manitoba Hydro (description of future hydroelectric generation development) and Plus4 Consulting Inc. (forestry).

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# 1.0 INTRODUCTION

Cumulative Effects Assessment (CEA) is required under the Federal *Canadian Environmental Assessment Act* (CEAA) that came into force in 1995. Section 16 of the CEAA states that every screening or comprehensive study of a project and every mediation or assessment by a review panel shall include consideration of the following:

*(A) the environmental effects of the project, including...any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out; and,*

*(B) the significance of the effects referred to in paragraph (A).*

The following sections outline the general approach to spatial and temporal scoping, and the list of actions (i.e., developments and activities) to be considered within the CEA for the Wuskwatim Generation Project (the Project). However, because the precise selection of appropriate spatial and temporal boundaries is dependent upon the **Valued Ecosystem Component** (VEC) under consideration, VEC-specific details are provided within each of the relevant sections of the Environmental Impact Statement (EIS).

A secondary purpose of this document is to describe the process of scoping for CEA, including assumptions, uncertainties, and discussion of the rationale for inclusion and exclusion of certain activities.

*It should be noted that this document focuses on the approach to cumulative effects taken for the biophysical component of the Environmental Impact Statement. Information on the approach taken for the socio-economic CEA is provided in Volume 1 and Volume 8.*

## 1.1 EIS GUIDELINES FOR CEA FOR THE WUSKWATIM PROJECT

The Guidelines for the Preparation of an Environmental Impact Statement for the Project (April 29 2002), indicate that:

*Cumulative effects assessment (CEA) shall form an integral part of the environmental and socio-economic assessment. The cumulative effects assessment shall look at all effects that are likely to result from the project when they are anticipated to occur in combination with other projects or activities that have been, or will be carried out. The environmental impact statement shall explain the approach and methods used to identify* *and assess the cumulative effects and provide a record of all assumptions and analysis that support the conclusions, including the level of confidence in the data used in the analysis.*

## 1.2 DEFINITION OF CEA

Cumulative effects assessment is defined in the Cumulative Effects Practitioner's Guide (Hegmann et al. 1999) as:

*Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions.*

*"Actions" are defined as "projects and activities".*

The Cumulative Effects Working Group (CEWG), which was established to provide guidance for the conduct of CEA in Canada, has recently provided additional guidance regarding the ultimate goal of CEA:

*Keep in mind that an assessment of a single project (which is what almost all assessments do) must determine if that project is incrementally responsible for adversely affecting a VEC beyond an acceptable point (by whatever definition). Therefore, although the total cumulative effect on a VEC due to many actions must be identified, the CEA must also make clear to what degree the project under review is alone contributing to that total effect. Regulatory reviewers may consider both of these contributions in their deliberation on the project application (Hegmann et al. 1999).*

Ultimately, the inclusion of CEA in the environmental assessment process works towards the goal of maintaining ecological integrity into the future. Thus, the spirit of CEA embodies the concept and ideology of sustainability and sustainable development.

# 2.0 METHODOLOGY FOR DEVELOPING AN APPROACH AND SCOPE FOR THE WUSKWATIM GENERATION PROJECT CEA

## 2.1 CEA FRAMEWORK

The CEAA Practitioners Guide (Hegmann et al. 1999) suggests the application of a five-step framework for CEA:

(1) Scoping;
(2) Analysis of Effects;
(3) Identification of Mitigation;
(4) Evaluation of Significance; and
(5) Follow-up.

The first step, scoping, is comprised of five general components, which are the focus of the discussion that follows (Griffiths et al. 1998):

(1) Issues identification;
(2) Valued Ecosystem Component selection;
(3) Spatial bounding;
(4) Temporal bounding; and
(5) Identification of included projects;

Although each component is somewhat discrete, all five components are inter-related and require an iterative approach. Furthermore, scoping activities require that each component be considered concomitantly.

## 2.2 PHASED APPROACH TO SCOPING

Scoping for the CEA was carried out through a phased approach, involving a combination of workshops with NCN and Manitoba Hydro, literature reviews, and input from an external expert for CEA, (Dr. P. Duinker, Dalhousie University). Background documents were distributed prior to the workshops and discussions at the workshops were recorded in proceedings documents for future internal use. The background document for the first CEA workshop was updated for the second workshop; the updated background document is provided in Appendix 1.

### 2.2.1 Phase 1: Development of General Approach

Initial scoping (temporal and spatial) exercises, the identification of potential included projects (i.e., assembly of a project inclusion list), preliminary identification of potential cumulative effects issues, and discussion of a general approach to CEA for the Project was undertaken through a Cumulative Effects Assessment Workshop held in Winnipeg on July 25, 2000, attended by representatives of NCN, Manitoba Hydro, and the Environmental Management Team (EMT), and Dr. P. Duinker. The overall scope of the CEA, as determined at the 2000 workshop was described as follows:

*The CEA will focus on VECs, but the assessment will incorporate a holistic view of the environment (i.e., consider all aspects of the environment relevant to assessing effects on that VEC). A CEA for a given VEC is not required if the Project will not cause a measurable impact on that VEC;*

*The focus of the CEA will be the future environment with and without the Project. Past and existing developments are important to the extent that they have changed or continue to change the existing environment. The future environment will be considered with existing developments (to the extent that they continue to affect the environment), in conjunction with other potential future developments and the proposed Project;*

The time scale for the CEA depends on the activity. For hydroelectric developments such as the Wuskwatim Generation Project, a 60 to 100 year overall time scale is appropriate but effects to specific VECs could be considered on several, shorter time scales (Section 3.3).

The spatial scale of the CEA is defined by the spatial extent of Project-related effects. This scale would vary among effects of the Project as well as VECs (Section 3.1).

Activities that should be considered for inclusion in the CEA include major developments such as forestry, mining, and hydroelectric development, as well as activities such as domestic and recreational resource use, outfitting, and eco-tourism (see below and Section 3.4).

### 2.2.2 Phase 2: Development of a List of Included Activities

Following additional collection and analysis of baseline data for the Project, a second CEA Workshop was convened on March 13, 2002 in Winnipeg, MB, also attended by representatives of NCN, Manitoba Hydro, the EMT, and Dr. P. Duinker. The main focus of the second workshop was to refine initial scoping exercises and, specifically, compile a list of other activities to be included in the CEA.

A wide range of actions was considered at the 2002 workshop for potential inclusion in the CEA. In determining the list of actions that was ultimately included, the goal of conducting a CEA that represents the "most likely" future scenario needed to be balanced against practical considerations, such as the availability of specific information for the potential developments. Developments that may occur in the future for which there is insufficient information related to key characteristics, such as location, were not included (e.g., mineral exploration is occurring in the area, but no location has been proposed for a mine). In identifying future projects to be included in the CEA, the following should be noted:

- at minimum, otherwise eligible projects or activities that have already approved must be taken into account;
- it would be prudent also to consider otherwise eligible projects or activities that are already in a government approvals process;
- other eligible projects or activities not subject to a formal government approvals process should be included if there is a high level of certainty that they will occur; and
- the environmental effects of uncertain or hypothetical projects need not be considered.

# 3.0 GENERAL SCOPING

The following sections provide a general approach applied for the CEA and document the scoping rationale applied to the CEA. In general, the CEA focused on measurable effects of the Project, in combination with effects from other projects or activities (i.e., actions) that overlap in space and time with the Project-specific effects, on VECs. A VEC-centric approach was used for the purposes of issues identification and spatial and temporal scoping.

More restrictive/specific scoping for specific VECs and associated issues was conducted concomitant with the EIS for the Project, in accordance with the identification of impacts that were anticipated to be measurable and with the potential to interact in a cumulative manner with other activities (i.e., a detectable Project-specific impact that overlaps spatially and temporally with effects of another activity). Thus, the following discussion refers only to broader scoping; specific information for each VEC is found in the relevant section of the EIS.

## 3.1 ISSUES AND VEC IDENTIFICATION

The approach to VEC selection is described in Volume 1, with information provided on specific VECs in the appropriate supporting volumes. A cumulative effects assessment was conducted for all VECs for the spatial or temporal scale where measurable effects were expected, as well as for environmental components that could have a measurable effect on a VEC (e.g., erosion).

## 3.2 GENERAL SPATIAL SCOPING

The first phase of spatial scoping involved determining the overlap between the VEC population and Project-induced changes in the environment. Physical effects of the Project are largely limited to the immediate Project area (i.e., access road, borrow areas, footprint of the generating station, Wuskwatim Lake, and the Burntwood River downstream to, and including, Opegano Lake). Once spatial overlap had been established, the actual geographic scale of the assessment varied, depending on the VEC in question. For example, the assessment for species with large home ranges that overlapped with Project-induced changes was based on the entire home range. Smaller spatial scales were also included, as it was also thought that in some instances, the central issue/impact(s) may be overwhelmed when placed in a larger context. The CEA then considered the potential effects of other actions within this geographic area.

## 3.3 GENERAL TEMPORAL SCOPING

As with the spatial scoping, the initial phase involved determining the temporal overlap between the VEC and Project-induced effects. Once the duration of the overlap had been established, the CEA evaluated conditions in the future, typically on more than one time scale. It should be noted that the time scales varied among disciplines as in some instances the level of uncertainty for long-term events precluded analysis.

The following general temporal periods were considered:

(1) Project Construction Period

The construction period was considered, as disturbances for many components of the environment occur during this period. This period was bounded by the beginning of construction to one year following commissioning, when the site clean-up has been completed.

(2) Environmental Transitional Period

This time period was chosen to be representative of the period in which environmental effects of the operation of the Project are in a state of change and in which effects are generally anticipated to be greatest and measurable. This was practically defined as 15-25 years post-construction. A range of dates is indicated here to account for differences in the temporal boundaries for different VECs. A 'worst-case-scenario' approach was adopted in which the cumulative effects of the Project and reasonably foreseeable developments coincided.

(3) Project Life Span Period

This period represents the longest temporal scale under consideration and reflects the life span of the Project. This is practically defined as 100 years post-construction. This scenario included the most potential developments as well as climate change, and thus presented a range of potential conditions.

It should be noted that cumulative effects assessments for future projects are often limited by a lack of detailed knowledge on both the projects and the potential effects of those projects. Cumulative effects assessments are, therefore, based on best available information and professional judgment in regards to what is known about the project and the potential effects of the projects at that point in time.

## 3.4 ACTIONS CONSIDERED FOR INCLUSION IN THE CEA

The following section lists the actions (i.e., projects and activities) that were considered for inclusion in the CEA for each of the disciplines. The set of included actions varied among disciplines, depending on whether the spatial and temporal scale of effects related to the actions overlapped with those of the Project. It should be noted that effects of past and existing developments were incorporated into the pre-Project baseline. In some instances, where on-going effects of these developments were expected to result in measurably different conditions in the future than at present, they were considered in the CEA. In most instances, this was not the case. In scoping the list of included actions for individual disciplines, some of the actions described below were not included, as there was too much uncertainty (either due to the hypothetical nature of the development or lack of information on future effects of existing developments) to support a CEA.

In dealing with uncertain developments or activities, it is important to note that any such project would typically be subject to its own regulatory review and approvals. Issues related to the cumulative effects of such new developments in combination with the Project can therefore be best and most properly assessed when and if new government approvals are sought for such projects.

### 3.4.1 Hydroelectric Development and Transmission Facilities

Churchill River Diversion

The current operation of CRD is described in Volumes 3 and 4. CRD is expected to continue to operate as it does today under current rules and regulations. In the long term, CRD inflow conditions are expected to be higher than the observed historic CRD inflows; this long-term change was incorporated into the assessment of the post-Project environment.

Transmission Facilities (existing)

The effects of existing transmission facilities were included in the existing environment baseline. No significant changes to the existing system are currently planned.

Kelsey Upgrade

A maintenance project involving an upgrade is planned for the Kelsey Generating Station on the Nelson River near the inlet to Split Lake. This generating station is well outside the biophysical zone of influence of the Project.

## Wuskwatim Transmission Project

The Project would require the construction of a new transmission line (with three segments), portions of which lie within the Nelson House RMA. One corridor extends eastward to Thompson (includes the development of the Birchtree Switching Station) while the other corridor lies in a southerly direction, eventually connecting to Herblet Lake (Figure 3-1). The line extends beyond Herblet Lake to the Rall's Island Station at The Pas. In addition, a Transmission Station, followed by a Switching Station, will be constructed at the Wuskwatim Generating Station site. The site selection process and routing of these facilities, as well as the environmental impacts, are described in the Wuskwatim Transmission Project EIS.

## Future Hydroelectric Generation and Transmission Facilities

Although there are no developments within the immediate Wuskwatim area under consideration within the 25 year time frame following the Wuskwatim 2009 ISD, there are three other hydroelectric generating stations in the northern region that may be considered for construction within this period. These stations are:

- the Gull (Keeyask) Generating Station on the Nelson River between Split Lake and Stephens Lake;
- the Notigi Generating Station on the Burntwood River at the site of the existing Notigi Control Structure; and
- the Conawapa Generating Station on the Nelson River downstream of the existing Limestone Station.

The Bipole III HVDC transmission facility, which would be developed along the eastern side of Lake Winnipeg, is also being considered.

All of these projects are well outside of the biophysical zone of influence of the Wuskwatim Generation Project.

Within the Project area, various studies have been undertaken to identify the possible hydroelectric development options and combinations of options that could be developed along the Burntwood River. The location of one set of the potential options is shown in Figure 3-2.

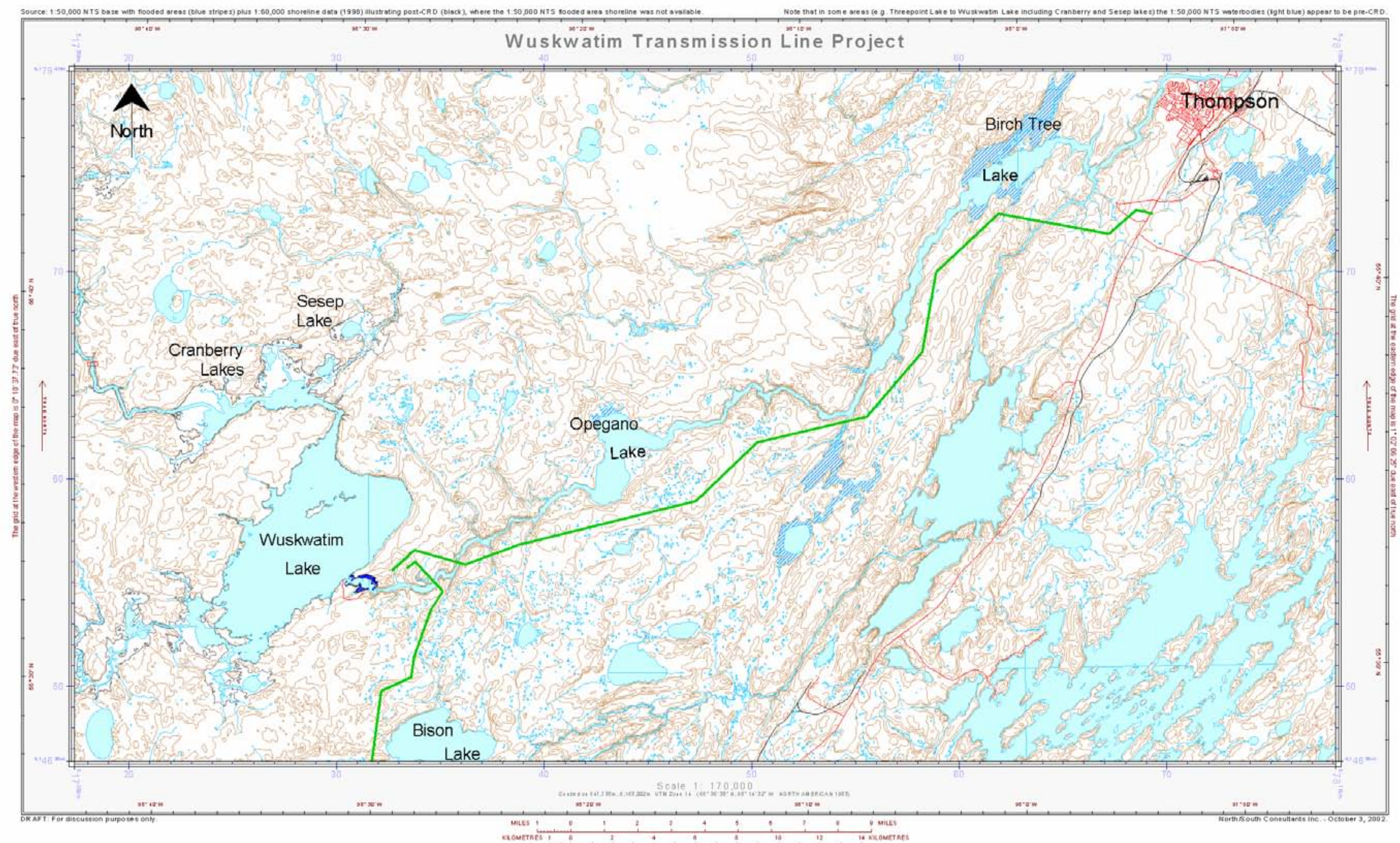


Figure 3-1. Location of proposed transmission corridors in the Wuskwatim region.

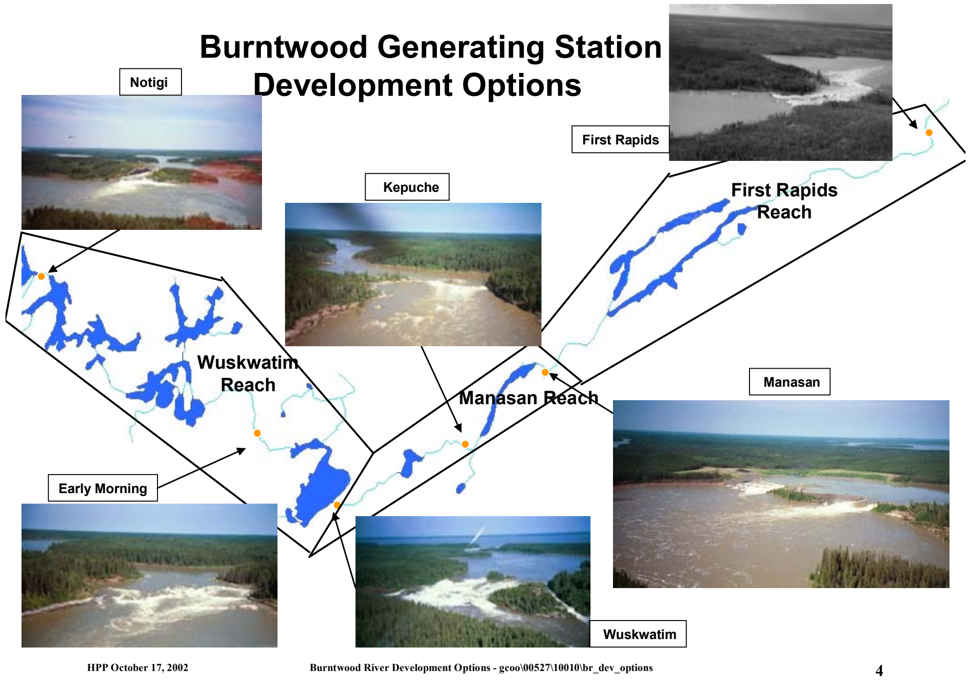


Figure 3-2. Burntwood River generating station development options.

There are currently no known plans to develop any of these projects within the next 10 to 20 years, nor applications or plans for applications for government approvals. The timeline for the next generating station in the immediate area of the Project could be in the 25 to 100 year horizon following development of the Wuskwatim Generation Project. A wide range of options is available at each site and the final developments will most likely go through a process where consideration is given to economics and the social and environmental issues of the day.

### 3.4.2 Commercial Forestry

Past and Present Timber Harvest Activities in the Wuskwatim Region

The FMLA #2 Forest Management Plan (FMP) (1997 – 2009), prepared by Repap Manitoba (1996: Repap Manitoba is now Tolko Industries), indicates areas of potential forest harvest and renewal activities within FMUs 66, 83, 84, 85, 87 & 89 that form part of the Wuskwatim study region (Volume 7). Although large operating areas have been identified in the FMP, these generally indicate areas of mature timber and opportunity for potential harvest. Specific harvest areas are identified in Tolko's Annual Harvest and Renewal Plans, the current version (2003) identifying areas to 2005.

Deviations have occurred from indicated plans in the FMP due to unforeseen circumstances that include changing economic conditions and projections, change in FMLA #2 license holders with different objectives, stakeholder objections, Treaty Land Entitlement negotiations and the nominations of lands under Manitoba's Protected Areas Initiative. A case in point is the Partridge Crop Hill Area[1] of Special Interest (ASI) (Figure 3-3) west of Wuskwatim Lake, which is under review for protected area status (Creed 2001). Reductions in timber volumes extractable from specific operating areas influence decisions to construct seasonal versus all-weather roads, which ultimately affect the degree of environmental disturbance.

Timber harvesting operations have been ongoing within the Wuskwatim region for approximately 25 to 30 years. The bulk of these operations have and continue to occur east of PTH #6 although a few harvest blocks have also been recently cut in the Wapisu and Suwannee Lakes areas by Nelson House Forest Industries under contract to Tolko Industries Ltd. (Volume 7).

Proposed operations up to and including 2005 continue to focus on areas east of PTH #6 but also include areas west of the highway, but east of the Taylor River, and at Suwannee and Apeganau Lakes (Volume 7). Projections to 2005 indicate a 52% increase in harvesting in the Wuskwatim region whereas the broader area will see a 13% decrease (Tolko 2002).

## Projections for Future Forestry Activity in the Wuskwatim Region

As discussed above, a variety of events have occurred which resulted in the projected harvests in the FMP not proceeding as originally projected. To provide the basis for the CEA for the Wuskwatim Generation Project, two potential scenarios were developed:

- Scenario 1: Partridge Crop Hill ASI is designated a protected area; and
- Scenario 2: Partridge Crop Hill ASI is not designated a protected area.

Forestry activities are considered for three different time frames for each scenario: 2005 to 2014; 2014 – 2034; and 2034 – 2109.

[1] Partridge Crop Hill is of spiritual and cultural interest to NCN. NCN has indicated that it would object to forestry operations in this area.

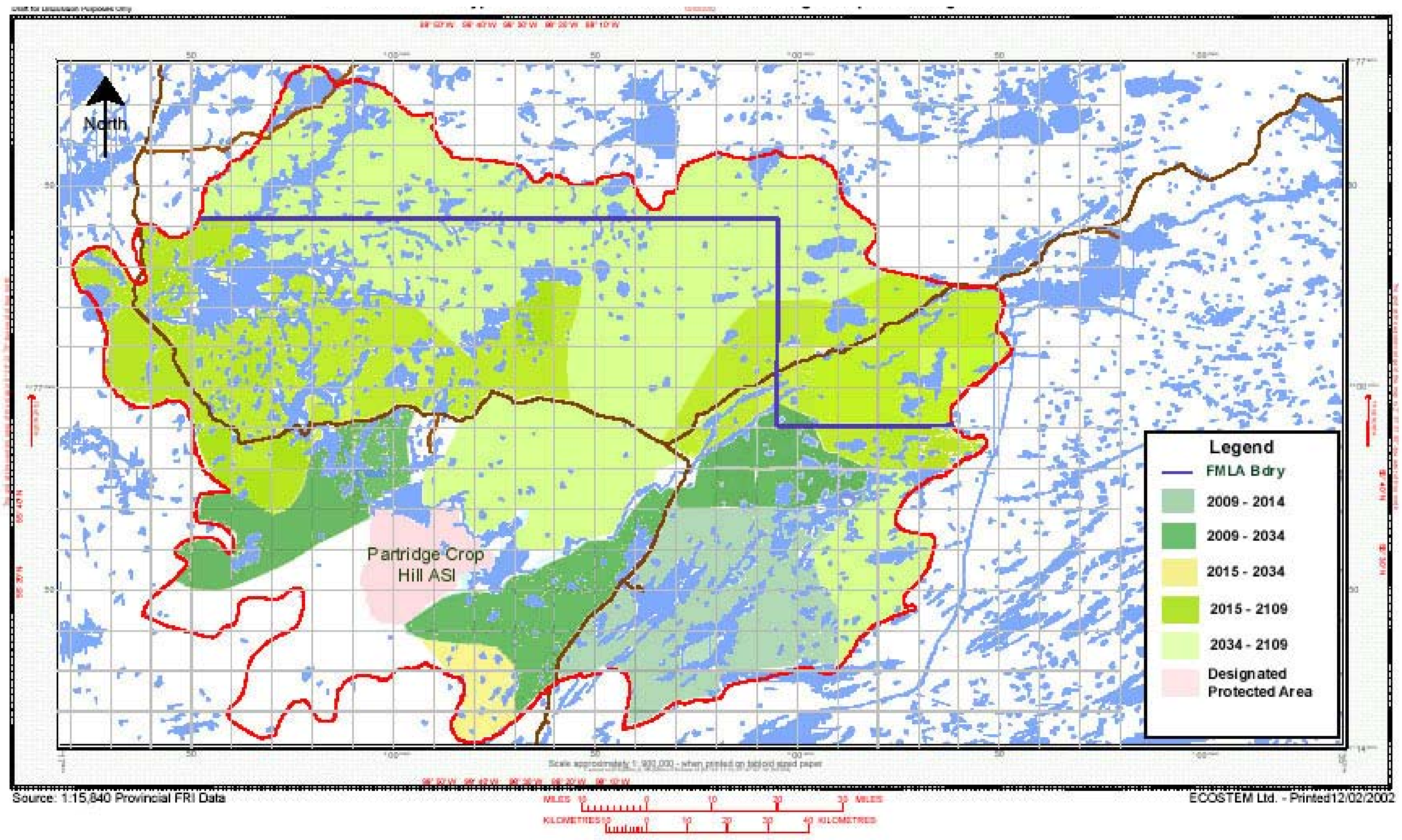


Figure 3-3. Scenario 1: Possible timber harvest with Partridge Crop Hill ASI designated as a protected area.

Near-term forestry activity projections will have a higher probability of being realistic than medium and long range projections. Major variables that could affect the scenarios include the following:

- climate change (Section 3.4.6);
- wildfire (currently the dominant influence on forestry and projected to be significantly greater under predicted climate change conditions);
- periodic fluctuations in allowable harvest levels (i.e., Annual Allowable Cut or AAC);
- technology developments in how the wood fibre resource is harvested and transported;
- demand for the wood fibre resource;
- economic conditions;
- population growth and distribution in and around the study area, nationally and globally; and
- societal value placed on protecting the natural environment.

Forestry projections were based on past and existing trends of operations and on Forest Resource Inventory data. General projections for harvest were made maintaining current rotation ages for forest stands and excluding the influence of wildfire. The Tolko 1997 to 2009 FMP was also consulted to determine company projections made in 1996 (Repap 1996). Draft projections were then discussed with Tolko (D. Hunt, Logging Superintendent; D. Aikman, Nelson River Forest Section Planning Forester) and Manitoba Conservation (B. Holmes, Regional Forester, Thompson) to obtain expert opinion into future short- and long-term forestry activities within the Wuskwatim region.

Harvest levels for 2005 to 2009 are expected to remain similar to the projections to 2005 discussed above. However, interest would shift to areas south and southwest of Wuskwatim Lake should the Partridge Crop Hill area not be designated a protected area.

Long-term forestry activities based on scenarios 1 and 2 (as described above) are as follows:

*Scenario 1: Partridge Crop Hill ASI is designated a protected area (Figure 3-3).*

This scenario seems highly likely (Holmes 2002 pers. comm.) as designation of this ASI as a protected area could be achieved within the next few years. Under this scenario the following effects are envisioned:

**2005 - 2014**

- reduced AAC (approximately 20% in the short term for the region) with harvest in region continuing at 2005 levels;
- focus on areas west of Nelson House, between PTH #6 and the Burntwood River, and east of PTH #6; and
- minimal road construction (winter roads only).

**2014 – 2034**

- increased level of harvest (75 – 85 % of softwood AAC and 60 – 70 % of hardwood AAC);
- focus on areas south and east of Wuskwatim Lake and between PTH #6 and the Burntwood River, as well as east of Thompson, west of Nelson House/Threepoint Lake, and north of PR 391; and
- primarily winter roads, with the possibility of access across the Wuskwatim Generating Station to the south side of the Burntwood River (use of this as access depends on the conditions that will be outlined in the Access Management Plan (Volume 3)).

**2034 – 2109**

- further increase in level of harvest (95 % of softwood AAC and 85 % of hardwood AAC);
- focus on areas north of PR 391, and south of PR 391 between Nelson House and Thompson, as well as east and northeast of Thompson; and
- all weather roads (considering poor frost conditions due to climate change) with supplementary winter roads.

*Scenario 2: Partridge Crop Hill ASI is not designated a protected area (Figure 3-4).*

This seems less likely than scenario 1 (Holmes 2002 pers. comm.). Under this scenario the following may occur:

**2005 - 2014**

- harvest remains constant in the short-term after which harvest levels increase (50% of softwood AAC and 5 % of hardwood AAC);

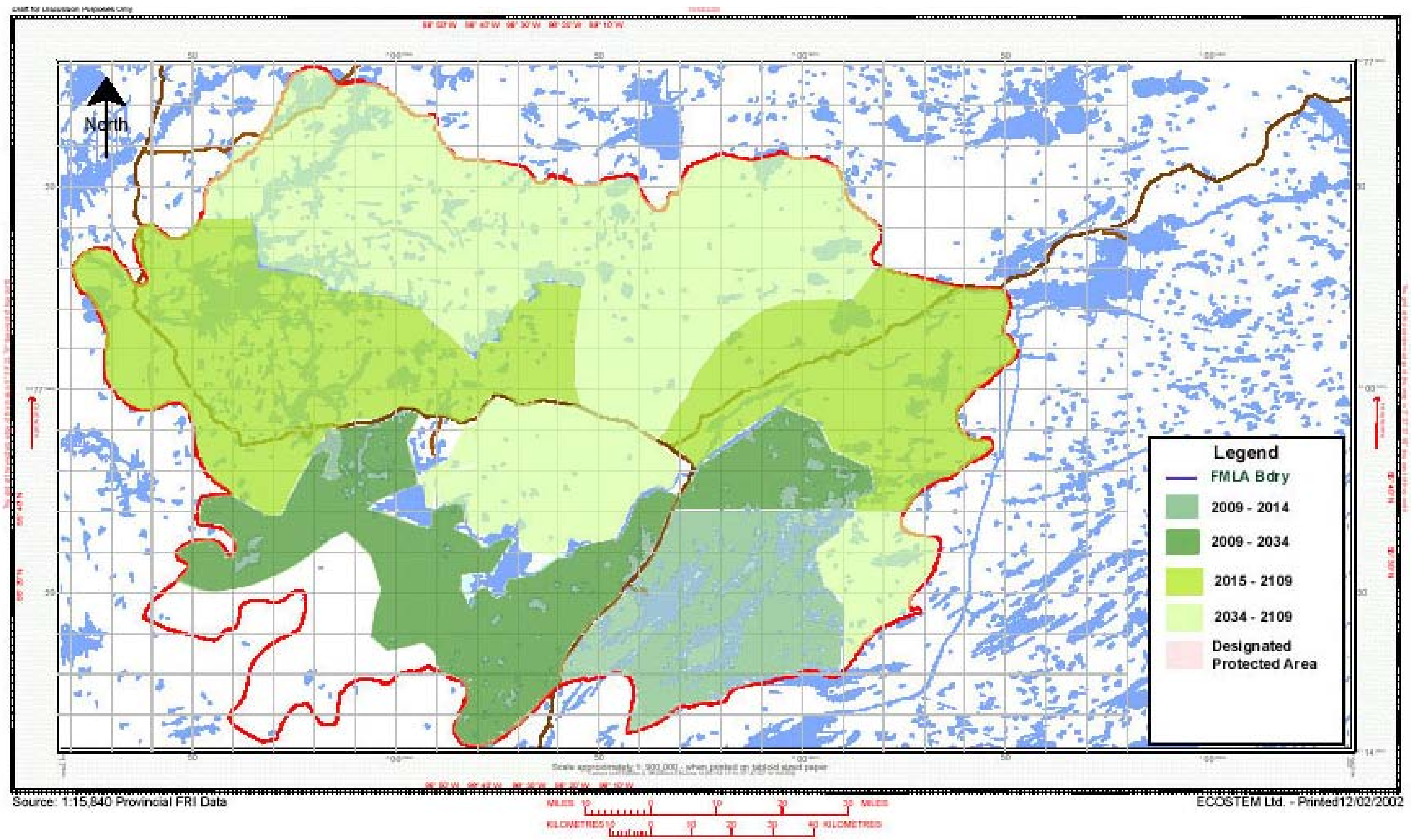


Figure 3-4. Scenario 2: Possible timber harvest with Partridge Crop Hill ASI not designated as a protected area.

- harvest west of Nelson House to Wapisu Lake south of PR 391 and between PTH #6 and the Burntwood River (including Partridge Crop Hill), as well as east of PTH #6 and Thompson; and
- an all-weather road into Partridge Crop Hill possibly supplemented by a winter road from the south, as well as off of the main road.

**2014 – 2034**

- increased level of harvest (75 – 85 % of softwood AAC and 60 – 70 % of hardwood AAC);
- focus on Partridge Crop Hill and area south and east of Wuskwatim Lake and between PTH #6 and the Burntwood River, as well as areas east and northeast of Thompson and west, northwest and north of Nelson House/Threepoint Lake; and
- roads as described above.

**2034 – 2109**

- further increase in level of harvest (95 % of softwood AAC and 85 % of hardwood AAC);
- focus on area north of PR 391, west and northwest of Wapisu Lake, and south of PR 391 between Nelson House and Thompson; and
- all weather (considering poor frost conditions due to climate change) supplemented by winter roads.

Overall, under both scenarios, harvest levels are expected to increase within the Wuskwatim region in the medium term and long term. The near term is dependant on whether or not Partridge Crop Hill receives protected area status and the logistics of accessing timber in the general area. Long-term increases are driven by global demand and more efficient harvesting and manufacturing technologies. Regional extraction areas are governed primarily by timber maturity and economic feasibility.

Although timber harvest volumes will increase over time along with associated harvest areas, impacts from forestry activities are relatively short term as forest renewal activities are initiated immediately following harvest. Roads that are no longer needed are retired and rehabilitated, thereby reducing access.

### 3.4.3 Commercial Mining and Smelting

Ruttan Mine: Hudson Bay Mining and Smelting Company

The Ruttan Mine was a base metal mine located in Leaf Rapids, MB, which discharged effluents into the Churchill River, upstream of Southern Indian Lake. Effects of the mine on water quality were not expected to be detectable in the Wuskwatim area and there was no potential for other overlap with other biophysical effects of the Wuskwatim Generation Project. The mine was closed in mid 2002. Any persistent effects of the project on water quality (e.g., from tailings piles) were not considered to be of significance.

Birchtree Mine: INCO Ltd.

The Birchtree Mine is a nickel mine located southwest of the City of Thompson which began production in 1966 through 1977, returning to production in 1989. A deepening of the mine is currently underway, resulting in an increase in ore production from 1,635 tonnes/day to 3,175 tonnes/day by 2004. The deepening is expected to increase the life span of the mine by at least 15 years (up to 2016). Ore is processed at the Thompson smelter and electrolytic nickel refinery. Mine dewatering water is discharged into the lower Burntwood River downstream of Birch Tree Lake but upstream of the City of Thompson, well downstream of the proposed Project.

Thompson Mine, Mill, Smelter, and Refinery: INCO Ltd.

The Thompson Mine is a nickel, copper, and cobalt oxide mine located in Thompson, MB. Water from these facilities is discharged into the Burntwood River, downstream of the proposed Project.

The INCO Limited, Thompson Division, operation is an integrated mining, milling, smelting and refinery complex. The facilities first reached full production in 1961, at which time they operated with few regulatory controls. In accordance with the introduction of industrial atmospheric discharge regulations in 1969 in the Manitoba Clean Environment Act, INCO was granted a license to discharge atmospheric contaminants in 1970. An Environment Act License was granted in 1988 to INCO Thompson, regulating the releases of sulphur dioxide ($SO_2$) and particulate matter from the smelter.

Nickel concentrate produced at the Voisey's Bay nickel project in Labrador will initially be shipped to INCO operations in Ontario and Manitoba (Thompson) for processing into a finished nickel product while Voisey's Bay Nickel Company's commercial processing facility is developed (VBNC 2002). Concentrate production is anticipated to begin in 2006, at which time processing of the concentrate will commence at the INCO Thompson (and Sudbury) smelter and refinery complex. Processing of the concentrate at Thompson, Manitoba and Sudbury, Ontario facilities will cease in 2011.

The following is a summary of a synthesis of information pertaining to historical studies of emissions and the effects of the emissions data that were prepared to support the Cumulative Effects Assessment for the Wuskwatim Generation Project (North/South Consultants unpublished report).

*The INCO Thompson Environmental Program*

Qualitative and quantitative studies describing existing environmental damage to vegetation and soils, and to a lesser degree to the aquatic environment and terrestrial mammals, in relation to atmospheric discharges of metals, sulfur dioxide, and other particulates from the INCO Thompson smelter were undertaken over a five-year period from 1976 to 1980. Details of this study are reported in Phillips and Slaney (1981). The study area encompassed an 80 km radius around the smelter in Thompson.

In general, the results of the study indicated that there was no evidence for *"serious widespread environmental impacts…although localized adverse effects on specific receptors are documented."* The prevailing winds in the region are west to northwest in summer (June-August), fall (September-November), and winter (December-February). Wind direction is predominantly from the northeast in spring (March-April). The primary dispersion sector, receiving stack emissions, is located southeast of the smelter and the secondary dispersion sector is in the southwest/west direction.

Emissions at the time of the study were comprised of sulfur dioxide and particulates (i.e., dust); flue dust was comprised of, in order of decreasing percentage: iron, nickel, aluminum, copper, zinc, lead, chromium, cobalt, manganese, and cadmium. Silicon, arsenic, calcium, and selenium were also present in the emissions.

The Wuskwatim study area falls within the secondary dispersion sector for the Thompson INCO smelter, with periods of high deposition occurring in the spring season (in accordance with prevailing winds in the region). General conclusions of the INCO Environmental Program regarding accumulation of metals in soils in the vicinity of Thompson indicated that contamination from smelter emissions occurred to approximately 25 km in the primary dispersion sector (i.e., southeast of the smelter).

Data obtained at study sites within the Wuskwatim study area also indicate that effects of the smelter on nickel in soils may extend as far west as Opegano Lake and as far northwest as the site on PR 391 located 26 km from Thompson. Soil pH was not related to the distance from the smelter, thus providing no indication that sulfur dioxide emissions had acidified the soils at the time of this study.

It was concluded at the time of the submission of the Thompson Environmental Program study in 1980 (Phillips and Slaney 1981), that air dispersion patterns would remain largely unchanged into the future and, subsequently, that continued smelter emissions could potentially cause increased concentrations of metals within 20 to 25 km radius of the smelter. The study further noted that *"the concentration of heavy metals in the LFH soil horizons will increase in the future as more smelter emissions impinge on the study area."*

A 'worst-case-emission' scenario for 15 years following the completion of the Thompson Environmental Program was evaluated to estimate potential cumulative effects of the smelter emissions on ambient metal concentrations. The overall incremental increase in the distance from the smelter that would experience elevated nickel concentrations was expected to be relatively small. Notable increases in soil nickel concentrations were anticipated near the smelter but the 100 μg/g isopleth was not projected to extend noticeably in the westerly direction.

Recent and on-going monitoring of effects of the INCO Thompson smelter emissions on the receiving environment has been, and continues to be, conducted by Manitoba Conservation. There are a total of 16 active monitoring sites maintained by Manitoba Conservation; however, these sites are not located in the Wuskwatim area. These sites were sampled in 1997 and 2002; a report is tentatively scheduled for completion in 2003, pending completion of analyses (Jones 2002 pers. comm.).

#### Mining Exploration/Future Mines

No new mines are currently planned for the area; on-going mineral exploration is assumed to continue at current levels and is incorporated in the present-day baseline.

### 3.4.4 Roads and Trails

#### PR 391

The presence of PR 391 is incorporated into the existing environment baseline. No major alterations or new highways area currently planned.

#### Exploration Trails/Cut Lines

Existing trails are incorporated into the existing environment baseline. It is assumed that the creation of new trails will be balanced by vegetation regeneration on old ones (though regenerated areas may not be identical to the original vegetation).

### 3.4.5 NCN Activities and Other Publics

The majority of activities in the Nelson House Resource Management Area will be conducted by NCN. It should be noted, however, that the general public also might have future activities (e.g., cabins) in the area.

#### Population Growth and Development in Nelson House

The community is expected to grow from the 2000 population level of approximately 2,300 individuals to between 3,000 and 3,700 residents by 2011 (Volume 8). Predictions beyond 2011 are highly uncertain; however, the rate of population growth is currently declining and it is expected that this trend will continue. The maximum future population of Nelson House is not possible to predict, as it depends not only on birth rates, but also on in and out migration.

#### Increased Number of Cabins in the Wuskwatim Area

Construction of an all weather access road to Wuskwatim Lake will increase access to the area, and related resource harvesting activities. These are considered within the impact assessment for fish (Volume 5), waterfowl (Volume 6), and mammals (Volume 6) as well as domestic and commercial resource harvesting (Volume 7). Experience in other areas that can be readily accessed from Nelson House by either road (e.g., PR 391) or boat (e.g., Threepoint Lake) indicates that more cabins are generally constructed in these areas than more remote regions. The Nelson House Resource Management Board, with representation from both NCN and Manitoba Conservation, is currently considering an approach to the management of cabin construction. As these cabins are constructed for traditional purposes, the permitting process for recreational cabins does not apply and individuals are able to construct cabins at any location. There are currently approximately 10 cabins on Threepoint Lake and, for the purposes of this assessment, it is assumed that construction of the access road would lead to a similar level of development on Wuskwatim Lake. An additional 10 cabins off the main waterbodies were designated in the terrestrial habitat CEA (Volume 6) to account for additional clearing in these areas.

## Domestic Harvest

The effect of existing domestic harvest is included in the present day baseline. The increased population is not expected to result in a proportional increase in domestic harvest, as the community has experienced a trend away from the traditional lifestyle. However, NCN is actively promoting traditional activities such as resource harvesting; therefore, for the purposes of this assessment, it was assumed that promotion of traditional activities in conjunction with increased population, would more or less counteract the tendency to reduced domestic harvest. It is assumed that activities such as domestic resource use, cabin construction, etc. would be carried out under an overall land management plan to ensure that natural resources are managed in a sustainable manner.

## Commercial Fishing

Existing harvest is included in the baseline. Potential changes in the future harvest related to direct Project effects are considered in the assessment (Volumes 5 and 7). No major changes in future, non Project-related factors affecting the fishery have been identified.

## Commercial Trapping

Existing harvest is included in the baseline. Potential changes in the future harvest related to the direct Project effects are included in the assessment (Volumes 6 and 7). No major changes in future, non Project-related factors affecting trapping have been identified.

## Ecotourism

NCN is currently considering some initiatives related to Ecotourism. Such initiatives are expected to target off-system waters (i.e., those not affected by either CRD or the Wuskwatim Project).

## Treaty Land Entitlements (TLE) in the Wuskwatim Area

Specific plans for these areas have not been developed. Therefore, the CEA considered how the Project could affect potential future uses of the TLE.

In addition to the above, NCN also has plans for a number of projects and activities that may influence the future. These include economic development plans, a community development planning process and plans for future housing and infrastructure developments. Most of the plans are either community-based (and in some cases part of the baseline setting) or involve economic activity that does not tend to involve the Wuskwatim area; these plans are often also confidential to NCN and not available to be reported on in this EIS. These projects and activities have not been included in the cumulative effects assessment set out in this EIS; aside from confidentiality and other limits, these are excluded primarily because they are not sufficiently developed to allow comment on the possibility of cumulative effects from the Project. It is understood, though, that NCN's internal reviews of the Project will fully consider any such other plans and projects to the extent that they may have any cumulative effects associated with the Project.

### 3.4.6 Climate Change

Climate change is neither a project nor an activity and, therefore, does not qualify for CEA analysis. It is also highly uncertain. However, climate change may have an effect on the environment and is addressed to the extent possible (given the high degree of uncertainty) in the biophysical CEA with respect to long-term trends.

Climate change is manifested as changes in atmospheric processes, weather patterns, temperature, precipitation, and ecosystem evolution. There is a high degree of uncertainty in the science defining the nature, magnitude, and timing of anticipated change and effects in any particular location. This uncertainty results from the many interacting parameters that contribute to climate change, including solar energy, greenhouse gases (GHGs), tropospheric aerosols, and volcanic activity (NASA 2002). Natural GHGs, including water vapour, carbon dioxide, methane, nitrous oxide and ozone, trap infrared heat energy that would otherwise be released into space, raising the temperature of the lower atmosphere and the Earth's surface. Anthropogenic GHGs originating from the burning of fossil fuels, deforestation and other land management practices accelerate the warming effect. Airborne particulates of natural and human origin, and land cover changes (e.g., changes in forest cover, crops, and human developments), have a cooling effect on the lower atmosphere and Earth's surface.

Climate models, based on fundamental laws of physics and conservation of mass, momentum and energy, express the complex climate system in a series of mathematical expressions. Projected responses of climate to changing conditions depend on estimates of future GHG, aerosol, and aerosol precursor concentrations, their duration in the atmosphere, and their radiative properties (NASA 2002). When modeling climate change, assumptions are made (on a multitude of variables) due to uncertainties regarding the effects of future policies and regulations, changes in societal values and practices, and the impact of these changes on the factors contributing to climate change. These estimations and assumptions result in significant uncertainties in climate change predictions.

However, all climate change models agree that temperatures are likely to rise and differ only slightly on the magnitude of change. There is more uncertainty in predicting subsequent changes in the amount of precipitation and precipitation patterns, these being extremely variable within each climate change model. In addition, the potential shift of extensive boreal forest areas from being natural carbon reservoirs to becoming net sources of atmospheric carbon as forest areas decline due to climate change, may contribute further to warming trends.

## Canadian Model

The Canadian climate model produced by the Canadian Centre for Climate Modeling and Analysis assumes greenhouse gas concentrations will double by 2030 and predicts spring and summer temperatures to increase by 3 - 4 $^{o}$C above the mean annual temperature (1970-1990) in Manitoba by the end of the 21$^{st}$ century (International Institute for Sustainable Development 2002). The greatest temperature increases are projected for the winter periods; the model suggests increases between 5 - 8 $^{o}$C. Spring precipitation is expected to increase by 5 - 20% across Manitoba, while fall precipitation is projected to increase in the north by 5 - 25% and decrease by 10 - 20% in the south. This model also suggests there will be an increase in frequency and severity of extreme weather events (e.g., heat waves, extreme precipitation, lightning/wind/ice storms, etc).

### *Central Manitoba Climate Scenarios*

Climate scenarios in Manitoba provided by "The Canadian Climate Impacts Scenario Project" suggest more extensive temperature increases than those predicted in the Canadian model (Canadian Climate Action Fund et al. 2002). These scenarios suggest summer and winter temperatures in central Manitoba will increase by 0.5 to 2 $^{o}$C by 2020, accompanied by precipitation changes ranging –5% to +15%. These models suggest drastic increases in temperature for central Manitoba by 2080. Winter temperatures are projected to increase by 5 - 9 $^{o}$C, while summer temperatures are to increase by 3 - 6 $^{o}$C (Table 3-1). The predicted changes in precipitation patterns across central Manitoba by 2080 range from decreases of 25% to increases of 25%. The general trend suggested in all scenarios is a significant decrease in precipitation across southern Manitoba and a significant increase in northern Manitoba. Currently, the mean summer and winter temperatures in Thompson, MB are 12.4 $^{o}$C and –20.0$^{o}$C, respectively, while the average total annual precipitation in Thompson is 517 mm, comprised of 348 mm rain and 186 cm snowfall (1971-2000 averages) (Environment Canada 2002).

Table 3-1. Thompson Area Current & Projected Temperature circa 2080.

| **Season** | **Current** | **Projected** | |
|---|---|---|---|
| | **Temperature $^0$C** | **Temperature $^0$C** | **Precipitation %** |
| Summer | 12.4 | 15.4 to 18.4 | -25 to +25 |
| Winter | -20.0 | -15.0 to -11.0 | |

*Sources: Environment Canada (2002) and the Canadian Climate Action Fund et al. (2002)*

## Impacts of Climate Change on the Boreal Forest in Central Manitoba

Given the uncertainty associated with the climate predictions, two scenarios are examined: the effect of increased temperature and increased precipitation; and the effect of increased temperature and decreased precipitation.

### *Impact of Increased Temperature and Increased Precipitation*

The effects of increased temperature and increased precipitation on the boreal forest in central Manitoba could include changes in species composition, biodiversity, and pest infestation. Slight increases in mean annual temperature and increased carbon dioxide levels may increase vegetative growth rates (NRC 2002a). However, at temperatures in the upper range of postulated increases, immigration rates of new species may not compensate for species loss related to heat stress (UN Environmental Programme 2002). Increased prevalence of forest fires may also be a concern as temperatures rise.

Increasing temperature, accompanied by an increase in precipitation, may cause change in species composition of the forest in the long term. The proportion of black spruce may increase providing the temperature increase is less than 3.2$^o$C (mean annual temperature at Thompson, MB is –3.2$^o$C). If the mean annual temperature rises above 0$^o$C the permafrost will thin, become sporadic and eventually disappear, creating areas of increased infiltration. Drier sites will favour jack pine and aspen over black spruce, white spruce and balsam fir.

Forest pests like spruce budworm, jack pine budworm, and tent caterpillars may become more prevalent (NRC 2002b). Pest infestations may increase in frequency and severity due to lower frequencies of extreme winter temperatures, which limit egg and larvae survival. In addition, a potential increase in the proportion of white spruce could give the forest a greater capacity to harbor spruce budworm; unless the current limited areas of white spruce are eradicated by the parasite.

Frequent winter thaws, increased occurrence and severity of spring floods, and increased intensity of summer rainfall may lead to flooding and soil erosion. As temperatures rise, permafrost will become more sporadic and disappear.

*Impact of Increased Temperature and Decreased Precipitation*

Increased temperatures accompanied by decreased precipitation may result in a longer forest fire season with an increased frequency and size of fires (Anonymous 2002). The total area burned may increase and a shift toward younger forest stand age classes will occur with increased representation of jack pine and aspen. Extreme increases in temperature, increased evapotranspiration and soil infiltration, accompanied by less precipitation could lead to severe drought stress (NRC 2002b). Drought stress could impact black spruce, putting this species at a disadvantage against competitors such as jack pine (Fleming et al. 2002). Effects of extreme climate change scenarios suggest disruption of the boreal forest boundaries and replacement in central Manitoba by a more temperate Aspen parkland forest (Figure 3-5) (NRC 2002a, NRC 2002c). The Wuskwatim area is expected to display more attributes of boreal/aspen parkland climate and fewer attributes of a boreal/subarctic climate.

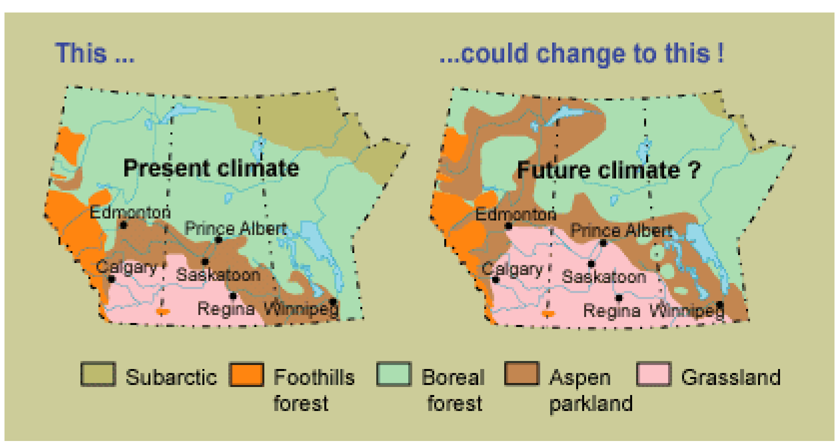


Figure 3-5. Predicted changes in Canada's ecozones (Hogg and Hurdle 1995).

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# APPENDIX 1

## WUSKWATIM GENERATION FACILITY:

## CUMULATIVE EFFECTS ASSESSMENT WORKSHOP BACKGROUNDER

## CUMULATIVE EFFECTS WORKSHOP MARCH 13, 2002

*EXECUTIVE SUMMARY*

Cumulative effects assessment, or CEA, looks at the effects on the environment of a proposed project in conjunction with existing and proposed future developments. This approach is important because, although the effects of a single project may not be considered significant, the environment could be significantly affected by the combined effects of several developments. Basically, CEA is a broad environmental management approach with the goal of maintaining the ecological integrity of a region into the future. The formal requirement for CEA as part of the environmental assessment process was established in 1992, as part of the Canadian Environmental Assessment Act, which subsequently came in to force in January, 1995.

The first CEA Workshop for the Wuskwatim Hydroelectric Generation Project was held in Winnipeg on July 25, 2000. The workshop was attended by representatives of the Nisichawayasihk Cree Nation (NCN), Manitoba Hydro, and the environmental study team, as well as an external advisor for CEA, Dr. Peter Duinker. This document is a revised version of the CEA backgrounder distributed prior to, and following (workshop proceedings), the first CEA Workshop for the Wuskwatim (and Notigi) Project(s). Although the main themes and elements of the framework presented in the previous Backgrounder remain unchanged, considerable effort was made here to update the previous version with current literature and to provide more practical guidance for the design and conduct of CEA in Canada, with an emphasis on northern developments and First Nations' concerns.

This document describes the general approach to CEA, as it is currently applied in Canada. A specific approach to CEA for the Wuskwatim Hydroelectric Generation Project will be discussed at the second CEA workshop attended by representatives of NCN, Manitoba Hydro, and the environmental study team on March 13, 2002. This workshop will provide a forum for further discussion of specific cumulative effects issues and approaches, first initiated at the CEA Workshop held in Winnipeg, July 25, 2000. Scoping, including early consultation, is often stated as the most important step in CEA as it provides the opportunity to communicate with local First Nations communities, regulators, proponents, and members of the scientific community that is fundamental to appropriate identification of valued resources, concerns, ecological considerations, project design considerations, and early development of environmental management plans for proposed projects/activities. It is particularly important to gain an understanding of the knowledge, concerns, and future management plans of potentially affected First Nations Communities, in order to appropriately and adequately identify and address issues associated with the project.

The following steps are prescribed to conduct Cumulative Effects Assessment for the proposed Project:

(1) Identify issues that should be included in the assessment (e.g., mercury) and ecosystem processes and components that may be affected;

(2) In considering ecosystem effects, identify important components of the environment that should be considered when evaluating the significance of the potential effects of the project (e.g., fish). These are sometimes called 'Valued Ecosystem Components' or VECs;

(3) Determine how far the effects of the project could extend in terms of geographic area. This 'spatial scale' may vary, depending on what part of the environment is being considered;

(4) Determine the time scale ('temporal scale') of the assessment. The starting point could be the present (i.e., including the existing developments) or some point in the past. The assessment extends to the future to include the lifetime of the proposed project, and possibly longer;

(5) Identify developments and activities that may cause the same effect as the proposed project that overlap in time or space with the project-specific effect (e.g., hydroelectric generating stations; tourism). This includes existing developments, as well as approved and planned future projects (i.e., those that will probably proceed). It can also include projects that are only under consideration;

(6) Carry out the assessment using various methods, depending on the issue that is being considered;

(7) Describe the predicted impacts of the proposed project, in conjunction with the other developments described in Step 5, on the environment;

(8) Decide what amount of change to the environmental components described in Step 2 should be considered 'significant'. In other words, define what level of change caused by the project is acceptable and determine whether the effects are within this level of change (i.e., is the project's contribution to a cumulative effect responsible for causing a shift to an 'unacceptable effect'); and,

(9) Determine what kind of monitoring, management plans, and mitigation might be required in the future in the area affected by the proposed project.

This document also describes several case studies to illustrate the various approaches to CEA. The three case studies are:

(1) Keenleyside Dam and Power Project (Columbia Basin Trust and Columbia Power Corporation);

(2) Cheviot Coal Mine (Cardinal River Coals Ltd.); and,

(3) Diavik Diamond Mines Project (Rio Tinto Inc. and Aber Diamond Mines Ltd.).

Emphasis was placed upon the approaches taken and 'lessons learned' from these projects, which is intended to help design an appropriate CEA for the Wuskwatim Project.

The participants at the workshop will discuss the general approach to CEA and more specifically, an approach to CEA for the Wuskwatim Project. The results of the workshop will form the basis for completion of the CEA component of the environmental impact statement for the Wuskwatim GS Project.

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| | |
|---|---|
| AEUB | Alberta Energy and Utilities Board |
| AEP | Alberta Environmental Protection |
| CARC | Canadian Arctic Resources Committee |
| CEAA | Canadian Environmental Assessment Agency |
| CEARC | Canadian Environmental Assessment Research Council |
| CRC | Cardinal River Coals Ltd. |
| CSR | Comprehensive Study Report |
| CEA | Cumulative Effects Assessment |
| CEWG | Cumulative Effects Working Group |
| DFO | Department of Fisheries and Oceans |
| DIAND | Department of Indian and Northern Affairs |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Impact Statement |
| ISR | Inuvialuit Settlement Region |
| NCN | Nisichawayasihk Cree Nation |
| NRC | Department of Natural Resources |
| MELP | Ministry of Energy, Mines and Petroleum Resources |
| RA | Responsible Authority |
| RMA | Resource Management Area |
| VEC | Valued Ecosystem Component |
| ZOI | Zone of Influence |

# 1.0 INTRODUCTION

The first Cumulative Effects Assessment (CEA) Workshop for the Wuskwatim Hydroelectric Generation Project was held in Winnipeg on July 25, 2000. The workshop was attended by representatives of the Nisichawayasihk Cree Nation (NCN), Manitoba Hydro, and the environmental study team, as well as an external advisor for CEA, Dr. Peter Duinker. This document is a revised version of the CEA backgrounder distributed prior to, and following (workshop proceedings), the first CEA Workshop for the Wuskwatim (and Notigi) Project(s). Although the main themes and elements of the framework presented in the previous Backgrounder remain unchanged, considerable effort was made here to update the previous version with current literature and to provide more practical guidance for the design and conduct of CEA in Canada, with an emphasis on northern developments and First Nations' concerns.

The following discussion outlines a general framework for the conduct of CEA. This framework may be used as a guide in the design and implementation of CEA for the proposed Wuskwatim Hydroelectric Project, which includes a generating station and associated infrastructure. Designing and conducting a thorough and appropriate CEA for these projects is important to address the concerns pertaining to cumulative effects raised at NCN scoping workshops for the Environmental Impact Statement (EIS), as well as meeting other requirements (e.g., regulatory).

As a 'stand alone document', the main purpose of this synthesis is intended to provide practical guidance on the scoping and conduct of CEA for the Wuskwatim Hydroelectric Project. The focus lies on defining CEA, outlining major components and frameworks for conducting CEA, and on providing clarification on the requirements of proponents for CEA. Thus, the following discussion is aimed primarily at an audience of practitioners and proponents, with a particular emphasis on the Wuskwatim Project and the surrounding environment (i.e., northern Manitoba).

However, as this document is to serve as the 'backgrounder' for the second CEA workshop for the proposed Wuskwatim Project, it is equally intended to provide guidance in the scoping exercises that are crucial to the completion of a successful CEA. This workshop will provide a forum for discussion of cumulative effects issues and approaches, and communication between Manitoba Hydro, NCN, and the environmental study team. Scoping, including early consultation, is often stated as the most important step in CEA as it provides the opportunity to communicate with local First Nations communities, regulators, proponents, and members of the scientific community that is fundamental to appropriate identification of valued resources, concerns, ecological considerations, project design considerations, and early development of environmental management plans for proposed projects/activities. It is particularly important to gain an understanding of the knowledge, concerns, and future management plans of potentially affected First Nations Communities, early in the process in order to appropriately and adequately identify and address issues associated with a project.

The following provides a brief discussion outlining the definition of CEA, legal requirements, guidance for those responsible for the preparation of project-specific CEAs, and a general framework for the conduct of CEA. In order to provide practical guidance on the appropriate scope and level-of-effort required for a project-specific CEA, guiding questions and suggested approaches are included. In addition, several case studies of CEAs submitted in Canada are included to provide a context for scoping of the proposed Wuskwatim Project. Although currently available resources were reviewed and included in the preparation of this document, it is emphasized that CEA in Canada (and abroad) continues to evolve.

# 2.0 DEFINITION, PURPOSE, AND HISTORY OF CEA IN CANADA

| | |
|---|---|
| *Cumulative Effects*: | "Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions." (Hegmann et al. 1999) |
| *Cumulative Effects Assessment*: | "A CEA is an assessment of those (see definition above) effects." (Hegmann et al. 1999) |
| *Actions*: | "Projects and Activities" (Hegmann et al. 1999) |

"Cumulative effects assessment is done to ensure the incremental effects resulting from the combined influences of various actions are assessed. These incremental effects may be significant even though effects of each action, when independently assessed, are considered insignificant" (Hegmann et al. 1999).

Cumulative effects assessment is not a new concept in environmental impact assessment (EIA) and land and resource use planning and management in Canada. Rather, cumulative effects assessment in theory and in practice has evolved since institution of formal EIA requirements in the 1970s. Beanlands and Duinker's (1983) "*An Ecological Framework for Environmental Impact Assessment in Canada*" laid the foundation for cumulative effects assessment in Canada. In 1984, the Canadian government created the Canadian Environmental Assessment Research Council (CEARC), whose mandate was to coordinate cumulative effects assessment research. Subsequently, a joint U.S.-Canada workshop on cumulative effects assessment was convened to address this subject (CEARC / U.S. NRC 1986). As cumulative effects assessment research evolved, implementation of CEA concepts began to appear in formal assessments of large-scale projects proposed in Canada (e.g., Northern Saskatchewan uranium mines; Alberta-Pacific pulp mill (AlPac)) (Hegmann et al. 1999).

In 1992, the requirement for CEA as a component of environmental assessment was included in the Canadian Environmental Assessment Act. When the Canadian Environmental Assessment Act came into force in 1995, consideration of cumulative effects became explicit and mandatory.

Alberta and B.C. currently have instituted CEA requirements in legislation. Alberta, B.C., and Manitoba have reached bilateral federal-provincial harmonization agreements for the conduct of environmental assessment, the goal of which is to avoid duplication between federal and provincial jurisdictions (Hegmann et al. 1999).

The foundation of CEA is the recognition that potential environmental effects of a development or activity are a result of interacting factors, including effects from other developments. In theory and practice, CEA may be considered as an extension of EIA (e.g., Bedford and Preston 1988). As such, it has been argued that a CEA should be an integral part of an EIA, rather than treating CEA as a distinct and separate process.

The major extensions of EIA embodied in CEA are:

(1) increased spatial scale of the study area;
(2) increased temporal scale (from pre-project to future);
(3) incorporation of effects of other projects in the study area on valued ecosystem components (VECs);
(4) consideration of effects arising from past, present, and proposed projects; and,
(5) evaluation of the significance of effects.

Ultimately, CEA is a response to the recognition that although effects may be insignificant when examined individually, they may be significant in a cumulative manner. In essence, CEA may be viewed as a broad, regional environmental management approach whose goal is to maintain ecological integrity into the future (i.e., sustainability). For NCN and Manitoba Hydro, CEA can be a tool used to evaluate and assess the potential effects of the proposed Wuskwatim hydroelectric development on future environmental conditions and resource management plans. CEA is a tool that may assist in ensuring wise stewardship of natural resources and, in particular, sustainability of traditional land uses and the supporting ecosystems (KAVIK-AXYS 2001).

## 3.0 LEGAL REQUIREMENTS

The Canadian Environmental Assessment Act, Section 16, states that every screening or comprehensive study of a project and every mediation or assessment by a review panel shall include consideration of the following:

(A) the environmental effects of the project, including...any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out; and,

(B) the significance of the effects referred to in paragraph (A).

The Cumulative Effects Working Group (CEWG), established to provide guidance for the conduct of CEA in Canada, has recently provided additional guidance regarding the ultimate goal of CEA:

> "Keep in mind that an assessment of a single project (which is what almost all assessments do) must determine if *that* project is incrementally responsible for adversely affecting a VEC beyond an acceptable point (by whatever definition). Therefore, although the total cumulative effect on a VEC due to many actions must be identified, the CEA must *also* make clear to what degree the project under review is alone contributing to that total effect. Regulatory reviewers may consider both of these contributions in their deliberation on the project application" (Hegmann et al. 1999).

# 4.0 TYPES OF CUMULATIVE EFFECTS

Cumulative effects may result from ongoing effects from one activity/development (i.e., 'actions') or from additive effects arising from two or more activities that overlap spatially and/or temporally to affect the same VEC and/or indicator (Figure A-1). For example, multiple stresses arising from a development may cause significant effects in a cumulative manner. There are at least eight types of cumulative effects, as described below (Cocklin et al. 1992; Hegmann et al. 1999; Sonntag et al. 1987):

(1) Time crowding refers to cumulative effects that result from frequent and repetitive impacts on a single environmental medium (e.g., fish harvesting exceeds stock regeneration time).

(2) Space crowding describes effects that result from a high density of impacts on a single environmental medium (e.g., multiple inputs of effluent/contaminants into a lake).

(3) Compounding effects are caused by synergistic effects arising from multiple sources on a single medium (e.g., arctic haze).

(4) Time lags refer to circumstances where there are long delays in experiencing effects (e.g., bioaccumulation of mercury in the food web).

(5) Space lags and extended boundaries describe effects that are manifest at an extended distance from the source of impact (e.g., migratory species or long-range atmospheric transport of contaminants).

(6) Trigger and threshold cumulative effects arise when an activity(s) disrupts ecological processes in a manner that fundamentally changes the ecosystem functioning (e.g., elimination of critical species).

(7) Indirect cumulative effects are secondary (or tertiary) effects caused by an activity(s) (e.g., road developments in undeveloped areas enhance access to the areas).

(8) Patchiness effects, incremental changes, and nibbling describes impacts that result in fragmentation of an ecosystem (e.g., roads).

From the preceding descriptions, it is apparent that there are a diversity of types of cumulative effects to be considered when conducting a CEA. Given the complexity and scope of cumulative effects, it is critical to develop a framework for the conduct of a CEA that is tailored to assessing the effects for a particular development/activity.

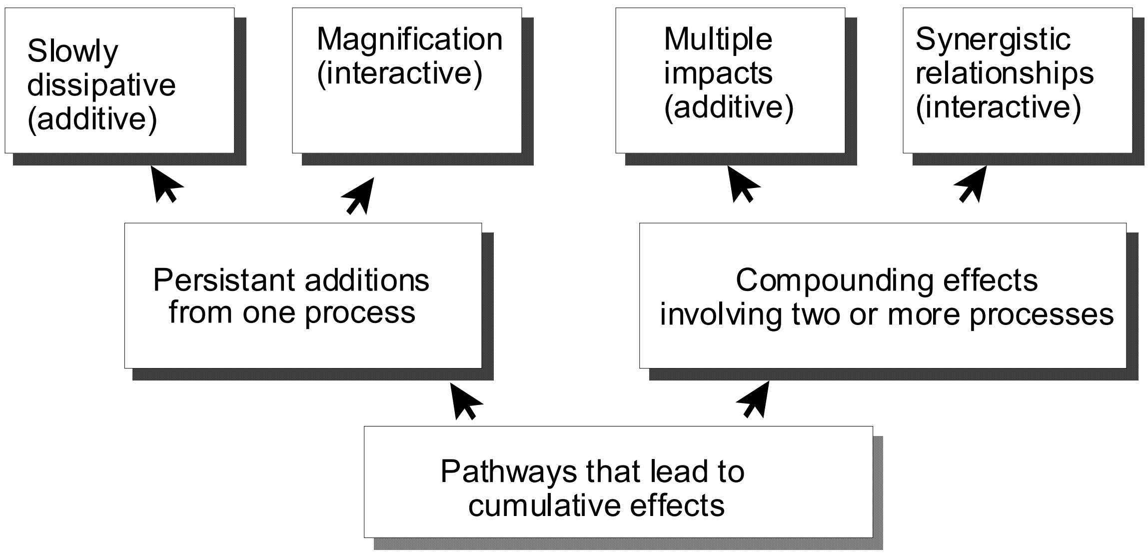


Figure A-1. Functional pathways that contribute to cumulative effects (Peterson et al. 1987).

# 5.0 CEA APPROACH/FRAMEWORK

"The purpose of any assessment is to provide adequate information to the reviewer to assist them in making a determination on the fate of your application." (KAVIK-AXYS 2001)

## 5.1 FRAMEWORKS, GUIDANCE DOCUMENTS, AND RESOURCES

The Canadian Environmental Assessment Agency (CEAA) released an operational policy statement to "provide clarification and guidance to responsible authorities (RAs) on how cumulative environmental effects should be considered in environmental assessments conducted under the *Canadian Environmental Assessment Act* (*the Act*)." (CEAA 1999)

The CEAA also produced the 'Cumulative Effects Practitioners Guide' (Hegmann et al. 1999) to provide further practical direction and information to practitioners performing CEAs. The Guide includes a five-step framework for conducting CEA in Canada.

A guide for the preparation and conduct of CEAs in the Inuvialuit Settlement Region (ISR) was recently prepared for proponents (KAVIK-AXYS 2001), as well as a guide for reviewers of CEAs prepared for activities and developments in the ISR (KAVIK-AXYS 2002). Although these documents were written with the ISR specifically in mind, the guiding principles and approaches to CEA discussed within these documents are applicable to other geographic regions, particularly where similar goals of preserving cultural identity and values may be present.

Numerous additional resources are available that deal with cumulative effects, ranging from theoretical to practical applications. An annotated CEA bibliography was also generated by the CEAA and is available on their web-site (http://www.ceaa-acee.gc.ca/0012/reports).

## 5.2 GUIDING PRINCIPLES, QUESTIONS, AND APPROACHES TO CEA

"The effort applied should be in proportion to the potential of the project to create negative environmental impacts." (KAVIK-AXYS 2001)

Although there is general agreement on the necessity for CEA in order to ensure sustainability into the future, there is less practical information or tools available for the conduct of CEA. Proponents and practitioners of CEA are faced with the difficult challenge of determining the scope and level of effort required for a project-specific CEA.

In general, a CEA for a proposed project should be scaled according to the geographic extent and the intensity of the proposed project (KAVIK-AXYS 2001). Hegmann et al. (1999) suggest that a competent CEA would address the following three fundamental questions:

1. Will the project have a measurable effect on the VEC in question?
2. Will the project effect act in a cumulative manner with those of other land use pressures?
3. Will the project effect, in combination with other land use effects, measurably change the state of the VEC?

Consideration of these guiding questions throughout the conduct of CEA, in conjunction with early and continued communication amongst interested parties, should result in adequate consideration of potential cumulative effects associated with a project and that issues are appropriately and thoroughly considered. Initiation of the consultation process (i.e., scoping) early in the project proposal phase is crucial to developing a focused EIA and CEA and appropriate allocation of resources and effort (KAVIK-AXYS 2001).

## 5.3 CEA METHODS

There are a variety of methods that may be employed for CEA, ranging from purely qualitative to highly quantitative approaches. The most appropriate type of approach(es) is selected based on the nature of the issues, the quantity and quality of data available, logistical and practical considerations of data collection and analysis, and the value of the VEC or level of risk associated with the issue. In general, there are nine procedures that may be employed for cumulative effects assessment:

(1) Checklist: list of cumulative effects; cause and effect is implied only; degree of an effect is assessed in a purely qualitative manner;

(2) Matrices: checklist with cause and effect associated format; degree of an effect is assessed either qualitatively or quantitatively;

(3) Impact Modeling: flow diagrams and loop analysis; focus on cause and effect and feedback relationships;

(4) Evaluation Techniques: comparisons of alternative scenarios and their effects;

(5) Numerical Modeling: mathematical equations and computer simulations of an environmental system;

(6) GIS Analysis: analysis of spatial relationships, spatial change over time, and future scenarios;

(7) Monitoring: identification and characterization (i.e., measurement) of existing environmental and socioeconomic conditions;

(8) Indicator Analysis: monitoring of valued ecosystem components (VECs); and,

(9) Risk Assessment: quantification of the probability of the occurrence of an effect; explicitly identifies uncertainty.

## 5.4 CEA FRAMEWORK

***Guiding Questions for CEA:***

1) Is the project likely to have negative environmental effects on VECs?
2) If so, will the residual negative environmental effects that remain after mitigation, combine with the effects of other projects, past, present, or future?
3) What is the significance of the overall cumulative environmental effects, including the effect of the project?
4) If this project, in combination with other projects in the area, is likely to create a "significant negative cumulative effect", are there further mitigation measures that could reduce or eliminate the project's contribution to these effects so that the combined effect is not significant? (KAVIK-AXYS 2001)

A five-step framework for CEA is suggested in the CEAA's Practitioners Guide (Hegmann et al. 1999). These five steps include:

(1) Scoping;
(2) Analysis of Effects;
(3) Identification of Mitigation;
(4) Evaluation of Significance; and,
(5) Follow-up

Within these five steps are nine general components (Griffiths et al. 1998):

(1) Issues identification;
(2) Valued ecosystem component selection;
(3) Spatial bounding;
(4) Temporal bounding;
(5) List of included projects (past, present, and future);
(6) Assessment methods;
(7) Impact characterization;
(8) Determination of significance; and,
(9) Future management options.

Although the scope and approaches taken within each of the nine major components varies considerably among projects, it is generally agreed that each component is essential to the conduct of an effective CEA (Beanlands and Duinker 1983; Hegmann et al. 1999; Hegmann and Yarranton 1995). It is also clear that each component must be considered on a project-by-project basis.

The first five components are essentially scoping exercises geared towards identifying issues and characterizing the types and extent of potential effects. In the CEAA framework, components one through five are, in fact, grouped into the first step, termed 'scoping' (Hegmann et al. 1999). Assessment methods, impact characterization, and determination of significance refer to the actual conduct and interpretation of CEA. The final component, future management options, refers to impact management programs and monitoring.

The following discussion describes each of these components and outlines what should be included in each step in order to conduct a thorough CEA that will stand up to a rigorous review process. In order to adequately address each of the nine components listed above, each is discussed discretely in the sections to follow. However, it is cautioned that although the CEAA framework and the 'list of components' are itemized in a linear fashion, the conduct of CEA is anything but linear. Rather, CEA is a highly iterative process and generally requires refinement of various components and steps at many points throughout the assessment process (e.g., as new information is obtained). Furthermore, many of the steps or exercises are concomitant and cannot, by nature, be treated discretely. For example, compilation of a project inclusion list and temporal and spatial scoping are often conducted simultaneously.

### 5.4.1 Issues Identification

The identification of project-specific issues is an iterative process aimed at determining socially and environmentally important issues. Socially important issues are identified via consultation with interested parties (e.g., First Nations). Environmentally important issues are identified using aboriginal (traditional) knowledge, consultation with interested parties (i.e., First Nations), scientific knowledge, literature review, and characterization of the environment (i.e., baseline studies). In addition, issues identification should address present and future natural resources management plans (i.e., First Nations management initiatives) and existing conservation and protection plans.

It is critical that the project is clearly defined in order to effectively, thoroughly, and accurately define pertinent issues. It is also important to possess a reasonably good understanding of the nature of the existing environment in order to adequately identify issues of concern. Issues should also be identified based on knowledge regarding cause-effect relationships related to changes that the proposed project may cause in the environment. Issues identification should be done early in the assessment process in order to ensure that the appropriate and relevant information is collected in baseline environmental studies. Furthermore, VECs and associated indicators cannot be selected until a comprehensive list of issues is completed.

Several workshops and meetings were held with NCN representatives to help define environmental issues related to the proposed Wuskwatim Project. This list of issues is being refined and updated and consultation will be ongoing as additional information becomes available. It has also been recommended that early scoping exercises, including issues identification, should include consultation with federal and provincial authorities in order to incorporate their concerns, as they relate to the proposed project, as early as possible. This may prevent the need to conduct additional studies and assessment at a later point.

### 5.4.2 Valued Ecosystem Components (VECs)

Once environmental and social issues are identified, appropriate components of the environment (i.e., VECs) and indicators are selected accordingly; a minimum of one indicator should be selected for each major cumulative effects 'issue' that is identified in the first step of scoping, in order to qualify or quantify each issue (KAVIK-AXYS 2001). A VEC is defined as: "Any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern" (Hegmann et al. 1999). VECs are selected based on their socioeconomic and/or environmental value through consultation with affected parties and stakeholder opinion; VECs are intended to reflect the values of those potentially affected and the range of issues identified in the initial stages of CEA. In general, VECs are often environmental attributes, and species of greatest public concern and/or of great ecological significance. Factors that have been used in other studies to select and rank VECs include: political importance; economic importance (e.g., income from trapping); subsistence hunting/fishing value; recreational hunting/fishing value; non-consumptive recreational importance; ecological importance; and vulnerability.

Indicators, which are the 'measurable parameters' used to assess an effect on a VEC, may then be selected based on the outcome of this ranking exercise. Indicators provide a means through which the responses of VECs to disturbance or change may be assessed. For example, to assess effects on drinking water quality (VEC), concentrations of contaminants in water may be used as an indicator for this VEC. A minimum of one indicator should be selected for each VEC identified above, in order to qualify or quantify each specific cumulative effect (KAVIK-AXYS 2001). Some examples of issues, associated VECs, and measurable parameters used to assess VECs are provided in Table A-1.

Issues (disturbances), valued ecosystem components, and indicators that represent measurable components of the environment, have been identified through consultation and discussion with NCN. As CEA is an iterative process, it is recognized that this list of issues and VECs may change in the future as more information becomes available.

Table A-1. Examples of VECs and measurable indicators (KAVIK-AXYS 2001).

| Issue/Disturbance | VECs | Indicators (Measurable parameters) |
|---|---|---|
| Sedimentation effects | Water quality | Total suspended solids |
| Fragmentation of wildlife habitat | Caribou | Reduced area of critical habitat type |
| Loss of vegetation communities | Diversity of vegetation communities | Distribution and abundance of specific community types |
| Effluent discharge | Water quality | Concentrations of nutrients and bacteria in water |
| Mercury contamination | Fish quality | Concentrations of mercury in fish |

### 5.4.3 Spatial Bounding

Spatial boundaries for CEA should encompass all of the area affected by a specific project-related effect and the area affected by similar effects from other actions that overlap with the project effect (KAVIK-AXYS 2001)

Spatial bounding involves defining the area over which potential effects of a proposed project are assessed *and the spatial extent of similar effects from other projects in the region* (KAVIK-AXYS 2001). Generally, spatial scales for CEA are larger than those used for conventional EIA, as CEA encompasses a broader context. Often spatial scales are selected based on:

- the probable zone of influence (ZOI) for the proposed project, in conjunction with other developments;
- the spatial extent of potential cumulative effects on VECs and/or indicators; and,
- what is perceived as the most appropriate scale for a particular effect, using professional and expert knowledge and judgement.

Usually, more than one spatial scale is used in a given context because the appropriate scale varies with the specific VEC and/or indicator to be assessed (i.e., must be appropriate for the affected resource). For example, to assess potential effects on water quality, the regional study area may be deemed as the entire watershed. Conversely, to assess effects on a VEC such as moose, the home range of this species might be selected as the most appropriate spatial scale. However, the spatial scale of the study area may be limited by availability of information and/or the feasibility of obtaining new data.

Criteria for selecting spatial (and temporal) boundaries for CEA, include (Drouin and LeBlanc 1994):

- size and nature of project and anticipated effects;
- availability of existing data and knowledge regarding the proposed project and potential effects;
- feasibility of obtaining new data and knowledge;
- size, nature, and environmental effects of other projects/developments in the area (including past, present, and future projects);
- characteristics and sensitivity of the receiving environment;
- relevant ecological boundaries (e.g., watersheds; sub-watersheds); and,
- relevant jurisdictional boundaries.

In addition, KAVIK-AXYS (2001) suggested that study areas should be selected such that collection and analysis of data for each VEC can be accomplished at a reasonable cost to the project. Furthermore, boundaries should incorporate knowledge and input from regional resource managers and resource users.

It is equally important to consider the mobility of the effect and the VEC, when establishing spatial scales (Table A-2). For example, discharge of effluents into a stream is a 'mobile effect', because the contaminants are transported downstream of the outfall. Conversely, a stationary project effect could be the project footprint. Similarly, VECs may be stationary (e.g., vegetation, traditional harvesting sites, highly territorial fish or wildlife such as stickleback) or mobile (e.g., migratory fish, caribou, migratory birds). The precise combination of the mobility of the effect and the VEC will dictate the appropriate spatial bounds (Table A-2). KAVIK-AXYS (2001) suggest using the following matrix for establishing spatial boundaries:

Table A-2. Guidelines for establishing spatial boundaries (from KAVIK-AXYS 2001).

| Effect | VEC Type | VEC example | Spatial Boundary |
|---|---|---|---|
| Stationary | Stationary | • Vegetation or relatively stationary fish and wildlife | the affected drainage basin(s) or population sub-unit |
| | | • Traditionally harvested species | the area encompassing other similar harvesting areas |
| | Mobile | • Groundwater | the defined aquifer |
| | | • Surface water | affected reaches or drainage basins |
| | | • Fish | affected reaches or drainage basins |
| | | • Wildlife | affected habitats or drainage basins |
| | | • Traditional harvesting | drainage basin or geographic area in which the harvesting occurs |
| Mobile | Stationary | • Vegetation or relatively stationary fish and wildlife | all of the affected drainage basins(s) or the population sub-unit(s) |
| | | • Traditionally harvested areas | area encompassing other similar harvesting areas similarly affected |
| | Mobile | • Surface water | drainage basin in which the effluent discharge occurs |
| | | • Wildlife: | Range of the wildlife population or population sub-unit |

### 5.4.4 Temporal Bounding

Temporal bounding involves defining relevant time scales for consideration in CEA for a particular project. The central issue in temporal bounding is the incorporation of a prolonged time scale for assessing effects, in order to evaluate potential long-term or chronic effects. For example, time-lagged effects, such as bioaccumulation of mercury in the aquatic food web, require long-term consideration.

Time scales that may be considered include: pre-development (i.e., conditions prior to any development); present (i.e., existing environment); and future. Hegmann et al. (1999) stated that the minimum time scale considered in CEA should incorporate assessment of conditions prior to development of the proposed project (i.e., present conditions) as well as future projections. Temporal scales must be selected in consideration of the specific effect on the land base, VECs, land use, or harvesting activities, as well as the time required for recovery from the effect (KAVIK-AXYS 2001).

Consideration of pre-development conditions (i.e., historical baseline) is often difficult or impossible due to inadequate, or a complete absence of, data (Note role/importance of traditional knowledge in this circumstance). Furthermore, the accuracy and usefulness of simulating pre-development conditions are frequently limited by high levels of uncertainty associated with insufficient data. The evaluation of pre-development conditions should be approached under the caveat that the ultimate goal of assessing pre-development conditions is to assist in predicting effects of the proposed development.

Consideration of present conditions is a critical component of CEA, because a clear understanding of present environmental conditions is fundamental to the predictive ability and subsequent monitoring of the potential effects of a proposed development on these aspects. The characterization of the existing environment usually requires a reasonably prolonged period of measurement time (i.e., several or more years) in order to account for natural variability (e.g., seasonal variation, inter-annual variation) and in order to discern and delineate trends. Traditional knowledge would provide longer-term trend information. However, its application to the present-day regulated-river setting (as opposed to pre-development setting) would need to be considered.

Assessors should describe future conditions with the project in place, as well as projected future conditions in the absence of project development (i.e., expected future conditions if the project were not developed). The operation period may be further broken down to include several time frames; at a minimum, a CEA should consider the period of peak disturbance, a transition period of recovery/change, and a period of greater stability under the new environmental setting. In addition, various future scenarios may be considered in the context of anticipated effects under various proposed (or reasonably foreseeable; see Section 5.4.5) future developments (i.e., included projects), that are likely to overlap in time with the effects from the proposed project.

### 5.4.5 Included Projects

Projects that are to be considered in the CEA for a proposed project include past, present (i.e., existing), and potential future projects (including future modifications to existing projects) that are relevant to the potential effects of the proposed project (i.e., that overlap in time and/or space and have the potential to affect the same VEC, indicator, or issue). The 'project inclusion list' is generally developed in conjunction with temporal and spatial scoping exercises. The *Canadian Environmental Assessment Act* (paragraph 16 (1)(a)) states that consideration should be granted to:

"Any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out".

In its operational policy statement, the CEAA states that RAs should focus on assessing "the most likely future scenario" for a project-specific CEA (CEAA 1999). However, at their discretion, RAs may also require consideration of projects that are not only "certain" to proceed, but also "reasonably foreseeable" or even "hypothetical." A project that is deemed "certain" to proceed is defined as: "the action will proceed or there is a high probability the action will proceed." Thus, projects that have been approved or have applied for approval would be considered certain to proceed. "Reasonably foreseeable" projects are defined as, "the action may proceed, but there is some uncertainty about this conclusion." An example of a 'reasonably foreseeable' activity is one that may proceed, depending on projected population increase or increase in demand for a product or service (e.g., electrical demand). 'Hypothetical' projects are defined as, "There is considerable uncertainty whether the activity will ever proceed…[they are] Conjectural based on current available information" (CEAA 1999). According to KAVIK-AXYS (2001), in general, proponents for a specific project are not expected to address induced projects in CEA (i.e., projects that may be developed if the proposed project is developed).

Clearly, the range of included projects can vary widely, at the discretion of the RAs. Initially, the CEAA 1994 Reference Guide advised that consideration of future projects in CEA was to focus exclusively on imminent projects; however, the CEAA later broadened this scope beyond projects that are certain to proceed to include reasonably foreseeable and hypothetical future projects (CEAA 1999). However, 'reasonably foreseeable projects or activities' are usually practically defined as actions that are in some form of a recognized approval process (KAVIK-AXYS 2001). Regardless of which projects are included in a CEA, the rationale for the selection of included projects, as well as for those that are excluded, should be clearly indicated. In selecting included projects, the level of certainty that a project will actually proceed should be considered (Hegmann et al. 1999). In general, assessments should focus on projects and activities with the potential to affect the same issue or VEC as the proposed project.

When identifying projects that should be considered in the Wuskwatim Project CEA, the following considerations may provide guidance for selection:

- which certain (past, existing and future) and reasonably foreseeable projects may have an impact on the same VECs as the project under assessment;
- is rapid development of the project area anticipated; and,
- are particular environmental sensitivities or risks involved (e.g., potential disturbance of caribou migration in region) (CEAA 1999)?

### 5.4.6 Assessment Methods

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"Under the *Canadian Environmental Assessment Act*, a project proponent is not required to consider cumulative effects to which their project will not contribute." (KAVIK-AXYS 2001).

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A proponent is required to consider those effects of their project that are detectable and may interact with effects of other projects/activities (past, present, or future). However, a project-specific effect does not have to be *significant* in order to be considered in CEA; rather, an effect only need be *measurable* (i.e., detectable), to trigger inclusion in CEA (KAVIK-AXYS 2001).

There are a variety of assessment methods (see section 5.3) that may be employed for CEA, ranging from purely qualitative to highly quantitative approaches. Assessment methods must be capable of considering interactions among impacts. Several different types of assessment methods may be employed within any CEA, varying, for instance, with the issue being assessed or the VEC. The type of approach will depend upon the scope of the proposed project, the nature and extent of the potential effect being evaluated, and the availability of data. Ideally, assessment of potential effects would entail highly quantitative methodologies with a high degree of certainty. However, this approach is often impractical, or not possible, owing to limited data, time, and/or finances. The precise tools employed (and the associated levels of resolution and accuracy), will also be dependent upon the project and its specific effects.

### 5.4.7 Impact Characterization

Cumulative impacts are usually defined as *residual effects* that remain after planned mitigation. They are characterized in terms of scope, magnitude, duration, frequency, and direction. Additional considerations may include: probability of effects; direct or indirect effects; mitigability; interactions with other residual effects; significance; certainty; spatial extent; and, potential to behave as a cumulative effect. Terms used to define impacts should be clearly and explicitly indicated and, wherever possible, impacts should be related to defined biological thresholds (e.g., critical level of habitat destruction or fragmentation; minimum population size) and standards (e.g., drinking water quality guidelines). Uncertainty associated with predictions made for potential effects should also be clearly defined and indicated, and quantified wherever possible. Similarly, any assumptions upon which impact predictions are made should be clearly described.

### 5.4.8 Determination of Significance

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"Does the project cause a problem of concern with respect to something that we value?" (KAVIK-AXYS 2001)

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It has been suggested that the determination of significance of a cumulative impact/effect is perhaps the most important component of CEA (Griffiths et al. 1998) and often the most challenging. For some issues, standards and guidelines are in place against which the significance of effects may be gauged (e.g., water quality standards). However, there is currently a lack of such goals or thresholds for many effects and issues. As such, significance is determined largely using professional judgment. Professional judgment should be established on carefully delineated rationale and criteria. Decisions regarding the significance of predicted effects related to the Wuskwatim Project will be based upon the particular VEC in question, discussions with NCN, and assessment by the reviewers. In general, a proponent should discuss: (1) the incremental contribution of their project to specific cumulative effects; and, (2) the importance of the predicted effect, in terms of sustainability of VECs and traditional and other land uses (KAVIK-AXYS 2001). In addition, cumulative effects should be predicted with and without the proposed project.

Factors that should be considered in determining significance include:

- magnitude of the effect on the component of the environment (i.e., VEC);
- geographic extent of the effect;
- duration and frequency of the effect;
- reversibility (or irreversibility/permanence) of the effect;
- ecological context within which the impact would occur; and,
- likelihood of impact to a component of the environment.

As CEA evolves, a greater number of thresholds and standards for discerning the significance of effects are being defined. For example, AXYS Environmental Consulting Ltd. recently completed a document pertaining to the development of thresholds for addressing cumulative effects on terrestrial and avian wildlife in the Yukon Territory (AXYS 2001). In these instances, significance may be gauged in a relatively clear, straight-forward manner. Thresholds may also be defined for a VEC based on ecological or social perspectives. Examples of semi-quantitative thresholds for VEC include:

- a subjective desired state (e.g., conservation plan);
- a trend in the VEC (e.g., sustained harvest levels, sustained population size or growth rate); and,
- a specific quantitative value or range of values (e.g., maximum access density per square km) (KAVIK-AXYS 2001).

However, for the majority of effects and geographical areas, there is no clear answer to the question of significance of an effect. KAVIK-AXYS (2001) suggests that in the latter instance, where significance is not easily defined, it is in the best interest of the proponent to develop complete and comprehensive mitigation and environmental management plans. In addition, in the absence of thresholds for the area affected by a project, it is often beneficial to borrow standards and thresholds that have been established for other jurisdictions or geographic areas (KAVIK-AXYS 2001).

In general, a CEA should provide information to authorities and decision-makers that facilitate rendering decisions regarding the implications of the project to VECs. KAVIK-AXYS (2001) indicates there are two options for evaluating significance. The first is to provide an objective assessment, with clearly defined assumptions and uncertainties, using either qualitative or quantitative methods. The second, which they highly recommend, involves undertaking five steps, outlined below, and completing an impact matrix (Table A-3):

(1) Determine if a known threshold is exceeded, conservation plans or resource management plans are affected (i.e., objectives are not met or potentially compromised), and if a specific site of value is directly affected by the project. For each 'yes' answer, the likelihood of a significant effect increases.

(2) Describe the magnitude of the effect (i.e., the degree of change caused by a project and for all projects combined), in terms of the measurable parameter or indicator (See Table A-3). Generally, the magnitude is described using qualitative terms such as low, moderate, and high, based on numerical values of predicted change; the precise numerical values depend on the precise issue or indicator in question.

(3) Describe the current trend for each VEC (i.e., increasing, neutral, or decreasing population).

(4) Assign a 'class' to each effect. Class is defined as a 'degree of concern' for an effect, in terms of magnitude of the effect on a VEC and the trend of the VEC. This assignation should be done for a project-specific effect (row 1 in the impact matrix – Table A-3) and for the same effect with all projects assessed together. General guidance for ranking classes of effects is provided in Table A-4.

(5) Formulate a conclusion regarding significance (significant or not), again for the project alone and for all projects together. A flow diagram that can be used to assist in the evaluation of significance is provided in Figure A-2.

Table A-3. A screening matrix for CEA (KAVIK-AXYS 2001).

| VEC | Project-Specific Effect | | Possible overlap with other actions? | | Cumulative effect on the VEC? | Effects Management | | Probable Trend of VEC | Effect Type | Estimated Magnitude of Effect | Class of Effect [1] | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Description | ZOI | Spatial | Temporal | | Project-specific | Regional | | | | | |
| VEC 1 | Describe effect | m or km affected by project | Yes or no; extent | Yes or no; when | Yes or No | Describe | Describe | Positive, neutral, or negative | Project[2] | Describe (% or low, moderate, high) | State Class of Effect: 1, 2, or 3 (See below) | Significant (S) or not significant (NS) |
| | | | | | | | | | Overall[3] | Describe (% or low, moderate, high) | State Class of Effect: 1, 2, or 3 (See below) | Significant (S) or not significant (NS) |
| VEC 2 | Repeat as above | | | | | | | | Project | | | |
| | | | | | | | | | Overall | | | |
| VEC 3 | Repeat as above | | | | | | | | Project | | | |
| | | | | | | | | | Overall | | | |

[1] Class Matrix

| Magnitude of Change to Benchmark | Trend in Resource | |
|---|---|---|
| | Positive | Negative or Neutral |
| Low (< 1%) | Class 3 | Class 3 |
| Moderate (1-10%) | Class 3 | Class 2 |
| High (> 10%) | Class 2 | Class 1 |

[2] Fill in first row (Project) for each VEC with the effects of project.

[3] Fill in the second row (Overall) for each VEC for effects of all projects collectively.

Table A-4. Class ranking for a cumulative effect (KAVIK-AXYS 2001).

| Effect Class | Narrative Description | Criteria |
|---|---|---|
| Class 1 | Serious concern | • The predicted trend for the indicator of a VEC could threaten the sustainability of the VEC in the study area.<br>• A negative change in VEC value > 25% from benchmark is considered Class 1, independent of VEC trend. |
| Class 2 | Moderate concern | • The predicted trend in a measurable parameter under projected levels of development will likely result in a decline in the VEC to lower-than-baseline, but stable levels in the study area after a period of transitional change and into the foreseeable future. |
| Class 3 | Low concern | • The predicted trend in the measurable parameter under projected levels of development may result in a decline in the VEC in the study area during the period of peak disturbance, but VEC levels should recover to baseline after a period of change due to disturbance. |

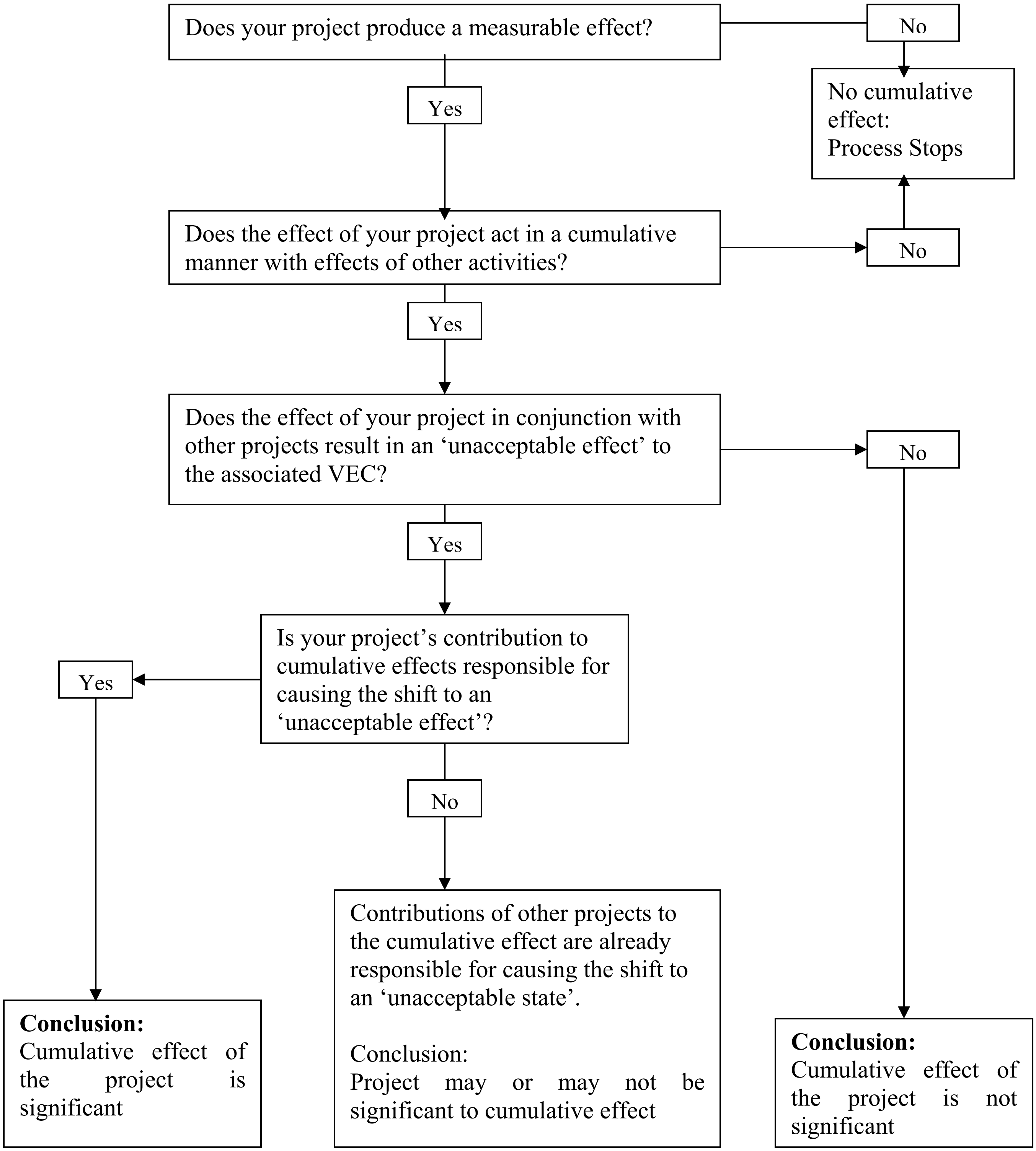


Figure A-2. Flow diagram for establishing significance (modified from KAVIK-AXYS 2001).

### Future Management Options

"Minimize your project's effects as much as possible through mitigation (e.g., by good engineering design, environmental best practices)."

"After you have done as much as you can, identify opportunities to manage cumulative effects through coordinated efforts involving yourself and other proponents and government." (KAVIK-AXYS 2001)

The final step in CEA is definition of future management options. Generally, future management options refer to long-term regional initiatives, such as monitoring and land-use planning, the purpose of which is to consider and manage cumulative effects of all development in a region and/or the environmental management plans for a specific project. The extent of, and commitment to, future management programs varies widely according to the project. For example, a commitment to monitor the environment in perpetuity was made with respect to uranium mining in northern Saskatchewan (Griffiths et al. 1998). Currently, there is an increasing trend towards development of comprehensive and collaborative monitoring and land-use planning initiatives across Canada. Regardless of the detail or comprehensiveness of the future management plan, programs to avoid potential cumulative impacts and plans for mitigating impacts should be established for every project. A detailed monitoring program should also be developed to evaluate predicted effects or lack of effects as well as to evaluate the effectiveness of mitigation and management measures.

# 6.0 CUMULATIVE EFFECTS ASSESSMENT FOR THE WUSKWATIM HYDROELECTRIC GENERATION PROJECT

There are a number of options available regarding the approach adopted for CEA, as well as some issues specific to the Wuskwatim Generation Project that require consideration in the development of a CEA. An approach for CEA for the Wuskwatim Project was the subject of the July 25, 2001 CEA workshop. The second CEA workshop, to be held on March 13, 2002 will assist in developing a more Wuskwatim-specific approach to CEA for the project.

## 6.1 GENERAL CONSIDERATIONS

Although the Wuskwatim Project is independent from the proposed Keeyask/Gull Project and possible future Notigi Project, for the purposes of CEA for the Wuskwatim Project, all three of these projects should be considered 'reasonably foreseeable' (all are within Manitoba Hydro's 20 year planning horizon). The inclusion of the Notigi and Wuskwatim Projects in a CEA does not mean that either of the projects will proceed. MB Hydro and NCN may proceed with none, one, or both of the projects (Notigi and Wuskwatim), just as MB Hydro and CNP may decide not to proceed with the Keeyask/Gull Project. Consideration of the potential cumulative effects of the Notigi, Wuskwatim, and Keeyask/Gull projects will serve to identify the potential for spatially and temporally overlapping effects.

## 6.2 GENERAL APPROACH

Cumulative effects assessment may be incorporated into environmental assessment in several ways: (1) included as a separate chapter; (2) generated as a separate document; (3) partially integrated as a section at the end of each chapter of effects assessment; or, (4) fully integrated as local and regional issues are raised and assessed. The current view is that the approach to be taken for the CEA for the Wuskwatim EIS will be the third option listed above; CEA will be incorporated as a sub-section under each major heading (e.g., water quality) within the EIS. The CEA will also be discretely summarized in the summary document.

## 6.3 EXISTING LOCAL AND REGIONAL STRESSORS

As one of the key components of CEA is consideration of the cumulative effects of a proposed project in the context of existing and proposed developments/activities (i.e., actions), it is important to identify key actions that may interact with VECs identified for CEA of the Wuskwatim Project. Initial consideration of projects to include in CEA for the Wuskwatim Project were identified at the first CEA Workshop held on July 25, 2000; the inclusion/exclusion of particular projects and activities (i.e., the Project Inclusion List) will be refined at the upcoming second CEA Workshop.

It is recognized that any evaluation of pre-development conditions should be approached under the caveat that the ultimate goal of this undertaking is to assist in predicting effects of the proposed development. In other words, it is important to consider the effects of past activities in terms of gaining an understanding of how these activities continue to affect the present (i.e., existing) environment. For example, it is useful to understand the current status of VEC trends, as they relate to past activities (e.g., decreasing, increasing, or stable population status of a VEC that was affected by a past activity).

Major activities and developments to consider include:

- NCN Resource Management Area (RMA) - Existing and future plans for the resource area;
- Harvesting;
- Hydroelectric - existing and future hydroelectric development (including transmission lines);
- Forestry - past, existing, and future harvesting activities (including Tolko Manitoba Inc.);
- Mining - abandoned, existing, and proposed mines and mills; exploration activities;
- Transportation Industry – highway or road construction;
- Municipal - City of Thompson Municipal Wastewater Facility
- Recreation/Tourism - past, existing, and future activities and developments;
- Other Industry - smelting; and,
- Other stressors - other activities with the potential to exert the same effect on VECs as the proposed project (e.g., highway construction).

## 6.4 GLOBAL-SCALE EFFECTS

Additional issues to consider in CEA for the proposed Wuskwatim Project fall into the context of global change. The CEWG states:

> “Transboundary effects (e.g., animal migrations) and global-scale effects (e.g., atmospheric effects such as ozone depletion and global warming) must be addressed if a proposed action may contribute to such effects. However, in recognition of the complexities and often practical difficulty

> of scoping these effects, the CEA should at least identify the action's contributing causes, attempt to quantify the magnitude of the action's contribution, and suggest appropriate mitigation responses. In this way, decision-makers can account for the action's contribution within broad (i.e., national or international) initiatives." (Hegmann et al. 1999)

However, the CEWG also recognizes that the "level of mitigative response is often ultimately beyond the capability of a single proponent" (Hegmann et al. 1999).

A major global issue pertinent to the Wuskwatim Hydroelectric Project is greenhouse gas generation and emissions and climate change. Firstly, estimates of the contribution of the project to the generation and emission of greenhouse gases will be required in order to address the issue of the effects of the proposed project on climate change. Secondly, it is also necessary to evaluate conditions (i.e., river discharges and water levels) in the study area under hypothetical scenarios of climate change. This facilitates evaluating the effects of the project under potential future environmental conditions, as well as defining operating and management plans for such an event as climate change. In essence, it is advised to consider the effects of climate change on the project and to consider the effects of climate change in conjunction with the effects of the project (i.e., climate change treated as an 'activity'). Other global issues may be identified during the course of development of the approach to CEA.

## 6.5 LAND-USE PLANNING

CEA for the proposed Wuskwatim Project should be designed and conducted within the context of future land-use plans identified by NCN and any other existing land-use plans. This undertaking would work towards sustaining ecological integrity and the needs and future plans of NCN.

As stated earlier, early and effective communication of existing and planned natural resource management plans and initiatives is imperative to successful completion of a CEA for the Wuskwatim Project. It is hoped that the second CEA Workshop will provide an effective conduit for NCN to communicate this, and other, information necessary for scoping the CEA component of the environmental impact statement.

# 7.0 CASE STUDIES

The following case studies are intended to provide a context for development of a CEA for the proposed Wuskwatim Generation Project. These case studies indicate the range of approaches that have been employed and the challenges of CEA. It is important to note, however, that CEA is rapidly evolving and there area no established standards at this time

## 7.1 KEENLEYSIDE DAM AND POWER PROJECT (COLUMBIA BASIN TRUST AND COLUMBIA POWER CORPORATION

Project: 150 MW hydroelectric generation facility and a 230 kV transmission line.

Location: West of Castlegar, B.C., at the southern reach of the Upper Arrow Reservoir.

Proponent: Columbia Basin Trust and Columbia Power Corporation.

Process: Formal EIA/CEA.

Ruling: Approved April 1998 following submission of the Project Report (no public hearing required).

### 7.1.1 Description of the Project

Construction and operation of a 150 MW hydroelectric generation facility at an existing dam (Hugh Keenleyside Dam) on the Columbia River watershed and a transmission line to an existing electrical substation near the Canada-U.S. border.

### 7.1.2 Process and Legislation

Regulators: B.C. Ministry of Energy, Mines and Petroleum Resources (MELP); and Department of Fisheries and Oceans (DFO).

Lead RA: DFO

Legislation: B.C. Environmental Assessment Act;
Canadian Environmental Assessment Act; and,
Fisheries Act.

### 7.1.3 Approach

Approach: Definition of a CEA framework and early identification of direct and indirect cumulative effects during scoping exercises; identified future projects; spatial bounding extended beyond the Canada-U.S. border. *A review of the impacts of the existing Hugh Keenleyside Dam was not required.*

Organized and held a cumulative effects workshop for public stakeholders.

Process: Inter-governmental workshops to define and establish CEA framework.

### 7.1.4 Major Issues

Major issues identified included: fish entrainment and compensation; increased water temperature; CEA scope; and, effects on fish usage for First Nations.

### 7.1.5 Description of the CEA

#### *7.1.5.1 Issues Identification*

Focus on water quality and fisheries issues (total gas pressure; fish entrainment; thermal alterations; in-stream flow requirements; effects on fish populations; fish harvesting issues; altered reservoir water levels; and transmission line effects).

#### *7.1.5.2 VECs and Indicator Selection*

Aquatic VECs/indicators: total gas pressure; flow volumes; water temperature; changes to fish populations and fish harvesting; and, alteration of riparian habitat.

Terrestrial VECs/indicators: area of cleared land; and, effects on traditional land use by First Nations.

#### *7.1.5.3 Spatial Bounding*

Study area consisted of an area ranging 260 km from the U.S. border (approximately 40 km south of the dam) to Revelstoke and extending between 10 and 40 km on either side of the Upper and Lower Arrow Reservoir. Termination of the study area at the Canada-U.S. border was based on jurisdictional issues and not ecologically relevant considerations. Assessment areas for each issue/VEC varied.

### *7.1.5.4 Temporal Bounding*

Past: conditions prior to construction of the dam in the 1960s.
Present: baseline conditions prior to project construction.
Future: conditions during construction and operation; future conditions with other projects.

### *7.1.5.5 Included Projects*

Future projects considered were limited to those already under formal regulatory review or approved. Projects considered included: upstream and downstream dams; pipelines; roads; recreational and residential developments; and, industrial and resource extraction activities.

### *7.1.5.6 Assessment Methods*

Assessment methods were defined through a workshop attended by federal, provincial, and First Nations representatives. Issues defined included: direct effects; other projects; geographic scope; temporal scope; scale of cumulative effects; mitigation; residual cumulative effects and significance.

Potential direct and indirect effects were identified and rated according to the following criteria: direct or indirect; mitigable; compensation applied; residual effect; significance; certainty; spatial extent; and, potential as a cumulative effect.

### *7.1.5.7 Impact characterization*

Aquatic Effects Examined: altered total gas pressure effects on fish; altered flow diversion and turbines on fish entrainment; and, altered thermal regimes.

Terrestrial Effects Examined: changes to forestry; changes to wildlife habitat; and, visual quality (aesthetics).

Approach: combination of quantitative and qualitative examinations of potential effects. Mitigation and compensation options were examined. Matrix identification of which 22 considered projects may contribute to cumulative effects.

*7.1.5.8 Significance*

Concluded that the project would exert small, incremental effects.

*7.1.5.9 Future management options*

Reliance upon mitigation and compensation to offset any cumulative effects.

### 7.1.6 Lessons Learned and Additional Considerations

It was in the best interest of the proponent to include all future hydroelectric projects in the cumulative effects assessment, as the same proponent would be involved (Ross 1998). The benefit to the proponent was the ability to determine an appropriate design and management of the current proposed project (i.e., Keenleyside dam and transmission line) in such a manner as to accommodate future developments.

There were very little data available to characterize the aquatic environment prior to construction of the Keenleyside Dam in the 1960's. As such, no attempts were made to describe the environment prior to this development or to speculate on anticipated environmental conditions in the present, had the dam not been constructed. Effects of the proposed generating station were then considered only in context of projected effects relative to current conditions (i.e., in the presence of the pre-existing hydroelectric development). In this context, little adverse effects were anticipated.

Initially, DFO requested a review of the effects of the existing dam on fish entrainment, with subsequent assessment of projected additional effects arising from the proposed generating station superimposed. It was further suggested that the Columbia Power Corporation provide appropriate compensation following this review. However, the existing dam is owned by a different corporate entity (B.C. Hydro) than the proponent. Ultimately, this review was considered to be outside of the scope of the CEA (B.C.) process.

DFO (lead RAs) required consideration of alternative means of carrying out the proposed project.

It was beneficial to the proponent to consider a large spatial scale in conducting the CEA, as this increased the range of potential mitigative measures available for addressing direct effects of the project (Hegmann et al. 1999).

The initial design of the proposed generation facility was altered from a 'load-shaping' design to essentially a run-of-the-river design to avoid conducting what was perceived as a financially unfeasible cumulative effects assessment. Had the initial design been pursued (i.e., peaking plant), CPC would have been required to assess the cumulative effects of the project on upstream power projects on the Columbia River system and on the operation of other reservoirs on the Columbia River system. It was believed that this undertaking would require such a large financial investment so as to have rendered development of the project unfeasible.

In general, there was a considerable amount of confusion on the part of the RAs and other federal agencies as to the specific requirements for the conduct of a CEA, partly due to the recency with which CEA legislation had been introduced.

## 7.2 CHEVIOT COAL MINE (CARDINAL RIVER COALS LTD.)

| | |
|---|---|
| Project: | Open pit coal mine. |
| Location: | near Hinton, Alberta. |
| Proponent: | Cardinal River Coals Ltd. (CRC). |
| Process: | Formal EIA; and<br>Joint Review Panel. |
| Interveners: | the Alberta Wilderness Association; Canadian Parks and Wilderness Society; Pembina Institute for Appropriate Development; Jasper Environmental Association; and, Canadian Nature Federation (represented by the Sierra Legal Defense Fund). |

### 7.2.1 Description of the Project

CRC proposed the construction and operation of an open pit coal mine near Jasper, Alberta.

### 7.2.2 Process and Legislation

| | |
|---|---|
| Regulators: | Alberta Energy and Utilities Board (AEUB);<br>Alberta Environmental Protection (AEP); |

CEAA; and,
DFO.

Lead RA: Joint Federal/Alberta Environmental Assessment Panel.

Legislation: Alberta Environmental Protection Act;
Coal Conservation Act (provincial);
Energy Resources Conservation Act (provincial);
Canadian Environmental Assessment Act; and,
Fisheries Act.

Process: EIA submitted in 1996;
Joint federal/provincial review panel issued report in 1997;
Project approved in 1997;
Project approval quashed by federal court 1999; and,
Joint federal/provincial review panel convened 2000.

Court Action: Application launched for judicial review by: the Alberta Wilderness Association; Canadian parks and Wilderness Society; Pembina Institute for Appropriate Development; Jasper Environmental Association; and, Canadian Nature Federation. Grounds for litigation included failure to properly address: the effects of the project in combination with other projects in the area; mitigation plans; the need for the project; alternatives to the open-pit mine; and, effects on sustainable development.

Decision: Court ruled in favour of the interveners (December 1998). April 1999, court ruled that the joint federal/provincial review panel did not collect enough information about the effects of the proposed mine and related industrial activity and the project approval was denied.

The court ruled that insufficient data were collected regarding the cumulative effects of other projects (e.g. forestry and mining) and that alternative mining practices (i.e., underground mining) were not adequately assessed. In failing to address these issues, it was ruled that "the environmental assessment was not conducted in compliance with the requirements of the Canadian Environmental Assessment Act."

### 7.2.3 Approach

Process: Joint federal/provincial review panel, consisting of DFO, AEP, and AEUB, conducted hearings and reviewed the environmental effects of the proposed project. A report was issued, in which it was recommended that the project receive approval. It was acknowledged that significant adverse effects, such as effects on wildlife and the integrity of Jasper National Park, were anticipated.

### 7.2.4 Major Issues

Major issues included destruction of wildlife habitat (mammalian carnivores, migratory birds) and effects of the development on the integrity of neighbouring Jasper National Park. Destruction of fish habitat was also identified as a concern.

### 7.2.5 Description of the CEA

#### *7.2.5.1 Issues Identification*

Issues were identified through consultation with regulators, expert opinion, and stakeholders.

#### *7.2.5.2 VECs and Indicator*

The proponent indicated that due to administrative, ecological/socio-economic and technical boundary constraints, cumulative effects studies would be conducted for only select VECs. These included grizzly bears, wolves, and lynxes.

#### *7.2.5.3 Spatial Bounding*

For the mammalian carnivore VECs, a study area large enough to encompass both the proposed mine site and the home range of these species was selected.

### *7.2.5.4 Temporal Bounding*

Past: None.
Present: Baseline conditions.
Future: Conditions at the construction, operation, and abandonment phases;
Conditions immediately after mine abandonment; and,
Conditions 100 years after mine abandonment, to determine whether carnivore habitat would recover within that time frame.

In addition, CRC considered effects in terms of duration and frequency.

### *7.2.5.5 Included Projects*

Projects considered included existing developments and activities (e.g., forestry; recreational areas; and other industrial activities). Consideration of potential future developments was limited to Manalta's Mercoal and McLeod River mines.

### *7.2.5.6 Assessment Methods*

Conducted comprehensive data collection and surveys to characterize baseline environmental conditions. Cumulative effects on carnivores were assessed via a cumulative effects model and GIS-based habitat modelling.

### *7.2.5.7 Impact Characterization*

Aquatic Effects Examined: effects on water quality and fish
Terrestrial Effects Examined: effects on mammalian carnivores

Approach: Impacts were assessed in terms of: magnitude; geographic extent; duration and frequency; reversibility; ecological context; and,
presence of environmental standards, guidelines, or objectives.

### *7.2.5.8 Significance*

Effects were considered insignificant where:

- effects occurred in a localized manner over a short period of time and had no measurable effects on the integrity of the population as a whole; and,

- effects on communities were negligible, of short duration, localized, and similar to natural variation.

Effects were deemed major where they required mitigation and have widespread or regional implications or are of long-term nature or high visual or ecological effects.

#### *7.2.5.9 Future Management Options*

Regional level planning to "identify and protect blocks of high quality, effective, carnivore habitat, and ensure connection of these areas with travel corridors usable by carnivores." A compensation package was also proposed to compensate for unmitigable losses of carnivores and their habitat. Additional studies of the environment were also proposed.

### 7.2.6 Lessons Learned and Additional Considerations

The Cheviot court ruling set a strong precedent concerning two major issues pertinent to CEA and EIA in Canada. Firstly, the ruling emphasized the legal requirement of consideration of other projects. CRC stated that:

"Because of administrative, ecological and technical boundary constraints, Cardinal River Coal acknowledges that it does not have the time, technical, and economic resources to carry out cumulative effects studies for all anthropogenic sources or address all cumulative effects assessment factors which could influence all affected VECs. As a result, the company elected to carry out cumulative effects studies only on selected VECs. Criteria for the selection of specific VEC cumulative effects studies were based either on professional opinion, public concern, or government interest in particular study disciplines."

It was decided that the decision to evaluate cumulative effects of select projects on select VECs was not acceptable.

Secondly, the decision emphasized the requirement of proponents to thoroughly evaluate alternative project designs.

## 7.3 DIAVIK DIAMOND MINES PROJECT

| | |
|---|---|
| Project: | Open pit / underground diamond mine. |
| Location: | 300 km northeast of Yellowknife, NT. |
| Proponent: | Rio Tinto Inc. and Aber Diamond Mines Ltd. |
| Process: | Formal EIA; and,<br>Comprehensive Study Report |
| Interveners: | Canadian Arctic Resources Committee (CARC). |
| Ruling: | Out-of-court settlement announced July 27, 2000. Diavik agreed to provide<br>$400, 000 for a study of cumulative environmental effects of mining in the Slave Geological Province, including evaluations of ecological indicators and thresholds to assist in cumulative effects assessment in the area. |

### 7.3.1 Description of the Project

The Diavik Diamond Mines Project would involve open pit mining of four kimberlite pipes located within Lac de Gras, NT. The ore would be accessed by constructing dikes around the pipes and dewatering the overlying water.

### 7.3.2 Process and Legislation

| | |
|---|---|
| Regulators: | Department of Indian and Northern Affairs (DIAND);<br>DFO; and,<br>Department of Natural Resources (NRC). |
| Lead RA: | DIAND |
| Legislation: | Northwest Territories Water Act;<br>Territorials Lands Act;<br>Fisheries Act (DFO); and,<br>Canadian Environmental Assessment Act. |
| Process: | EIA submitted in 1998;<br>EIA reviewed and Comprehensive Study Report (CSR) released in 1999;<br>Project approved in 1999;<br>Legal action launched by CARC; and,<br>Out-of-court settlement reached 2000. |

Court Action: Application launched for judicial review by CARC. Grounds for litigation were based on two primary issues: (1) alternative mining methods for carrying out the project were not granted adequate attention; and, (2) inadequate conduct of CEA, including failure to consider cumulative effects of other projects in the area, particularly projects that had been proposed prior to the conduct of CEA.

### 7.3.3 Approach

Process: RAs reviewed the EIA and consulted with First Nations and other members of local communities. A CSR was drafted and then reviewed by a Steering Committee consisting of DFO, DIAND, NRC, CEAA, and a federal-territorial inter-governmental working group. The CSR was issued, in which it was recommended that the project receive approval. However, a number of recommendations were issued including detailed descriptions for monitoring. In addition, RAs indicated that a regional cumulative effects management framework be developed.

### 7.3.4 Major Issues

Major issues included destruction of wildlife habitat (caribou) and effects of the development on water quality in and downstream of Lac de Gras. Destruction of fish habitat was also identified as a concern.

### 7.3.5 Description of the CEA

#### *7.3.5.1 Issues Identification*

Issues were identified through community consultation and via professional and technical opinion. Major issues included effects on caribou and other large mammals, water quality (drinking water quality and water quality for the protection of aquatic life), fish, and fish habitat.

#### *7.3.5.2 VECs and Indicator Selection*

Aquatic VECs/indicators: fish; water supply; water quality
Terrestrial VECs/indicators: caribou; grizzly bear; carnivores; raptors; and, small game

***7.3.5.3 Spatial Bounding***

In general, study areas were selected at several scales to accommodate fine and coarse scale assessments of potential effects. For wildlife, three study areas were selected: (1) the project footprint; (2) a local study area; and, (3) a regional study area. A local and regional study areas were identified for evaluation of fish and water.

***7.3.5.4 Temporal Bounding***

Past: None.
Present: Baseline conditions.
Future: Conditions at the construction, operation, closure, and post-closure phases.

Not all time frames were assessed for each discipline.

***7.3.5.5 Included Projects***

Only existing projects and activities were evaluated in the CEA. Future projects, including an expansion of the neighbouring BHP Diamond Mine (Ekati), for which an application for approval was submitted prior to completion of the CSR for Diavik, were not evaluated.

***7.3.5.6 Assessment Methods***

Assessment methods were largely based upon modelling and linkage diagrams associated with key questions.

***7.3.5.7 Impact Characterization***

Aquatic Effects Examined: water quality; fish habitat; water supply
Terrestrial Effects Examined: effects on wildlife VECs; air quality

Approach: Impacts were assessed in terms of magnitude, duration, and geographic extent. Additional considerations included ecological context, frequency, reversibility, and confidence.

### *7.3.5.8 Significance*

In terms of cumulative effects, only impacts deemed of high probability and magnitude within the regional study areas were considered significant. Where uncertainties associated with predictions were high, assessment was deferred to monitoring.

### *7.3.5.9 Future Management Options*

Monitoring and mitigation plans for the aquatic environment, wildlife, and air quality were developed and an environmental management plan was proposed. RAs indicated further additions to these plans. The Minister of the Environment committed the federal government to develop a regional cumulative effects management framework.

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