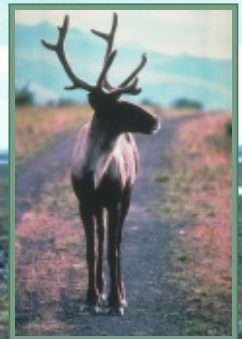


# Report of Environmental Assessment and Reasons for Decision on the De Beers Canada Mining Inc. Snap Lake Diamond Project



Mackenzie Valley  
Environmental Impact Review Board

July 24, 2003





**Charlie Snowshoe**



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**Cover Photo credits :** GNWT-RWED - caribou, mother and child  
De Beers Canada Mining Inc. - Visuals of the proposed Snap Lake mine site  
Heidi Klein, Gartner Lee Ltd. - Heath boulder field

# **Report of Environmental Assessment and Reasons for Decision on the De Beers Canada Mining Inc. Snap Lake Diamond Project**

**July 24, 2003**



**Mackenzie Valley**  
Environmental Impact Review Board



July 24th, 2003

The Honourable Robert D. Nault, P.C., M.P.  
Minister, Indian and Northern Affairs Canada  
MINISTER'S OFFICE  
10 Wellington St. North Tower  
Hull, P.Q. K1A 0H4

Dear Minister Nault:

**Re: De Beers Canada Mining Inc. Report of  
Environmental Assessment and Reasons for Decision**

It is my pleasure to convey the Mackenzie Valley Environmental Impact Review Board's Report of Environmental Assessment and Reasons for Decision on the proposed De Beers Canada Mining Inc. Snap Lake Diamond Project for your attention. The Mackenzie Valley Environmental Impact Review Board (Review Board) has recommended that this development proceed to the regulatory phase of approvals, subject to a number of recommended measures to mitigate the residual environmental impacts of the proposed project. The Review Board's decision was taken in accordance with paragraph 128(1)(b)(ii) of the *Mackenzie Valley Resource Management Act*.

The preparation of this Report of Environmental Assessment would not have been possible without the commitment and effort of each Board member, Board staff and its consultants. I also wish to acknowledge the contributions of DeBeers Canada Mining Inc., the intervenors and all participants to the environmental assessment process. Recognition is also due to Regional Indian and Northern Affairs Canada staff whose active participation was essential in producing a thorough and timely assessment. The Review Board appreciates the collective efforts of all those involved in producing this report.

We look forward to your response to this Report of Environmental Assessment.

Sincerely,

A handwritten signature in black ink, appearing to read 'Gordon Why', written over a circular stamp.

Gordon Why  
Chair of the DeBeers  
Snap Lake Diamond Project  
Environmental Assessment

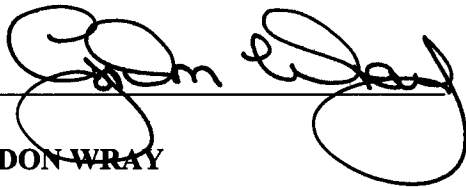
Attachment

## **Review Board Environmental Assessment Decision**

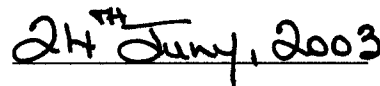
To make its decision in this Environmental Assessment (EA), the Mackenzie Valley Environmental Impact Review Board has relied upon all the information on the Public Record. Having considered this evidence, the Review Board has made its decision in accordance with Section 128 of the *Mackenzie Valley Resource Management Act* (MVRMA).

It is the Board's opinion that without additional mitigation, the proposed development, considered as a whole, would be likely to cause a significant adverse impact on the environment. In order to prevent this significant adverse impact, the Board has recommended a number of measures in this report.

The Board has concluded, pursuant to subparagraph 128(1)(b)(ii) of the MVRMA that with the implementation of the measures recommended in this Report of EA and the commitments made by De Beers during the course of the EA (see Appendix D), the proposed development will not likely have a significant adverse environmental impact and should proceed to the regulatory phase of approvals.



**GORDON WRAY**  
**Chair of the DeBeers**  
**Snap Lake Diamond Project**  
**Environmental Assessment**



**DATE**



## **Summary: Report of Environmental Assessment**

### **Introduction**

De Beers Canada Mining Inc. (De Beers) submitted applications for a Class A Land Use Permit and a Class A Water License for the proposed Snap Lake Diamond Project (SLDP) to the Mackenzie Valley Land and Water Board, for the development of a 3,000 tonne per day underground diamond mine with an operating life of 22 years. The proposed SLDP is approximately 220 kilometres northeast of Yellowknife, NWT and is situated on Snap Lake at the headwaters of the Lockhart River drainage system (Figure A). The mine footprint will house up to 350 people and will have infrastructure including a camp complex, mining related buildings such as a process plant, a paste plant, an explosives factory, various storage buildings, a water treatment plant, waste disposal systems, power plant and airstrip. Outside of the mine footprint are winter roads for access to the site and an esker south of the mine site that will be used for quarrying purposes.

The North Pile will be the most noticeable mine site feature and is the surface containment feature for processed kimberlite and potentially acid generating waste rock. A landfill, landfarms to treat any hydrocarbon contaminated soils, and three granite quarries will be located within the North Pile footprint. An engineered ditch will surround the North Pile and other laydown areas to collect water that drains from these features. This water will be directed to settling ponds and then to the water treatment plant before being released to Snap Lake. Approximately half of the processed kimberlite that is produced each year will be mixed with cement and then pumped back into the mine for permanent storage as backfill material. The remainder of the processed kimberlite will be pumped to the North Pile for permanent storage.

Almost all the water that comes into contact with the SLDP during construction and operation will be treated before being released into Snap Lake. Water for the SLDP will be taken from Snap Lake for diamond processing and for domestic use at the camp.

For shipping of major supplies, such as fuel, to the site, the SLDP will use the Tibbitt-Contwoyto winter road, plus a winter access road between the proposed mine site and the Tibbitt-Contwoyto winter road.

### **EA Process**

The proposed SLDP was referred to the Mackenzie Valley Environmental Impact Review Board (Review Board) on May 23, 2001. The approach that was taken for this EA has been to resolve technical issues throughout the process and to develop an understanding of positions between the Parties of the EA and the De Beers. It is the Review Board's view that this approach has facilitated a thorough understanding of the SLDP. The EA process for the SLDP has included 2 major stages: 1) an issues focusing stage; and, 2) an issues evaluation stage.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The issues focusing stage included:

- Completion of a Terms of Reference;
- Submission of the developer's (De Beers) Environmental Assessment Report;
- Completion of the Conformity Analysis;
- Completion of four rounds of Information Requests (IRs) for a total of 433 IRs; and,
- Ten days of Technical Sessions.

The issues evaluation stage included:

- Completion of Technical Reports by the Parties of the EA;
- Completion of a Pre-hearing Conference;
- Completion of a five-day Public Hearing; and,
- Completion of the Review Board's Report of EA and Reasons for Decision (this document).

The next stage in the EA process is the review of the Review Board's Report of Environmental Assessment and Reasons for Decision by the Minister of the Department of Indian Affairs and Northern Development as required by the *Mackenzie Valley Resource Management Act* (MVRMA). Following the review, the Minister will issue a decision with respect to this report that will either authorize the project to proceed or to undergo additional assessment.

All of the information generated during the EA process has been filed on the Review Board public registry. A total of 16 parties consisting of federal and territorial departments, aboriginal organizations and communities, and non-governmental organizations were registered as Parties to the EA for the assessment of the Snap Lake Diamond Project.

The Review Board makes recommendations only where there is a likelihood or potential for significant adverse impacts. Under section 130(5) of the MVRMA, "*a first nation, local government, regulatory authority or department or agency of the federal or territorial government affected by a decision made under this section shall act in conformity with the decision to the extent of its authority*". Suggestions are offered where potential significant adverse impacts are not predicted, but in the opinion of the Board additional measures should be considered by regulatory authorities to ensure effective long term management of issues over the life of the mine.

### Environmental and Socio-economic Impacts Analysis

This report considers the impacts of the SLDP and is organized to include:

- Summary of the developer's (De Beers) submission;
- Summary of responses from the Parties to the EA;
- An analysis of key issues;
- Conclusions; and,
- Recommendations or suggestions.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The Review Board narrowed its consideration of the issues for purposes of this Report of EA to those matters which, in the Board's opinion, required additional discussion, analysis and, in some cases, action by responsible Ministers. The Review Board considered all information on the public record in its deliberations.

The environmental and socio-economic impacts analysis considered:

- Geotechnical issues associated with the North Pile;
- Impacts on groundwater quantity and quality;
- Impacts on hydrology (surface water quantity);
- Impacts on surface water quality;
- Aquatic organisms and habitat (including fish);
- Impacts on geology and terrain, including permafrost from mine site and off-site development; such as the esker for quarrying purposes;
- Impacts on vegetation and biodiversity;
- Impacts on wildlife and wildlife habitat;
- Impacts on air quality and contribution to greenhouse gases from mine emissions;
- Impacts from mine site noise;
- Economic impacts;
- Socio-cultural impacts;
- Impacts on resource use, including the Tibbitt-Contwoyto winter road;
- Environmental health;
- Biophysical and socio-economic cumulative impacts;
- Effects of the environment (e.g. unusual weather events, earthquakes, climate change) on the mine development;
- Accidents and malfunctions at the proposed mine site and on the Tibbitt-Contwoyto winter road;
- Project alternatives and opportunities for mine development;
- Abandonment and reclamation, including progressive reclamation; and,
- Follow up monitoring programs including adaptive management.

One of the larger issues raised during the Public Hearing for the SLDP was the lack of sufficient environmental and socio-economic baseline information. These information deficiencies were most noted for Surface Water Quality, Aquatic Resources, Wildlife, Economics and Socio-cultural topic areas. In some instances, De Beers did not gather sufficient environmental baseline information to provide the Review Board with assurances that the uncertainties around EA predictions were reasonable. In these instances, the Review Board has developed specific recommendations, as provided in this report, to address these deficiencies.





# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

## Review Board's Conclusions

The Review Board developed conclusions regarding the significance of impacts related to all of the areas considered in the impacts analysis. For environmental and socio-economic areas where the Board considered that there are likely or potential significant adverse impacts, recommendations were developed to mitigate such impacts. The following lists those areas for which recommendations were developed:

- Mine groundwater discharge quality;
- Aquatic effects monitoring program;
- Total Dissolved Solids in Snap Lake;
- Conflicts between carnivores and mine site development;
- Completion of a Socio-Economic Agreement;
- Caribou population and movements;
- Carnivore mortality, population, behaviour and movements; and,
- Regional cumulative effects program for the Slave Geological Province.

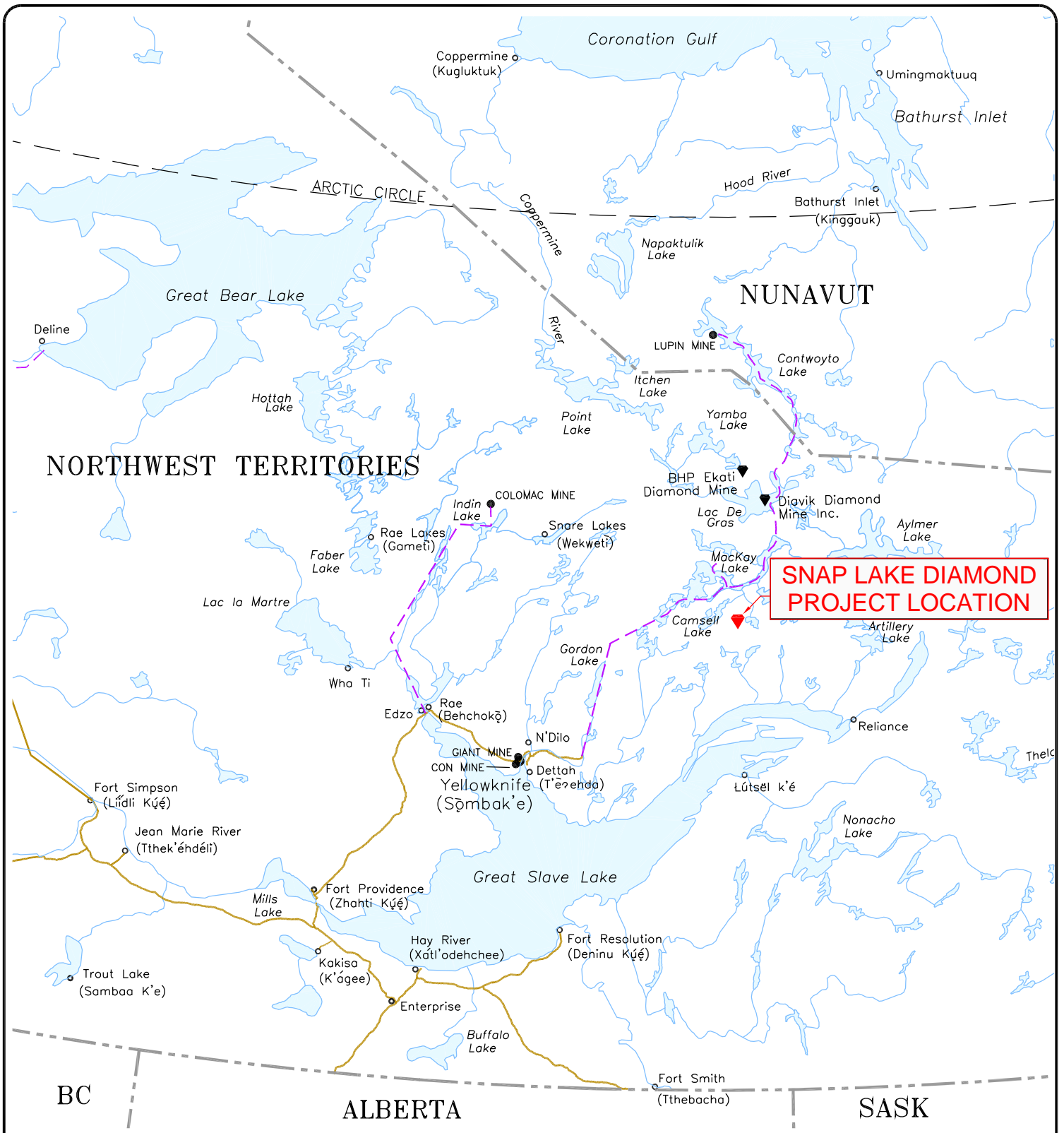
The complete recommendations for each of the areas summarized above are provided in Section 2 of this report and are compiled in Appendix C.

The Review Board made a number of suggestions related to aspects of the impacts analysis other than those listed above. These suggestions are provided in Section 2 of this report and are also compiled in Appendix C.

## Review Board Environmental Assessment Decision

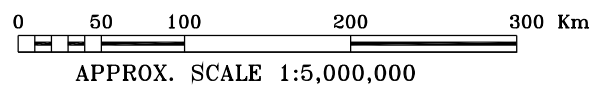
The Review Board relied upon all of the information filed on the public record for the preparation of the Report of Environmental Assessment and Reasons for Decision. The Review concludes that, with the implementation of the measures recommended in this Report of EA and implementation of commitments and mitigation measures proposed by De Beers, the proposed development will not likely have a significant adverse environmental impact and should proceed to the regulatory phase of approvals.





**SNAP LAKE DIAMOND PROJECT LOCATION**

- LEGEND:**
- ALL-WEATHER HIGHWAYS
  - - - WINTER ROADS
  - COMMUNITY
  - ▼ DIAMOND MINE/EXPLORATION
  - GOLD MINE



**SOURCE OF FIGURE:**  
 FIGURE ADAPTED FROM GOLDER ASSOCIATES FIGURE 1.2-1 TITLED "LOCATION OF SNAP LAKE DIAMOND PROJECT - NORTHWEST TERRITORIES" PROJ. NO. 012-6492 DATED 19/11-01, FOR DE BEERS.

ORIGINAL SOURCE: SELECTED MINERAL DEPOSITS OF THE NORTHWEST TERRITORIES, DEPARTMENT OF ENERGY MINES AND RESOURCES, MINERAL INITIATIVES 1991 TO 1996 REVISED OCTOBER, 1996.



**Mackenzie Valley**  
 Environmental Impact Review Board

REPORT OF ENVIRONMENTAL ASSESSMENT AND REASONS FOR DECISION ON THE DE BEERS SNAP LAKE DIAMOND PROJECT

**LOCATION MAP**

FILE NAME:  
23065-D1-04.DWG

FIGURE NO. **A**

# Table of Contents

	Page
<b>Summary: Report of Environmental Assessment</b>	<b>i</b>
<b>1. INTRODUCTORY INFORMATION</b>	<b>1</b>
<b>1.1 Introduction</b>	<b>1</b>
1.1.1 Referral of the Proposed Development to the Review Board	1
1.1.2 Requirements of the Mackenzie Valley Resource Management Act	2
<b>1.2 Environmental Assessment Process</b>	<b>3</b>
1.2.1 Parties to the EA	3
1.2.2 EA Approach	4
1.2.2.1 Issues Focusing Stage	5
1.2.2.2 Issues Evaluation Stage	8
<b>1.3 Scope of the Proceeding</b>	<b>11</b>
1.3.1 Scope of Proposed Development	11
1.3.2 Scope of the Assessment	12
<b>1.4 Determining Significance and Review Board Recommendations</b>	<b>13</b>
<b>1.5 Public Participation in the Snap Lake EA</b>	<b>17</b>
1.5.1 Community Engagement	17
1.5.2 Consultation	18
1.5.3 Participant Funding	21
<b>1.6 Environmental, Socio-economic and IBA Agreements and Part 5 of the MVRMA</b>	<b>22</b>
<b>1.7 Overview of Snap Lake Diamond Project</b>	<b>25</b>
1.7.1 General Description of the Environment at Snap Lake	25
1.7.2 Site Features	27
1.7.3 Development and Mining the Ore	30
1.7.4 Recovering the Diamonds	30
1.7.5 Storing Waste Rock and Processed Kimberlite	30
1.7.6 Water Management	31
<b>2. IMPACT ANALYSIS</b>	<b>33</b>



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>2.1</b>	<b>Review Board’s Analysis Approach.....</b>	<b>33</b>
2.1.1	Structure of Analysis .....	33
2.1.2	Issue Identification .....	34
2.1.3	Developer’s Commitments.....	35
<b>2.2</b>	<b>Study Areas .....</b>	<b>36</b>
<b>2.3</b>	<b>Geotechnical, Geochemical, and Thermal Influences .....</b>	<b>39</b>
2.3.1	Summary of Developer’s Submissions.....	40
2.3.2	Summary of Responses from the Parties.....	41
2.3.2.1	INAC’s Position .....	41
	Dr. Chris Burn, Consultant to INAC, NWT Region .....	42
2.3.2.2	Yellowknives Dene First Nation .....	43
2.3.2.3	Natural Resources Canada.....	43
2.3.3	Key Issues.....	44
2.3.3.1	Temperature Model for the North Pile .....	44
	Description of Issue .....	44
	Conclusions.....	45
2.3.3.2	Cryoconcentration Effects in the North Pile .....	47
	Description of Issue .....	47
	Conclusions.....	48
2.3.3.3	North Pile Seepage Quantity and Quality .....	48
	Description of Issue .....	48
	Conclusions.....	50
2.3.3.4	North Pile Seepage Collection Ditch.....	51
	Description of Issue .....	51
	Conclusions.....	51
2.3.3.5	Geotechnical Suggestions for North Pile .....	52
<b>2.4</b>	<b>Hydrogeology .....</b>	<b>52</b>
2.4.1	Summary of Developer’s Submission .....	52
2.4.2	Summary of Responses from the Parties.....	54
2.4.3	Key Issues.....	55
2.4.3.1	Mine Groundwater Discharge Quantity .....	55
	Description of Issue .....	55
	Conclusions.....	56
	Suggestions .....	56
2.4.3.2	Mine Groundwater Discharge Quality .....	57
	Description of Issue .....	57
	Recommendations.....	60



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>2.5 Hydrology</b>	<b>61</b>
2.5.1 Summary of Developer’s Submissions	61
2.5.2 Summary of Responses from the Parties	63
2.5.3 Conclusions	63
2.5.4 Suggestions	63
<b>2.6 Surface Water Quality</b>	<b>64</b>
2.6.1 Summary of Developer’s Submissions	65
2.6.2 Summary of Responses from the Parties	69
2.6.3 Key Issues	73
2.6.3.1 Aquatic Effects Monitoring Program (AEMP)	74
Description of Issue	74
Conclusions	75
Recommendations	75
2.6.3.2 Phosphorus and Dissolved Oxygen	75
Description of Issue	75
Conclusions	76
Suggestions	77
2.6.3.3 Effects of TDS in Snap Lake - Accuracy of Predictions	77
Description of Issue	77
Conclusions	78
Recommendations	79
2.6.3.4 Certainty of Mixing of TDS in Snap Lake	79
Description of Issue	79
Conclusions	80
Recommendations	80
2.6.3.5 Site Specific Water Quality Benchmarks	81
Description of Issue	81
Conclusions	82
Suggestions	82
<b>2.7 Aquatic Organisms and Habitat</b>	<b>82</b>
2.7.1 Summary of Developer’s Submissions	83
2.7.2 Summary of Responses from the Parties	85
2.7.3 Key Issues	88
2.7.3.1 Adequacy of Baseline Data – Aquatic Environment	88
Description of Issue	88
Conclusions	89
Suggestions	90
2.7.3.2 Phosphorus and Dissolved Oxygen	90
Description of Issue	90



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

	Conclusions.....	92
	Suggestions .....	92
2.7.3.3	Effects of TDS on Aquatic Life .....	93
	Description of Issue .....	93
	Conclusions.....	95
	Recommendations.....	96
2.7.3.4	Effects of Trace Metals .....	96
	Description of Issue .....	96
	Conclusions.....	97
2.7.3.5	Assessment Endpoints and Keystone Species .....	98
	Description of Issue .....	98
	Conclusions.....	99
2.7.3.6	Toxicant Interactions.....	99
	Description of Issue .....	99
	Conclusions.....	99
	Suggestions .....	100
2.7.3.7	Fish Habitat .....	100
	Description of Issue .....	100
	Conclusions.....	102
	Suggestions .....	103
<b>2.8</b>	<b>Geology and Terrain .....</b>	<b>103</b>
2.8.1	Summary of Developer’s Submissions.....	103
2.8.2	Summary of Responses from the Parties .....	104
2.8.3	Conclusions .....	105
2.8.4	Suggestions.....	105
<b>2.9</b>	<b>Ecological Land Classification and Biodiversity .....</b>	<b>105</b>
2.9.1	Summary of Developer’s Submissions.....	106
2.9.2	Summary of Responses from the Parties .....	108
2.9.3	Conclusions .....	109
<b>2.10</b>	<b>Wildlife and Wildlife Habitat .....</b>	<b>109</b>
2.10.1	Summary of Developer’s Submissions.....	110
2.10.2	Summary of Responses from the Parties .....	112
2.10.3	Key Issues.....	114
	2.10.3.1 Impacts on Wildlife Habitat .....	114
	Description of Issue .....	114
	Conclusions.....	117
	Suggestions .....	118
	2.10.3.2 Change in Movement Patterns and Behaviour .....	119



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

	Description of Issue .....	119
	Conclusions.....	123
	Recommendations.....	124
2.10.3.3	Wildlife Abundance .....	125
	Description of Issue .....	125
	Conclusions.....	128
	Recommendations.....	128
<b>2.11</b>	<b>Resource Uses.....</b>	<b>129</b>
2.11.1	Summary of Developer’s Submissions.....	129
2.11.2	Summary of Responses from the Parties.....	131
2.11.3	Conclusions .....	132
2.11.4	Suggestions.....	133
<b>2.12</b>	<b>Air Quality .....</b>	<b>133</b>
2.12.1	Summary of Developer’s Submissions.....	133
2.12.2	Summary of Responses from the Parties.....	134
2.12.3	Key Issues.....	135
2.12.3.1	Local and Regional Air Quality .....	135
	Description of Issue .....	135
	Conclusions.....	135
	Suggestions .....	136
2.12.3.2	Greenhouse Gases .....	136
	Description of Issue .....	136
	Conclusions.....	137
	Suggestions .....	138
<b>2.13</b>	<b>Noise 138</b>	
2.13.1	Summary of Developer’s Submissions.....	138
2.13.2	Summary of Responses from the Parties.....	139
2.13.3	Conclusions .....	139
2.13.4	Suggestions.....	139
<b>2.14</b>	<b>Environmental Health.....</b>	<b>140</b>
2.14.1	Summary of Developer’s Submissions.....	140
2.14.2	Summary of Responses from the Parties.....	140
2.14.3	Key Issues.....	142
2.14.3.1	Effects on Wildlife and Human Health .....	142
	Description of Issue .....	142
	Conclusions.....	144
	Suggestions .....	145



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>2.15 Biophysical Cumulative Effects.....</b>	<b>145</b>
2.15.1 Summary of Developer’s Submissions.....	145
2.15.2 Summary of Responses from the Parties.....	148
2.15.3 Key Issues.....	150
2.15.3.1 Environmental Health Cumulative Effects.....	150
Description of Issue.....	150
Conclusions.....	151
2.15.3.2 Wildlife Cumulative Effects.....	151
2.15.3.2.1 Cumulative Effects - Direct and Indirect Wildlife Habitat Loss.....	151
Description of Issue.....	151
Conclusions.....	152
Suggestions.....	154
2.15.3.2.2 Cumulative Effects - Caribou Population and Movement.....	154
Description of Issue.....	154
Conclusions.....	157
2.15.3.2.3 Cumulative Effects - Direct Carnivore Mortality.....	160
Description of Issue.....	160
Conclusions.....	162
Recommendations.....	163
2.15.3.2.4 Cumulative Effects - Monitoring and Integrated Resource Management.....	164
Description of Issue.....	164
Conclusions.....	167
Recommendations.....	169
<b>2.16 Economic.....</b>	<b>170</b>
2.16.1 Approach on Project-specific & Cumulative Effects.....	170
2.16.2 Summary of Developer’s Submissions.....	170
2.16.3 Summary of Responses from the Parties.....	173
2.16.4 Key Issues.....	174
2.16.4.1 Predicted Employment and Business Opportunities.....	175
Description of Issue.....	175
Conclusions.....	176
Recommendations.....	177
2.16.4.2 Rate of Production.....	177
Description of Issue.....	177
Conclusions.....	177
2.16.4.3 Hydroelectric Energy Option.....	178
Description of Issue.....	178
Conclusions.....	178
2.16.4.4 Resource Depletion, Economic Sustainability and Diversification.....	179





# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

	Description of Issue .....	179
	Conclusions.....	180
	Suggestions .....	180
2.16.4.5	Government Finances.....	180
	Description of Issue .....	180
	Conclusions.....	181
	Suggestions .....	182
<b>2.17</b>	<b>Socio-Cultural.....</b>	<b>182</b>
2.17.1	Approach on Project-specific & Cumulative Effects .....	182
2.17.2	Summary of Developer’s Submissions.....	183
2.17.3	Summary of Responses from the Parties .....	188
2.17.4	Key Issues.....	191
2.17.4.1	Social Stability and Community Wellness.....	191
	Description of Issue .....	191
	Conclusions.....	194
2.17.4.2	Community Services and Housing.....	195
	Description of Issue .....	195
	Conclusions.....	197
2.17.4.3	Cultural Well-Being .....	197
	Description of Issue .....	197
	Conclusions.....	199
2.17.4.4	Socio-Cultural Suggestions .....	200
2.17.4.4.1	Suggestions .....	200
<b>2.18</b>	<b>Effects of the Environment on the Development .....</b>	<b>201</b>
2.18.1	Summary of Developer’s Submissions.....	201
2.18.2	Summary of Responses from the Parties .....	203
2.18.3	Conclusions .....	203
<b>2.19</b>	<b>Accidents and Malfunctions .....</b>	<b>204</b>
2.19.1	Summary of Developer’s Submission .....	204
2.19.2	Summary of Responses from the Parties .....	205
2.19.3	Key Issues.....	206
2.19.3.1	Winter Road Spills .....	206
	Description of Issue .....	206
	Conclusions.....	207
<b>2.20</b>	<b>Project Alternatives and Opportunities.....</b>	<b>207</b>
2.20.1	Summary of Developer’s Submission .....	208
2.20.2	Summary of Responses from the Parties .....	210



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

2.20.3	Key Issues.....	211
2.20.3.1	Water Treatment Technology.....	211
	Description of Issue .....	211
	Conclusions.....	212
2.20.3.2	Landfarm and Landfill .....	212
	Description of Issue .....	212
	Conclusions.....	213
	Suggestions .....	213
2.20.3.3	Employee / Worker Schedule and Living Conditions.....	214
	Description of Issue .....	214
	Conclusions.....	214
<b>2.21</b>	<b>Abandonment &amp; Reclamation.....</b>	<b>214</b>
2.21.1	Summary of Developer’s Submissions.....	214
2.21.2	Summary of Responses from the Parties.....	216
2.21.3	Key Issues.....	218
2.21.3.1	Reclamation Criteria .....	218
	Description of Issue .....	218
	Conclusions.....	219
	Suggestions .....	220
2.21.3.2	Contaminant Uptake by Plants.....	220
	Description of Issue .....	220
	Conclusions.....	221
<b>2.22</b>	<b>Follow-up Programs.....</b>	<b>222</b>
2.22.1	Summary of Developer’s Submissions.....	222
2.22.2	Summary of Responses from the Parties.....	223
2.22.3	Conclusions .....	223
2.22.4	Suggestions.....	224



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

## List of Figures

Figure 1	Review Board’s Approach to the Snap Lake EA .....	4
Figure 2	Location Map.....	26
Figure 3	General Site Layout, Snap Lake Diamond Project.....	28
Figure 4	Site Plan, Snap Lake Diamond Project.....	29

## List of Tables

Table 1	Issuance and Response Dates for Each IR Round.....	7
Table 2	Number of IRs Issued by the Review Board for the Snap Lake EA .....	7

## Glossary of Terms

## List of Appendices

Appendix A.	List of Supplemental Technical Documents Submitted by De Beers
Appendix B.	List of Recommendations and Suggestions
Appendix C.	List of Issues Raised in the Snap Lake EA Process
Appendix D.	List of De Beers Commitments



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

## Abbreviations

<b>AEMP</b>	Aquatic Effects Monitoring Program
<b>AEP</b>	Advanced Exploration Program
<b>CARC</b>	Canadian Arctic Resources Committee
<b>CCME</b>	Canadian Council of Ministers of the Environment
<b>CEAM Strategy &amp; Framework</b>	Cumulative Effects Assessment and Management Strategy and Framework
<b>De Beers</b>	De Beers Canada Mining Inc.
<b>DFO</b>	Department of Fisheries and Oceans
<b>Diavik</b>	Diavik Diamond Mines Inc.
<b>EA</b>	Environmental Assessment
<b>EAR</b>	Environmental Assessment Report (De Beers)
<b>EIR</b>	Environmental Impact Review
<b>EKATI</b>	BHP Billiton EKATI Diamond Mine™
<b>ELC</b>	Ecological Land Classification
<b>GHG</b>	Greenhouse Gasses
<b>GNWT</b>	Government of Northwest Territories
<b>IBA</b>	Impact Benefits Agreement
<b>INAC</b>	Indian and Northern Affairs Canada
<b>IR</b>	Information Request
<b>LSA</b>	Local Study Area
<b>MVRMA</b>	Mackenzie Valley Resource Management Act
<b>NNL</b>	No Net Loss
<b>NO<sub>2</sub></b>	Nitrogen Dioxide
<b>NO<sub>x</sub></b>	Oxides of nitrogen
<b>NRCan</b>	Natural Resources Canada
<b>NSMA</b>	North Slave Métis Alliance



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>NWT</b>	Northwest Territories
<b>PAH</b>	Polycyclic aromatic hydrocarbon
<b>PK</b>	Processed kimberlite
<b>PM</b>	Particulate matter
<b>RSA</b>	Regional Study Area
<b>SLDP</b>	Snap Lake Diamond Project
<b>SO<sub>2</sub></b>	Sulphur dioxide
<b>TDS</b>	Total Dissolved Solids
<b>TK</b>	Traditional Knowledge
<b>TSP</b>	Total suspended particulate
<b>USEPA</b>	United States Environmental Protection Agency
<b>VEC</b>	Valued ecosystem component
<b>WWF</b>	World Wildlife Fund Canada
<b>YKDFN</b>	Yellowknives Dene First Nation



# 1. Introductory Information

**Section 1, *Introductory Information***, provides an overview of the Review Board’s environmental assessment (EA) process and discusses several overarching policy matters which emerged during the EA process. It also provides a brief description of the development proposal.

**Section 2, *Impact Analysis***, considers each of the environmental components that De Beers was required to examine during its impact assessment of the Snap Lake Diamond Project (SLDP) on the biophysical and socio-economic environment. Section 2.1 includes further detail on the Review Board’s approach to the *Impact Analysis*.

## 1.1 Introduction

This report constitutes both the Reasons for Decision of the Review Board and Report of Environmental Assessment (EA) required by the sections 121 and 128(2) of the *Mackenzie Valley Resource Management Act* (MVRMA).

This section of the Report of EA outlines the roles and responsibilities of the Mackenzie Valley Environmental Impact Review Board (Review Board or Board) and describes the EA process for the SLDP, including a brief description of some of the overarching issues which affected the Review Board’s EA process. It also provides a summary description of the development proposal under consideration.

### 1.1.1 Referral of the Proposed Development to the Review Board

On February 2, 2001, De Beers Canada Mining Inc.<sup>1</sup> (De Beers) submitted applications for a Class ‘A’ Land Use Permit and a Class ‘A’ Water Licence for the proposed SLDP to the Mackenzie Valley Land and Water Board for the following developments:

- Development of a 3,000 tonne per day underground diamond mine with an operating life of 22 years;
- Construction of support facilities, including a camp complex for up to 350 people, process plant, paste plant, cement plant, processed kimberlite (PK) containment area, explosives factory, storage buildings, waste disposal systems, and power plant;
- Expansion of existing facilities, including tank farm, airstrip, and explosive storage;
- Establishment of annual winter access and esker access roads along existing routes; and,
- Quarrying of esker material as required for construction and operational purposes.

On May 23, 2001, the Mackenzie Valley Land and Water Board referred the development to the Review Board for an EA, in accordance with ss.125(1) of the MVRMA. The Review Board is required by

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<sup>1</sup> De Beers Canada Mining Inc. is also referred to as the “developer” in this Report of EA.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

ss. 126(1) of the MVRMA to conduct an EA of a development referred in accordance with a preliminary screening decision made under s. 125 of the MVRMA.

On June 25, 2001, the Review Board issued a document including draft Terms of Reference and a Work Plan for the Snap Lake EA, for consultation purposes. The Review Board considered submissions and comments on this document received between June 25<sup>th</sup> and September 20, 2001. The final *Terms of Reference and Work Plan for the Environmental Assessment of the De Beers Canada Mining Inc. Snap Lake Diamond Project* (the Terms of Reference) were issued on September 20, 2001.

The Terms of Reference contain:

- Description of the development;
- Description of the roles and responsibilities of the Parties involved in the EA;
- Outline of the general approach for completing the EA, including milestones and a schedule;
- Review Board's determination of scope of the development;
- Review Board's determination of scope of the assessment; and,
- Directions to the developer on the requirements to be met in the EA process.

### 1.1.2 Requirements of the Mackenzie Valley Resource Management Act

The Mackenzie Valley Environmental Impact Review Board administers Part 5 of the MVRMA and has decision-making responsibilities in relation to the proposed Snap Lake development. The Review Board is responsible for the conduct of an EA which considers the environmental, socio-economic and cultural impacts of the proposed development in accordance with sections 114 and 115 of the MVRMA. The conduct of the Board's EAs and environmental impact reviews is based on its Rules of Procedure.<sup>2</sup> Pursuant to s. 117 of the MVRMA, the Board must determine the scope of development and sets out the factors to be considered in the EA of a development in consultation with the federal and responsible and Ministers, if such consultation is requested. The Board is also required to prepare and submit a Report of Environmental Assessment in accordance with ss. 128(2), a decision under ss. 128(1), and written reasons, required by s. 121, to the federal Minister of Indian and Northern Affairs Canada .

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<sup>2</sup> The Review Board released *Rules of Procedure for Environmental Assessment and Environmental Impact Review Proceedings* on March 21, 2001. For the purposes of the De Beers EA, the Review Board adopted these Rules on September 17, 2001 as the *De Beers Snap Lake Diamond Mine Rules of Procedure for Environmental Assessment and Environmental Impact Review Proceedings* ("Rules of Procedure").



## **1.2 Environmental Assessment Process**

### **1.2.1 Parties to the EA**

According to the Rules of Procedure, De Beers is a directly affected party. Sixteen (16) government departments, Aboriginal groups and other organizations were accepted as registered Parties to the EA<sup>3</sup>, either as a directly affected party or as an intervenor, as defined in the Review Board's Rules of Procedure. They included:

- Indian and Northern Affairs Canada (INAC);
- Fisheries and Oceans Canada (DFO);
- Natural Resources Canada (NRCan);
- Environment Canada;
- Government of the Northwest Territories (GNWT);
- Yellowknives Dene First Nation (YKDFN);
- North Slave Metis Alliance (NSMA);
- Dogrib Treaty 11 Council;
- Lutsel K'e Dene First Nation (LKDFN);
- Northwest Territory Metis Nation;
- Metis Nation, Rae-Edzo Local #64;
- Dene Nation;
- Canadian Arctic Resources Committee (CARC);
- NWT and Nunavut Chamber of Mines;
- World Wildlife Fund Canada - Yellowknife; and,
- World Wildlife Fund Canada - Toronto.

The Review Board's process includes an opportunity for representatives of government departments to identify their interest in the proceedings and to notify the Board of their Minister's determination to participate in the proceeding in the role of a "responsible minister", as defined in s. 111 of the MVRMA. In the Snap Lake EA proceedings Responsible Ministers included the Ministers of DFO, NRCan, Environment Canada, and the Department of Resources Wildlife and Economic Development of the Government of the Northwest Territories. The Minister of INAC is the "federal minister" as defined by the MVRMA and plays a central decision-making role in the EA process.

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<sup>3</sup> For purposes of clarity in this Report of EA, the terms "Parties to the EA" or "Parties" have not been used to include De Beers Canada Mining Inc. despite the Rules of Procedure. These terms are used herein to collectively refer to the government departments, Aboriginal groups, and other organizations listed in Section 1.2.1 (above).





## 1.2.2 EA Approach

The Review Board's approach to this EA included two main stages:

- 1) the Issue Focusing Stage; and,
- 2) the Issue Evaluation Stage.

Figure 1 illustrates the approach and the steps involved in the Issue Focusing and Evaluation Stages. Review Board staff held several meetings with the Parties to the EA and De Beers throughout the EA in support of this approach. The Issue Focusing and Evaluation Stages are described further below.

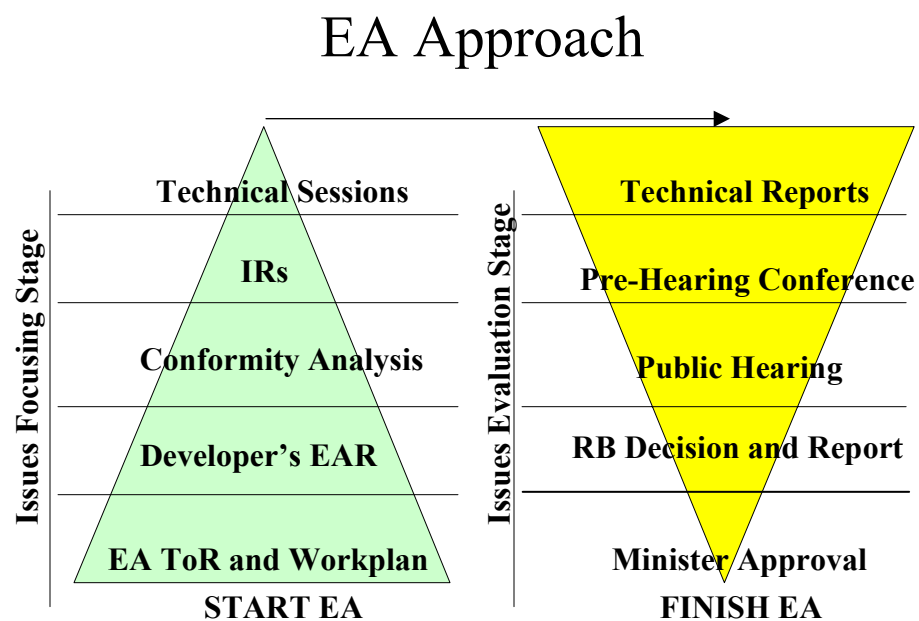


Figure 1 Review Board's Approach to the Snap Lake EA



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### 1.2.2.1 Issues Focusing Stage

The *Issues Focusing Stage* was made up of 5 steps:

1. Development of the Terms of Reference and Workplan;
2. Developer's Environmental Assessment Report;
3. Conformity Analysis;
4. Information Requests; and,
5. Technical Sessions.

Details of each step in the Issues Focusing Stage, of the Snap Lake EA, are described below.

#### Development of the Terms of Reference and Work Plan

The draft Terms of Reference and Work Plan were issued on June 21, 2001. The final document was issued on September 20, 2001 after consultation on the document with the Parties to the EA.

Five amendments to the September 20<sup>th</sup> Workplan were made during of the EA:

- January 2002 – to accommodate a delay in De Beers' submission of the EAR to the Review Board;
- July 2002 – to accommodate delays in the Information Request phase;
- August 2002 – to accommodate delays in round 3 of the Information Request phase;
- February 2003 – to allow additional time for Parties to review De Beers' technical reports after the Technical Sessions; and,
- July 2003 – to extend the time for completion of the Review Board's Report of EA.

#### Environmental Assessment Report

De Beers submitted its three-volume *De Beers Canada Mining Inc. Snap Lake Diamond Project Environmental Assessment Report* (EAR) to the Review Board on February 26, 2002. The EAR was to be prepared according to the Terms of Reference issued by the Board on September 20, 2001.

De Beers held several technical and non-technical meetings with communities, regulators, government and non-government organizations in the preparation of its EAR.

After the submission of its EAR, De Beers sponsored two Technical Information Sessions in Yellowknife. The session on April 17-19, 2002 provided an overview and opportunity to ask questions about the EAR. The session on October 9, 2002 provided an overview and opportunity to ask questions about the *Report on Snap Lake Diamond Project 2002 Environmental Information, North Lakes Program* (North Lakes Report), issued by De Beers on October 2002 as a supplement to the EAR.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### Conformity Analysis

Section 4.1.6 of the EA Terms of Reference required that the Board decide if De Beers' EAR was in conformity with the EA Terms of Reference. The conformity analysis determined whether or not De Beers had responded to all items in the EA Terms of Reference. This step in the Review Board's process is not intended to reflect the technical adequacy of the information provided by De Beers. The Board issues a deficiency statement if any part of the report is not in conformity with the EA Terms of Reference.

During the course of conducting its conformity analysis, the Review Board asked the Parties to the EA to examine the EAR for conformity issues and report back to the Board on their findings.

The Review Board concluded on April 15, 2002 that there were several elements of the EAR which were not in conformity with the Terms of Reference. These areas of non-conformity included:

- Communities impacted by increased traffic volumes;
- Impact of closure on mine employees;
- Project Components – Employment;
- Environmental Impacts – Net Effect on Government;
- Environmental Impacts – Subsistence Economy;
- Consideration of Alternatives – Rotation;
- Cultural Effects;
- Sustainable Development; and,
- Infrastructure Effects.

The Review Board instructed De Beers to respond to these gaps and De Beers complied, submitting a *Conformity Response* to the Review Board on August 22, 2002. This response addressed each of the identified non-conforming topics. On September 24, 2002, the Review Board ruled that the Snap Lake EAR, with the accompanying *Conformity Response*, satisfied the requirements of the Terms of Reference and was in conformity.

### Information Requests

Following De Beers' submission of its EAR the Information Request (IR) phase of the EA process began. The purpose of the IR phase was to clarify the contents of the EAR or to secure additional information related to the impact analysis and predictions in the EAR. The IRs assist the Parties requesting the information to complete their analysis and reach a conclusion about the developer's EAR. The Rules of Procedure provide that IRs can be directed to De Beers or to other Parties by the Review Board or by any of the Parties to the EA. Rules 41 to 49 outline the IR process. All IRs are issued under the Review Board's authority and are subject to the scrutiny and approval of the Board.

The Review Board authorized four (4) rounds of IRs among De Beers and Parties to the EA between March and November, 2002. Most of the IRs were directed to De Beers. The first and second round of



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

IRs allowed the Board and the Parties to the EA their first opportunity to ask the developer questions about its EAR. The intent of the third (3a) and fourth round (3b) was for the Board and the Parties to ask additional questions based on De Beers' response to the first and second round IR responses.

Table 1 shows the Board's issuance dates for each IR round and the De Beers response dates.

**Table 1 Issuance and Response Dates for Each IR Round**

<b>Round</b>	<b>Date IRs Issued by Board</b>	<b>Date De Beers Responded to IRs</b>
1	March 25, 2002	June 12, 2002
2	May 1, 2002	July 30, 2002
3a	August 8, 2002	September 23, 2002
3b	September 25, 2002	October 17, 2002
Supplementary 3b	November 1, 2002	November 6, 2002

Subsequent to the Pre-hearing Conference in March 2003, the Board reviewed the public record and the EAR and determined that additional information was needed in specific areas before the Public Hearing could proceed. The Board then issued a final set of IR questions to the GNWT and De Beers on April 4, 2003. De Beers and the GNWT responded to all Information Requests prior to the Public Hearing.

A total of 433 IRs were developed for the Snap Lake EA, and a total of 944 requests or questions were contained within those IRs (Table 2).

**Table 2 Number of IRs Issued by the Review Board for the Snap Lake EA**

<b>Organization that Developed the IRs</b>	<b>No. of IRs</b>	<b>No. of Specific Requests within IRs</b>
<b>Review Board</b>	123	243
<b>INAC</b>	61	173
<b>GNWT</b>	74	212
<b>Environment Canada</b>	29	48
<b>DFO</b>	23	27
<b>NRCan</b>	21	37
<b>YKDFN</b>	21	31
<b>NSMA</b>	36	85
<b>Dogrib Treaty 11 Council</b>	27	51
<b>LKDFN</b>	17	35
<b>CARC</b>	0	0
<b>WWF</b>	1	2
<b>Total</b>	<b>433</b>	<b>944</b>



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

## Technical Sessions

The Snap Lake Technical Sessions took place over a 10-day period in Yellowknife between November 25 and December 6, 2002. The Technical Sessions produced an opportunity for the Parties to meet in person, to seek a better understanding of the evidence on the record, to refine and/or formulate their positions, and in some cases, to resolve issues. Members of the public were welcomed to these sessions and notice of the time, location and subject matter of the sessions was provided through newspaper ads.

The agenda for the Technical Sessions was based on issue statements developed by the Board and the Parties to the EA. The issue statements largely documented the issues that the Parties or the Board considered worthy of resolution, based on their review of the EAR and De Beers' responses to the IRs. Each day of the Technical Sessions was devoted to a specific discipline topic (e.g., wildlife, hydrogeology etc.). Following a presentation by De Beers at the start of each day (and sometimes at mid-day as well), the Parties were given the opportunity to ask questions of De Beers and undertake discussion of their concerns about topics relevant to the EA.

The Technical Sessions were simultaneously translated into two languages (Chipewyan and Dogrib). In addition to summary notes, a full transcript (English) of the Technical Sessions was made available to all Parties and filed on the public record.

In response to commitments made during question periods at the Technical Sessions, De Beers prepared 24 Supplemental Technical Documents, largely in the form of technical memoranda (see list in Appendix A). These documents were submitted to the Review Board between January 2003 and February 28, 2003. A number of smaller technical memoranda were submitted by De Beers after February 28, 2003, to document on-going discussions regarding outstanding issues with some of the Parties.

### 1.2.2.2 Issues Evaluation Stage

The *Issues Evaluation Stage* was made up of four main components:

- Technical Reports (by the Parties to the EA);
- Pre-Hearing Conference;
- Public Hearing; and,
- Review Board's Report of EA.

Details of each of the steps in the Issues Evaluation Stage, as they pertain to the Snap Lake EA, are described below.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

### **Technical Reports (by the Parties to the EA)**

Based on a template developed in consultation with the Parties to the EA, the Parties prepared Technical Reports (February 14, 2003) of their evaluation of various issues and their respective positions in light of the results of the IRs, the Technical Sessions and the Supplemental Technical Documents submitted by De Beers. The Parties were later given the opportunity to submit Addenda (March 14, 2003) to their Technical Reports and positions as a result of the Supplemental Technical Documents submitted by De Beers.

The Technical Reports outlined, in the opinion of the Parties, the issues that each Party believed to be outstanding in the EA. For each outstanding issue, the position of the Party was described by outlining:

- The developer's conclusion on the issue;
- The Party's conclusion on the issue and the rationale for the conclusion; and,
- The Party's recommendation(s) to the Review Board.

De Beers and the Parties to the EA continued to discuss, evaluate and resolve issues to the extent possible right up to the start of the Public Hearing.

### **Pre-Hearing Conference**

A pre-hearing conference was held by Review Board staff and legal counsel on March 26 and 27, 2003 in Yellowknife. There was public notification via public radio and newspaper announcements of the Pre-hearing Conference. Parties to the EA and the public were invited to attend. The first day of the pre-hearing conference was set aside to clarify outstanding technical issues to go forward to the Public Hearing. The Board's consultants prepared an issue synopsis table, which was presented and used as a basis for reviewing the outstanding technical issues and gaining clarification of these issues where possible. The table was based on the Technical Reports prepared by the Parties, and De Beers' EAR and Supplemental Technical Documents. The issue synopsis table has been integrated into Appendix B (see Section 2.1.2).

The second day of the pre-hearing conference was devoted to a discussion of the Hearing process and procedures, and setting a day-by-day draft agenda for the Public Hearing.

Summary notes of the pre-hearing conference were prepared and filed on the public record.

### **Public Hearing**

A Public Hearing for the SLDP was held between April 28 and May 2, 2003 in Yellowknife. The public was notified of the Public Hearing by means of public radio announcements and newspaper ads. The principal goal of the Public Hearing was to allow the public an opportunity to hear and participate in a discussion of technical issues unresolved during the EA Process leading up to the Public Hearing, and to enable members of the public to speak to issues they perceived to be of importance.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project



**Review Board members (l to r) Frank Pope; Charlie Snowshoe; Gordon Wray (panel chair); Danny Bayha, John Stevenson.**

Twelve (12) of the registered Parties to the EA and three (3) groups from the public participated in the Public Hearing.

Issues were discussed by discipline topic, based on the final Hearing agenda and Hearing presentations submitted to the Review Board by De Beers and all other Parties prior to the Public Hearing. De Beers and the Parties were given the opportunity to present their position on outstanding issues for each topic. Members of the Public were also given the opportunity to give a presentation on any issue of concern to them. A question period followed each presentation. Following the issues discussion, closing statements were made by De Beers and the Parties to outline their final positions on the issues discussed at the Public Hearing.

The Public Hearing was simultaneously translated into two languages (Chipewyan and Dogrib). Transcripts were prepared for the entire Hearing and filed on the public record.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Parties registered to participate in the Public Hearing included: INAC, DFO, NRCan, Environment Canada, GNWT, YKDFN, NWTMN, NSMA, Dogrib Treaty 11 Council, LKDFN, CARC, and NWT and Nunavut Chamber of Mines. Elders from the YKDFN, NSMA, LKDFN, and Dogrib Treaty 11 Council also contributed to the Hearing. The following members of the public also registered and participated in the Public Hearing: Yellowknife Catholic Schools, NWT Construction Association, and Yellowknife Metis Nation Local 66.

### **Review Board's Report of EA**

The public record closed on May 23, 2003. This was the final date for filing evidence on the public record including additional information arising from undertakings made at the Hearing.

This Report of EA outlines the Review Board's decisions, recommendations and suggestions on the Snap Lake EA based wholly on the public record in this proceeding. Scientific and Traditional Knowledge (TK) have been given equal weight in the Board's decisions with respect to this Report of EA.

## **1.3 Scope of the Proceeding**

The MVRMA requires that the Review Board determine the scope of an EA proceeding by setting the scope of development and the scope of the assessment under subsections 117(1) and (2) respectively. These determinations are set out in the Terms of Reference of the Snap Lake EA and are briefly summarized below.

### **1.3.1 Scope of Proposed Development**

The scope of the Snap Lake development includes both the Review Board's determination of the principal development and any accessory developments directly dependent on the principal development. The principal development is the underground mining of kimberlite ore. The accessory undertakings and developments associated with the principal development are outlined below.

#### ***a) Mined Rock***

- Storage and handling of waste rock;
- Storage and handling of processed kimberlite;
- Processing of the kimberlite ore for the removal of diamonds;
- Removal of the diamonds from the minesite; and,
- Removal of waste rock, kimberlite and mine water from the underground workings.

#### ***b) Water Management***

- Storage, handling of mine water;
- Surface water management;
- Removal of water from Snap Lake for use at the mine site; and,
- Reintroduction of managed water into Snap Lake.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### c) *Transport and Surface Structures*

- Use of the current Tibbitt-Contwoyto winter road;
- Winter road access off of the Tibbitt-Contwoyto winter road to the mine site;
- Esker access road from esker quarry to mine site;
- Airstrip and support infrastructure for air travel;
- Solid waste management and containment areas;
- Surface structures (process plant, power plant, magazines, camps, roads etc.); and,
- Petroleum, cement, and chemical storage areas.

### d) *Decommissioning and, or, Modification of the Snap Lake Advanced Exploration Camp*

## 1.3.2 Scope of the Assessment

The scope of the assessment is the Review Board's determination of which components of the environment must be examined during the EA. Subsection 117(2) of the MVRMA requires consideration of the following factors in an EA:

- The impact of the development on the environment, including the impact of malfunctions or accidents that may occur in connection with the development and any cumulative impact that is likely to result from the development in combination with other developments;
- Any comments submitted by members of the public;
- Any other matter determined to be relevant;
- Significance of the impact; and,
- Mitigation measures.

The scope of the SLDP assessment for the SLDP EA was set out in the *Terms of Reference and Workplan for the Environmental Assessment of the De Beers Canada Mining Inc. Snap Lake Diamond Project*. In setting the scope of the SLDP assessment, the Review Board considered comments from the Parties on the draft Terms of Reference. The Board decided that the following components of the environment had to be considered in the Snap Lake assessment:

- Air Quality and Climate;
- Terrain (geotechnical, geology);
- Water Quality and Quantity;
- Aquatic Habitat;
- Vegetation and Plant Communities;
- Wildlife and Wildlife Habitat;
- Cultural and Heritage Resources;
- Land and Resource Use;
- Economy (including government and infrastructure);
- Human Health;
- Noise; and,



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Visual and Aesthetic Resources.

This Report of EA addresses all of the above listed environmental components, but the names of the component headings used in the Report of EA were chosen to more closely resemble the terminology used by the Parties during the EA process.

### 1.4 Determining Significance and Review Board Recommendations

Section 128 of the MVRMA requires the Review Board to decide, in its opinion, based on all the evidence on the public record, whether or not the Snap Lake development will likely have a significant adverse impact on the environment or be a cause for significant public concern. These conclusions are reported to the federal Minister in this Report of EA.

The Parties to the EA were asked to provide assistance to the Review Board by documenting the basis for their conclusions about the significance of the potential impacts of the development. In doing so, the Review Board requested that the Parties include the identification of the expertise applied and, if possible, the source of the information upon which the Parties' conclusions were based.

Ultimately, however, the Review Board is required by law to make its determination on the question of impact significance. In so doing, the Review Board considers the following characteristics of any impacts identified:

- Magnitude;
- Geographic extent;
- Timing;
- Duration;
- Frequency;
- Irreversibility of impacts; and,
- Probability of occurrence and confidence level.

If the evidence on the public record raises issues of public concern, the Review Board evaluates that evidence both in its own right and in light of any determinations made about the significance of the impacts caused by the development. Significant public concern is also a test under which the Review Board could refer the development to Environmental Impact review.

#### Review Board Recommendations

Certain legal consequences flow from the Review Board's determinations. Where a determination is made that a significant adverse impact on the environment is likely or that mitigative or remedial measures are required in order to prevent a significant adverse impact on the environment, the Review Board may make recommendations for consideration by the federal and responsible Ministers. The authority to make such recommendations is based on section 128 of the MVRMA and provisions in the Gwich'in and Sahtu Land Claims. If the federal and responsible Ministers accept the Review Board's recommendations, subsection 130(5) of the MVRMA "*a first nation, local government, regulatory*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*authority or department or agency of the federal or territorial government affected by a decision made under this section shall act in conformity with the decision to the extent of its authority”.*

During the course of an EA, the Review Board has the opportunity to consider the effects of a development in light of government activities, policies and operations. It also considers the development in relation to other development activities and gains a unique perspective and knowledge of the project and its possible effects. Even where significant adverse environmental impacts are not identified, the EA process may nonetheless result in insights about the development, the development process or the potential response to the development by government agencies and others.

In such instances, the Review Board may decide to make non-binding suggestions to government and other authorities. These suggestions are intended to assist government and others affected to more fully address the changes that may result from the development. Their implementation is not mandatory even if the federal and responsible Ministers accept this report of EA. The Review Board nonetheless includes such suggestions in this report of EA in order to encourage a more comprehensive response to the Snap Lake development.

The Review Board’s legal authority to make recommendations to mitigate the impacts of the proposed Snap Lake development is based on the MVRMA and on the language of sections 24 and 25, respectively, of the *Gwich’in and Sahtu Dene and Metis Comprehensive Land Claim Agreements*. The Board’s interpretation of these authorities is set out below.

Subsection 128(1) of the MVRMA outlines the Review Board’s options upon completion of an Environmental Assessment as follows:

*128. (1) On completing an environmental assessment of a proposal for a development, the Review Board shall,*

*(a) where the development is not likely in its opinion to have any significant adverse impact on the environment or to be a cause of significant public concern, determine that an environmental impact review of the proposal need not be conducted;*

*(b) where the development is likely in its opinion to have a significant adverse impact on the environment,*

*(i) order that an environmental impact review of the proposal be conducted, subject to paragraph 130(1)(c), or*

*(ii) recommend that the approval of the proposal be made subject to the imposition of such measures as it considers necessary to prevent the significant adverse impact;*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*(c) where the development is likely in its opinion to be a cause of significant public concern, order that an environmental impact review of the proposal be conducted, subject to paragraph 130(1)(c); and*

*(d) where the development is likely in its opinion to cause an adverse impact on the environment so significant that it cannot be justified, recommend that the proposal be rejected without an environmental impact review.*

The Review Board's authority to make recommendations subsequent to the completion of an EA only arises in the context of subparagraph 128(1)(b) (ii) of the Act. A reading of paragraph (b) and subparagraph (ii) indicates that the Review Board has the authority to recommend measures to mitigate impacts in those situations where the Board has found a significant adverse environmental impact.

The language in these provisions also seems to require that any recommendations made must be directly linked to the finding of a significant adverse environmental impact. A strict interpretation of this paragraph could prevent the Review Board from recommending measures intended to prevent adverse environmental impacts from becoming significant. In other words, a strict reading of paragraph 128(1)(b) and subparagraph (ii) could arguably indicate that if an adverse environmental impact is not already significant then the Review Board has no authority to recommend measures to reduce the significance of that impact or to prevent the impact from becoming significant (this is called the "restrictive interpretation" below). This result is not in keeping with good environmental impact assessment practice.

In the Review Board's opinion, one of the important benefits of an EA is the opportunity to minimize all identified adverse impacts through the imposition of mitigative measures. Consequently, the Review Board has adopted a more remedial interpretation of 128(1)(b). This interpretation is in keeping with the overall purpose of environmental impact assessment legislation and with a reading of these provisions in the context of the MVRMA and the land claims upon which the Act is based. There is clear authority for such an interpretation of paragraph 128(1)(b) and subparagraph (ii). The Board's reasons are outlined below.

Before proceeding with this analysis, we remind the reader of the statutory system for the treatment of measures recommended under paragraph 128(1)(b). Any measures recommended by the Review Board under paragraph 128(1)(b) are considered by the federal and responsible Ministers under paragraph 130(1)(b) of the MVRMA. If the recommended measures are adopted by these authorities, they must be carried out to the extent of their jurisdiction under subsection 130(5) and by the Land and Water Boards under section 62 of the Act.

Thus the EA process is linked to the regulatory process and any measures recommended by the Review Board to minimize adverse environmental impacts and adopted by the appropriate decision-makers must be carried out by regulatory authorities. The result is the "integrated system of land and water management" referred to in the long title of the MVRMA and required by the Gwich'in and Sahtu land claims

The interpretation of paragraph 128(1)(b) will determine whether the Review Board has the authority to recommend measures to mitigate any adverse environmental impacts which are not now but might



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

become significant, or only those which have already been determined to be significant. This distinction is important and strikes at the heart of the EA process under the MVRMA. If the restrictive interpretation were to prevail, the EA process would, in the Review Board's view, be much less effective and could fall short of the goals articulated in paragraphs 115 (a) and (b) of the MVRMA.

Those paragraphs speak to the need to protect the environment and the social, economic and cultural well-being of residents of the Mackenzie Valley. In the Review Board's opinion the protection resulting from an EA process will fail to achieve these statutory goals if only significant adverse impacts on the environment can be mitigated. Paragraph 115(b) for example, does indicate that the protection required for the social, economic and cultural well-being of Mackenzie Valley is limited to protection from only significant impacts. To ignore evidence of adverse impacts which can be mitigated simply because the impacts are not yet significant would not be consistent with the MVRMA or with the Review Board's duty to protect the environment.

The Review Board has considered this issue carefully and has decided that it has the authority to recommend measures both to reduce the effect of a significant adverse environmental impact below the level of significance and measures to prevent an adverse environmental impact from becoming significant.

The authority for this interpretation is based in section 24.3.5 (a) of the *Gwich'in Comprehensive Land Claim Agreement* and in section 25.3.5 (a) of the *Sahtu Dene and Metis Comprehensive Land Claim Agreement*. These sections are identical so we will only reproduce the language from the Sahtu claim below:

*25.3.5 (a) Subject to 25.3.3(a), a development proposal shall be assessed by the Review Board in order to determine whether the proposed development will be likely to have a significant adverse impact on the environment or will likely be a cause of significant public concern. **In making its determination the Review Board may consider terms and conditions to the proposed development which would prevent significant adverse impact on the environment and may recommend the imposition of such terms and conditions to the Minister.** Such terms and conditions shall be subject to review pursuant to 25.3.14. (our emphasis)*

This provision clearly intended that the Review Board be able to recommend terms and conditions (measures) to the Minister which are intended to "prevent significant adverse impact on the environment". This authority goes beyond the restrictive interpretation of paragraph 128(1)(b) discussed above. It does not require that an impact already be determined to be significant before the Review Board can recommend measures. Instead the Review Board can recommend measures to prevent an impact which is not yet significant from becoming so.

It appears to the Review Board that in this regard the restrictive interpretation of paragraph 128(1)(b) of the MVRMA is not consistent with these paragraphs of the Gwich'in and Sahtu land claims. The Review Board is therefore of the view that the interpretation of paragraph 128(1) (b) should be more liberal in order to make it consistent with the land claims and with section 115 of the MVRMA as well.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Section 3.1.18 of the Sahtu land claim (3.1.19 of the Gwich'in claim) specifies that the Agreement may be used as an aid to interpretation where there is any doubt in respect of any legislation implementing the provisions of the Agreement. Section 3.1.22 of the Sahtu land claim (3.1.23 of the Gwich'in) and section 5 of the MVRMA specify that when there is an inconsistency or conflict between any law and a land claim agreement that the land claim agreement applies to the extent of the inconsistency or conflict. This legal hierarchy is clear. The land claim provisions are paramount. Consequently, the Review Board has decided that it has the authority to recommend measures both to reduce significant adverse environmental impacts below the level of significance and to prevent adverse environmental impacts from becoming significant. This finding is in keeping with good EA practice and is consistent with both the Gwich'in and Sahtu land claims.

### **1.5 Public Participation in the Snap Lake EA**

#### **1.5.1 Community Engagement**

The Review Board encourages public participation in its EA process and to that end, instructed De Beers through the Terms of Reference to make efforts to involve the public and affected communities in the development of its EAR and throughout the EA process. De Beers identified a number of primary communities, which in its view were likely to experience the greatest impacts, due to their proximity to the project site and their expected contribution to the project workforce. The primary communities included Lutsel K'e, Dettah, N'dilo, Rae/Edzo, Gameti, Wha Ti, Wekweti and Yellowknife (including the NSMA population).

De Beers has committed to maintaining on-going communications and consultation programs with the public and primary communities throughout the life of the SLDP.

Public and community engagement on this development was initiated in 1998 through Winspear Resources Ltd., and De Beers continued these efforts after acquiring the Snap Lake AEP in 2000. Since 1998, meetings have been held in all primary communities. De Beers also met with the Chiefs and Councils of the YKDFN, LKDFN, Dogrib Rae Band, Gameti First Nation, Wha Ti First Nation, Dechi Laot'i First Nation, Dogrib Treaty 11 Council and the Executive of the NSMA.

De Beers noted that its consultation was or will, in the future, be linked to:

- AEP permit submissions;
- Construction and operation of the AEP;
- Development of baseline and monitoring wildlife studies;
- De Beers' acquisition of the SLDP;
- SLDP land use permit and water licence submissions;
- SLDP EA submission;
- Technical review of the EA submission;
- Training and employment opportunities;



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Business opportunities;
- Water licence hearings;
- Construction;
- Operation; and,
- Closure and reclamation.

The methods of consultation used by De Beers have included:

- Information sessions in all primary communities;
- Public (open house) community meetings;
- Guided site tours – all primary communities had the opportunity to visit the site more than once. Government reviewers, regulators, non-government organizations, and local businesses have also had the opportunity to visit the site; and,
- One-on-one interviews in the primary communities.

De Beers also published a Snap Lake News newsletter, a regular Snap Lake Update in News North, a video of Snap Lake, and provided information on the De Beers website.

Community issues and concerns identified as part of De Beers' EAR were documented in Table IV.1-1 of Appendix IV.1. De Beers incorporated some of the results of its community engagement efforts in the design of the development. Examples include fencing the water management pond, redesign of sewage effluent disposal and changes to employee work scheduling and living conditions.

De Beers provided a summary of community meetings to the Board through a letter dated May 23, 2003 and in its response to an April 22, 2003 Information Request (Q3.2b) issued by the Board. These documents are available on the Review Board's web site. De Beers stated that prior to its EAR submission, a total of 93 in-person interviews and 38 meetings were held to develop the Socio-economic Impact Assessment contained in the EAR. Most of these meetings were held within the primary communities. Since the submission of the EAR De Beers has held an additional 52 in-person interviews and 15 community meetings.

The Review Board notes that the Parties to the EA did not challenge De Beers' efforts at community engagement and the Board is satisfied with the work of De Beers in this regard. Questions were raised during the EA with respect to the Crown's obligation to consult first nations. The Review Board's views on that issue are set out below (Section 1.5.2).

### 1.5.2 Consultation

During the course of the SLDP EA, the issue of "consultation" was raised with the Review Board on a number of occasions. Various Parties, including representatives of the federal and responsible Ministers expressed their views about the relationship between the Review Board's EA process and the "duty to consult" as framed by the courts in cases involving the infringement of Aboriginal rights.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The clearest expression of concern over the consultation issue was raised by the NSMA in its April 3, 2003 application for an adjournment of the Public Hearings for SLDP. The essence of the NSMA position was that the federal and territorial governments and the developer, De Beers, had failed to adequately consult with the NSMA. The application for the adjournment made by the NSMA alleged that the failure of these Parties to consult with the NSMA had adversely affected the Review Board's jurisdiction and that consequently, the Hearing should not continue. The Review Board ruled on this application at the outset of the Public Hearing and has filed written reasons for its decision on the public record. It is not our intention to revisit that ruling in this report.

Irrespective of its decision on the NSMA application, it appears to the Review Board that many of the Parties to this EA are not clear about the respective roles and obligations of government, the developer and the Review Board in the consultation process. Some evidence of this lack of clarity can be gleaned from the letter from the LKDFN to the Minister of INAC and his response to Chief Catholique. The Review Board wishes to outline its views on this issue and its position with respect to its role in the consultation process.

There is no doubt that the Crown has a fiduciary obligation to consult with Aboriginal groups whose rights may be infringed by activities authorized by government. A number of cases decided by the Supreme Court of Canada support this assertion. The "duty to consult" can vest in either the federal or provincial governments, depending on the nature of the approval being given. By extension, in appropriate circumstances, this duty could also vest in the GNWT.

Early in the Snap Lake EA, the Review Board issued IRs to INAC, DFO, Environment Canada and the GNWT, asking the following question:

*"Please provide the Review Board with a detailed summary of your government, department or agency's efforts to ensure effective consultation with First Nations and Metis groups affected by the proposed development. Provide dates, and places of meetings, correspondence and details of other efforts to ensure adequate consultation. Indicate any plans for ongoing consultation efforts as the regulatory process unfolds."*

The responses varied. GNWT and Environment Canada indicated that they would not be issuing regulatory approvals and therefore would not be infringing any Aboriginal rights. DFO indicated that it would consult when appropriate but that it had not yet initiated any approvals processes. INAC's response both challenged the assertion that government had a duty to consult with Aboriginal groups whose rights might be infringed upon and indicated that the department would conform to the principles set out in Supreme Court of Canada decisions on consultation. INAC went on to say that :

*"It is INAC's position that the Review Board and the Mackenzie Valley Land and Water Board are the primary vehicle for effective environmental assessment consultation with First Nations and Metis groups impacted by the proposed development."* (INAC response to IR # 1.1.69, June 3, 2002)





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

It is not clear to the Review Board what “environmental assessment consultation” may be or how it may play a part in the consultation required of the Crown when the infringement of Aboriginal rights may occur as a result of a development. In *Mikisew Cree First Nation*<sup>4</sup> the Federal Court noted that the duty to consult was a positive one although it can vary depending on the nature of the circumstances and the prospective infringement. The Board cites *Mikisew* because it was a case where consultation issues arose in the context of a screening under the *Canadian Environmental Assessment Act*. The question of whether first nation consultation had to be “separate and distinct” from the process offered to other stakeholders was considered in *Mikisew*. The court held that merely involving the first nation in the general public consultation process which was part of the environmental screening was not sufficient.

The Review Board recognizes that *Mikisew* may be successfully appealed. The Board notes, however, that suggestions that its EA process is somehow a component of, or may be in satisfaction of the Crown’s duty to consult, are not consistent with this decision.

Furthermore, the assertion that the EA process is part of government consultation could confuse the public government functions of the Review Board in the environmental impact assessment process with the special fiduciary relationship between the Crown and Aboriginal rights holders. It certainly appears that the NSMA’s application was based on the view that the Review Board might play an instrumental role in the Crown’s consultation process.

The Review Board does not believe that it has any direct role in the Crown’s consultation process. The Review Board must be fair to the Parties which participate in its proceedings. The issue of the role of administrative tribunals in the consultation process was considered by the Supreme Court of Canada in *Quebec (Attorney General) v. Canada (National Energy Board)*, [1994] 1 S.C.R. 159. In that case the suggestion that the National Energy Board had a fiduciary obligation to the Cree while at the same time fulfilling an adjudicative function was refuted by the Supreme Court of Canada. The National Energy Board also dealt with an application for an adjournment very much like that advanced by the NSMA in this proceeding during its Alliance Pipeline Proceeding.<sup>5</sup> The application was dismissed because the National Energy Board took the view that it had no direct role in the consultation process.

Whatever the eventual outcome of *Mikisew*, the Review Board is firmly of the view that it plays no direct role in the consultation process arising from the Crown’s fiduciary duties. The Review Board must be fair and in order to ensure a thorough and complete environmental impact assessment process, it must ensure thorough public and community engagement in its proceedings. Consultation, if required, is the Crown’s responsibility. Government departments are, of course, free to choose to wait until after an EA process is complete before determining and acting on their duty to consult. Ultimately, however, this obligation will have to be honoured.

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4 *Mikisew Cree First Nation v. Sheila Copps, Minister of Canadian Heritage and the Thebacha Road Society*, 2001 FCT 1426. This case is under appeal.

5 *National Energy Board, Hearing Order GH-3-97*, 20 March 1998.



### **1.5.3 Participant Funding**

CARC, NSMA and LKDFN expressed concern throughout Snap Lake EA process that their ability to participate in the review process was hampered by their lack of capacity and because there was no participant funding provided to address these capacity issues. They suggested to the Board that it continue its efforts to secure a source of participant funding in order to assist Parties to its proceedings to overcome these capacity problems.

CARC advised the Review Board that the National Round Table on the Environment and the Economy recommended that the Board receive \$500,000/year for intervenor funding to effectively carry out its mandate. CARC noted that the recommendation of the National Round Table on the Environment and the Economy has not been followed up.

CARC recommended that the Board:

*“request supplemental funding for an arm's length participant funding program from the Department of Indian Affairs and Northern Development. A participant funding program could be modeled after the current program, under the... Environmental Assessment Agency, with additional public consultation that you may wish to carry out here.*

*In the event that your Board does not wish to pursue supplemental funding, we would ask that you recommend to the Minister of Indian Affairs Northern Development that he appoint a senior representative to report on options for participant funding within six months of the release of your report on this environmental assessment, and that opportunities for cost recovery, including participant funding, from proponents be examined.”*

(Kevin O'Reilly, CARC, Public Hearing Transcripts, Day 1, April 28, 2003, p.128-129.

The Board recognizes the value and fundamental importance of the participation of Aboriginal groups and non-government organizations in the EA process under the MVRMA. The Board further notes the benefits of the involvement of Aboriginal communities and non-government organizations in the EA for the SLDP and their contributions to the Board's decision.

A mechanism to provide participant funding at the EA level does not currently exist under the MVRMA. Only when a project is referred to an Environmental Impact Review (EIR) can the authorities take steps to secure participant funding. The Review Board has not yet conducted an EIR. Even in the case of an EIR, participant funding under the MVRMA is established on a case-by-case basis. The Review Board would negotiate additional funding for both the EIR process and participant funding, above and beyond its annual budget, with INAC.

The Board notes that if participant funding were to be made available as part of a Board EA or EIR proceeding, arrangements would have to be made for independent decisions about the distribution of any approved funds. Given the Board's obligation to be fair in its EA processes, it could not take direct



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

responsibility for decisions about participant funding. Arm's length arrangements of this nature are in place for panels established under the *Canadian Environmental Assessment Act*.

In almost five years of operation since the coming in to force of the MVRMA, there has never been an EIR. It appears to the Review Board that arrangements may have been made for participant funding in EIRs under the MVRMA because they are the equivalent of panel reviews under the *Canadian Environmental Assessment Act*. However, the Review Board has been able to deal with several major projects, including the SLDP, without resort to an EIR, by setting out an EA process which includes Public Hearings. In these circumstances northern residents, Aboriginal groups and non-government organizations do not have the same access to participant funding as do southern Canadians under the *Canadian Environmental Assessment Act* process. The answer to the Review Board would not seem to be to force developments to the EIR level in order to ensure that participant funding is available. The answer would be to provide participant funding in appropriate cases for EAs of large developments.

### **The Board suggests that:**

**(S1) The Government of Canada considers the development of a method for providing participant funding at the EA level under the MVRMA. This funding should be primarily targeted at NWT residents and communities, including Aboriginal and non-aboriginal groups. The method should include the establishment of an independent authority to administer the funds that is applicable at both EA and environmental impact review levels.**

## **1.6 Environmental, Socio-economic and IBA Agreements and Part 5 of the MVRMA**

The Board is of the opinion that effective environmental management in the NWT requires a comprehensive and mature environmental impact assessment process. Similarly, effective management of the social and economic issues associated with economic growth in the NWT requires the cooperative and coordinated action of various stakeholders.

At this time and in the context of the SLDP EA process, an Environmental Agreement can provide a tested mechanism to assure the Board and the Parties to the EA that the project developer will implement those commitments to environmental monitoring and adaptive management that cannot be included in regulatory instruments. De Beers has made a number of such commitments throughout this EA process.

A Socio-economic Agreement between the developer and the GNWT can serve a similar purpose by providing assurances that general socio-economic effects will be managed and monitored and that positive socio-economic impacts will, to the extent possible, be enhanced. Equally important to the acceptability of the Snap Lake project in terms of socio-economic issues is the company's commitment to negotiate and enter into Impact Benefit Agreements (IBAs) with affected Aboriginal groups.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Once the EA process is complete, the negotiation of Environmental, Socio-economic and IBA agreements between industry and government and Aboriginal groups serves an important purpose. These agreements can:

- Provide tailor-made solutions to improve environmental performance and corporate-community relations throughout the life of a project;
- Foster a co-operative atmosphere between communities, government and industry; and,
- Ensure the direct involvement of Aboriginal groups in the resultant economic activities that result if the development is approved.

This model of regulatory approvals supplemented by Environmental, Socio-economic and IBA agreements was implemented by the Governments of Canada and the Northwest Territories for the BHP Billiton EKATI Diamond Mine™ (EKATI) and Diavik Diamond Mines Inc (Diavik) projects. Although in the mining context there is no legal requirement for such an approach to the overall approval of the SLDP, a number of the Parties to the EA, including De Beers, INAC, GNWT and Aboriginal groups made submissions to the Board which assumed that this model would be applied. The evidence shows that De Beers' strategy for mitigating project effects and for working with affected communities includes such agreements. The Board heard evidence that De Beers is already negotiating IBAs, that INAC and De Beers have begun considering of the contents of an Environmental Agreement and that discussion of a Socio-economic Agreement is ongoing between De Beers and the GNWT.

The benefits of this model have proven out in the EKATI and Diavik developments. These non-regulatory agreements have become an important accessory to the development approvals process in the NWT. The Board endorses this approach and has accepted this model for this Report of EA. There are, however, some effects of the implicit adoption of this model on the EA process, which the Board would like to draw to the attention of the federal and responsible Ministers.

Notwithstanding the obvious benefits of resorting to Environmental, Socio-economic and IBA agreements to enhance the acceptability of a major development project, the Board experienced difficulties during the Snap Lake EA process because the nature and content of the proposed Environmental, Socio-economic and IBA Agreements for the SLDP had not been well defined by the time the Hearing was held. No part of any of these proposed agreements was filed on the public record during the EA process. Consequently, a false sense of security may have developed among the Parties to the EA based on their assumptions about the matters which will be addressed and resolved by these agreements. All of these agreements are negotiated and there is no guarantee as to their contents.

Furthermore, the Parties to the EA do appear to make assumptions about the contents of these agreements, and thus, there can be a tendency to focus attention on the negotiating table and to reduce the scope and thoroughness of the evidence they advance in the EA process.

In the Board's view, this problem was evident in the socio-economic evidence filed in this proceeding. As our discussion of these matters below will indicate, the Board was not satisfied with either the extent or the quality of the evidence provided by the Parties, in particular, De Beers in this area. As a result, the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Board had to issue IRs a little over a month before the Hearing because in its view, the evidence on the record was not sufficient to enable the Review Board to meet its mandate in the area of socio-economic impact assessment for the SLDP. Despite the IR responses, the Board still had to resort to inference and to socio-economic information collected from the EKATI and Diavik projects to meet its statutory obligation to address socio-economic impacts.

There is, in the Board's view, a legitimate concern that by diverting the Parties attention to the negotiation table before the EA process is completed the desire to complete such agreements may starve the EA process of the information it needs to satisfy the Board's obligations under sections 114, 115 and 117 of Part 5 of the MVRMA.

The Board accepts that IBAs are private agreements and notes that the negotiation of Environmental and Socio-economic Agreements also occurs outside the public process. One important function of the MVRMA EA process is to ensure that everyone with an interest or concern has access to the Board and through it to senior government decision makers. EA is a public process, accessible to all. This access contributes to the acceptability of the outcome of a development review. Legitimate questions can therefore be raised about the impact of private negotiations on the public EA process.

There is in the Board's view, one final cautionary note which warrants mention with respect to the use of agreements as an adjunct to the EA process. Some stakeholders involved in the development of these agreements may not have the resources and skills to negotiate effectively. Poor negotiations may lead to poor agreements that do not achieve their full potential and which, in years to come, could cause ongoing problems between communities, Aboriginal groups and developers.

If the federal and responsible Ministers act on the assumptions of the Parties to the EA and the recommendations of the Board and endorse the negotiation of Environmental, Socio-economic and IBA agreements, the Board suggests that government give further thought to the way this model, and the negotiation of these private agreements in particular, impacts on the effectiveness of the public proceedings constituted under Part 5 of the MVRMA. It is possible and, in the Board's view, essential that the MVRMA system and this model for capturing and ensuring that non-regulatory issues and benefits are enforced, reinforce each other and work in harmony. Some adjustment to current practice may be necessary to achieve this goal.

In the interim and in future Review Board proceedings addressing major projects, the Board will ask the Parties involved in such negotiations for an outline of the scope, content and goals of any proposed Environmental and Socio-economic agreements. Furthermore, the Board will ask the Parties involved in IBA negotiations to identify those impacts that will be mitigated through the successful completion of negotiation of these agreements. This information will be filed on the public record. It is important in order for the Board to satisfy its mandate, that the impacts to be mitigated and the benefits to be derived from such agreements be identified publicly so that the Board and the Ministers to which it reports can be certain that the EA process has been thorough and has achieved the purposes set out in s. 114 and 115 of the MVRMA.



## **1.7 Overview of Snap Lake Diamond Project**

The Snap Lake site is currently permitted as an advanced exploration program (AEP). The permits were issued in December 1999 to Winspear Resources and assigned to De Beers Canada Mining Inc. in July 2000 and subsequently extended. The purpose of the AEP was to further delineate the grade, value and variability of the kimberlite dyke that begins on the northwest peninsula, continues beneath Snap Lake and extends under the land north of Snap Lake. The program included the construction of on-site processing plant, a processed kimberlite containment facility, a power generating plant, a camp, an airstrip, an explosive storage facility, a fresh water intake system, and fuel storage and distribution facilities.

Most of the facilities developed for the AEP are to be expanded, or used as is, for the proposed Snap Lake mine. The active mine area (i.e., the area that will be disturbed) is expected to be approximately 250 ha. This area lies within the surface lease area for the site (i.e., excluding winter roads) of approximately 550 ha.

The kimberlite dyke, in which the diamonds are found, will be mined using underground mining methods at an average production rate of 3,000 tonnes per day (tpd), subject to plant capacity limitations affected by operating efficiencies. The resource is currently estimated at approximately 22.8 million tonnes of ore, including dilution of approximately 20%. Underground development will be started while the mill and surface facilities are being constructed.

The anticipated staff and contractor personnel requirement during the construction phase is on average approximately 450 people. During operations about 525 staff will be required.

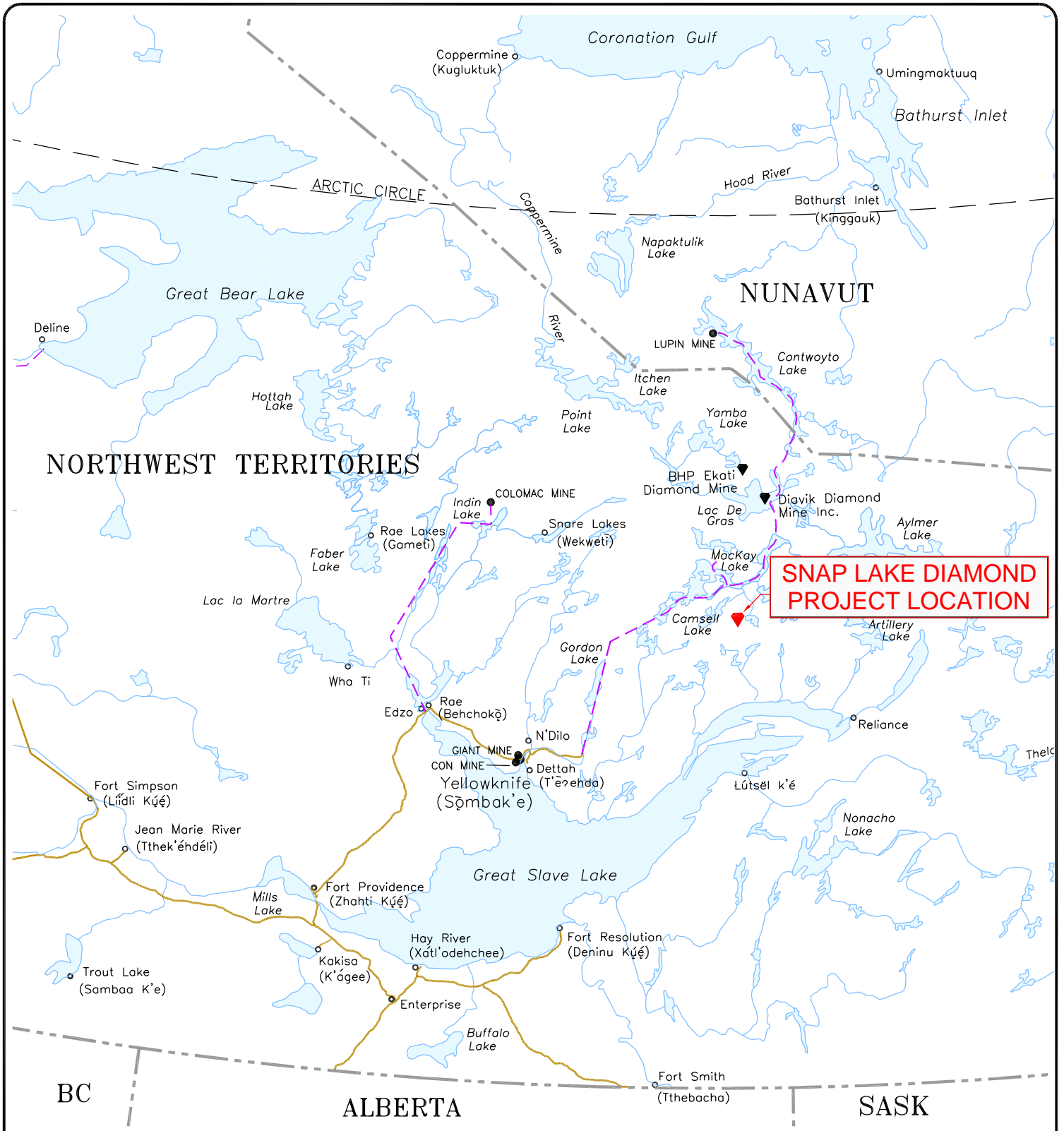
### **1.7.1 General Description of the Environment at Snap Lake**

The following is a general description of the environmental setting of the Snap Lake area. It is intended to provide context for the reader.

The SLDP is located approximately 220 km northeast of Yellowknife, NWT (Figure 2). It is situated in the Slave Geological Province on the south and west sides of Snap Lake, a small lake, found at the headwaters of the Lockhart River drainage system. The Lockhart River system flows north to MacKay Lake, east to Aylmer Lake and then south to Artillery Lake where the river finally drains into the east arm of Great Slave Lake.

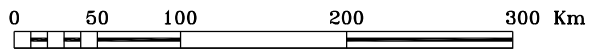
The topography of the area in which the SLDP is located is gently sloping with occasional bedrock knolls. Large scattered boulders and frost-shattered rocks dominate the ground. Permafrost features occur in small pockets where poorly drained, peat-filled depressions are present. Snap Lake is mapped in the zone of continuous permafrost. Mean annual air temperatures are approximately -6 Degrees Celsius.





**SNAP LAKE DIAMOND PROJECT LOCATION**

- LEGEND:**
- ALL-WEATHER HIGHWAYS
  - WINTER ROADS
  - COMMUNITY
  - DIAMOND MINE/EXPLORATION
  - GOLD MINE



APPROX. SCALE 1:5,000,000

**SOURCE OF FIGURE:**  
 FIGURE ADAPTED FROM GOLDER ASSOCIATES FIGURE 1.2-1 TITLED "LOCATION OF SNAP LAKE DIAMOND PROJECT - NORTHWEST TERRITORIES" PROJ. NO. 012-6492 DATED 19/11-01, FOR DE BEERS.

ORIGINAL SOURCE: SELECTED MINERAL DEPOSITS OF THE NORTHWEST TERRITORIES, DEPARTMENT OF ENERGY MINES AND RESOURCES, MINERAL INITIATIVES 1991 TO 1996 REVISED OCTOBER, 1996.



**Mackenzie Valley**  
 Environmental Impact Review Board

REPORT OF ENVIRONMENTAL ASSESSMENT AND REASONS FOR DECISION ON THE DE BEERS SNAP LAKE DIAMOND PROJECT

**LOCATION MAP**

FILE NAME:  
23065-D1-01.DWG

FIGURE NO. **2**

## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The SLDP is situated within the Taiga Shield Ecozone in the High Subarctic Ecoclimatic Region. The Snap Lake area is mostly composed of boulder fields and heath tundra. Stunted stands of black spruce and tamarack with white spruce, and ground cover of dwarf birch, willow, cottongrass, lichen and moss are interspersed among the boulders. Tussocks of sedge, cotton grass, and sphagnum moss can be found in poorly drained sites.

The SLDP is situated in an area that provides habitat for wildlife, including caribou, grizzly bears, arctic and red foxes, wolves, and wolverines. A variety of birds also occur in the Snap Lake area, including small perching birds, shorebirds, gulls, ravens, ptarmigan, raptors (e.g., peregrine falcons and gyrfalcons), and waterfowl.

De Beers recorded 53 archaeological sites in the Snap Lake area. De Beers noted that the area is not regularly used for traditional land use purposes, and that little fishing occurs in the area. In the past the region has been used for trapping, as a travel route to hunt wolves, and harvest caribou to the north of the project area.

### 1.7.2 Site Features

General site layout of the proposed mine site is illustrated in Figure 3. Figure 4 shows the mine footprint and a more detailed look at the proposed mine facilities and buildings.

Most of the above-ground facilities for the SLDP will be located in the northwest peninsula of Snap Lake. Facilities include a process plant, materials and ore storage areas, water and sewage treatment plants, water management pond, fuel storage, power plant, and worker accommodation and offices.

The North Pile will be one of the SLDP's most noticeable features, and will be located west of most of the above-ground facilities. The North Pile is the surface containment facility for processed kimberlite and potentially acid generating waste rock. A landfill, land farm (bioremediation of hydrocarbon-contaminated soils) and three granite quarries will be located within the North Pile footprint. Two laydown areas will be situated south of the North Pile. An engineered ditch and sump system will collect water that drains from the North Pile and laydown areas. This water will be directed to settling ponds, and then into the water treatment facility before being released to Snap Lake. The water management pond will provide storage capacity.







**SOURCE OF FIGURE:**

FIGURE 1.2 IS ADAPTED FROM A FIGURE ENTITLED "SNAP LAKE DIAMOND PROJECT, SOUTH VIEW AFTER 10 YEARS OF OPERATION" SUPPLIED BY DE BEERS CANADA MINING INC.



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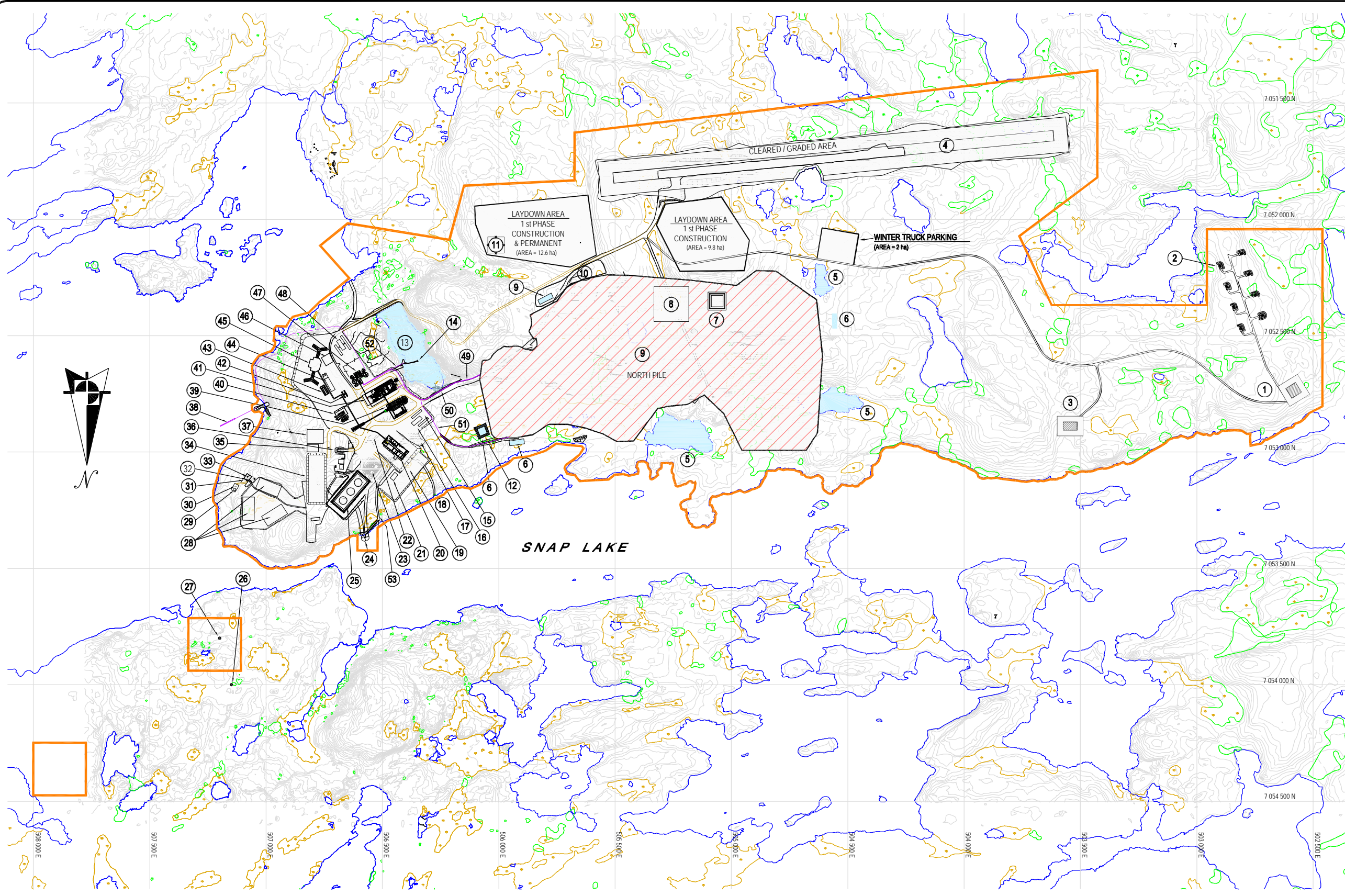
REPORT OF ENVIRONMENTAL ASSESSMENT AND REASONS FOR DECISION ON THE DE BEERS SNAP LAKE DIAMOND PROJECT

**GENERAL SITE LAYOUT  
SNAP LAKE DIAMOND PROJECT**

FILE NAME:  
23065-D1-02.DWG

FIGURE NO.

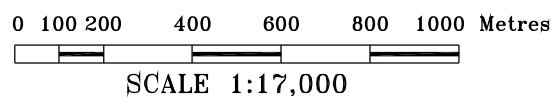
3



**MINE FACILITIES & BUILDINGS**

- 1 BULK EMULSION PLANT
- 2 EXPLOSIVES STORAGE
- 3 AN STORAGE
- 4 AIRSTRIP
- 5 SEDIMENTATION PONDS
- 6 SUMPS
- 7 LAND FARM
- 8 LANDFILL
- 9 NORTH PILE
- 10 PORTABLE CRUSHER  
ROCK/ESKER STOCKPILE AREA
- 11 WASTE TRANSFER STORAGE AREA
- 12 BERM
- 13 WATER MANAGEMENT POND
- 14 RECLAIM PUMPS
- 15 CONSTRUCTION CAMP EXTENSION
- 16 EXISTING CONSTRUCTION CAMP
- 17 EXISTING CAMP  
SEWAGE TREATMENT PLANT
- 18 WINTER ROAD ACCESS
- 19 CONTAINER STORAGE
- 20 SERVICE COMPLEX
- 21 COLD STORAGE BUILDING
- 22 EXISTING PILOT PLANT FACILITIES
- 23 EXISTING FUEL TANKS
- 24 FRESHWATER INTAKE  
& PUMPHOUSE
- 25 FUEL TANKS
- 26 MINE EXHAUST VENT #2
- 27 MINE EXHAUST VENT #1
- 28 CEMENT STORAGE
- 29 MINE COMPRESSOR
- 30 EMERGENCY EGRESS RAISE
- 31 #2 INTAKE VENT RAISE
- 32 INTAKE FAN SWITCH HOUSES
- 33 #1 INTAKE VENT RAISE (EXISTING)
- 34 KIMBERLITE ORE STOCKPILE AREA
- 35 BATCH PLANT
- 36 MINE PORTAL
- 37 AGGREGATE CRUSHING
- 38 OUTFALL AND DIFFUSER
- 39 CRUSHED ORE RECLAIM BUILDING
- 40 POWER PLANT
- 41 PROCESS & PASTE BACKFILL PLANT
- 42 EMERGENCY POWER GENERATOR
- 43 CORE SHACK
- 44 INCINERATOR /  
SEWAGE TREATMENT PLANT /  
AUXILIARY BOILER /  
POTABLE WATER TREATMENT
- 45 PERMANENT ACCOMMODATION  
CENTRE
- 46 PARKING
- 47 WATER TREATMENT PLANT
- 48 TEMPORARY CONSTRUCTION CAMP
- 49 NORTH PILE DRAINAGE WATER  
PIPELINE (INITIAL YEARS)
- 50 PK SLURRY PIPELINE TO NORTH PILE
- 51 NORTH PILE DRAINAGE WATER  
PIPELINE (LATER YEARS)
- 52 PIPELINES TO AND FROM WATER  
MANAGEMENT POND AND WATER  
TREATMENT PLANT
- 53 FRESH WATER PIPELINE

- LEGEND:**
- EXISTING FACILITIES
  - WETLAND
  - TREES
  - GROUND SURFACE CONTOUR
  - MINE FOOTPRINT



**SOURCE OF FIGURE:**  
FIGURE IS ADAPTED FROM FIGURE 3.1-3 "SNAP LAKE DIAMOND PROJECT OVERALL SITE PLAN" BY GOLDER ASSOCIATES. DATED 12/11/0.

THIS DRAWING IN TURN WAS BASED ON ORIGINAL DRAWING SUPPLIED BY AMEC IN DIGITAL FORMAT. ORIGINAL DRAWING NAMED 210C001.DWG, REVISION F, TITLED "SNAP LAKE DIAMOND PROJECT OVERALL SITE PLAN, DATED NOVEMBER 6, 2001.



REPORT OF ENVIRONMENTAL ASSESSMENT AND REASONS FOR DECISION ON THE DE BEERS SNAP LAKE DIAMOND PROJECT

**SITE PLAN  
SNAP LAKE DIAMOND PROJECT**

FILE NAME:  
23065-D1-03.DWG

FIGURE NO.  
**4**

## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

A 1,900 m long airstrip will be located about 1.5 km west of the plant site. This airstrip will be capable of handling large aircraft (C-130 Hercules and Boeing 737 or equivalent aircraft), and will provide the main mode of transportation for workers and for shipment of rough diamonds to Yellowknife.

Bulk emulsion and explosives storage areas will be located at the far west end of the project site, about 1.5 km from the main activity area of the project.

### **1.7.3 Development and Mining the Ore**

During the Advanced Exploration Program (AEP), which was completed in September 2001, a portal was developed from the surface reaching underground to the kimberlite deposit under Snap Lake. The portal is about 5 m wide and 4.5 m high. It is large enough to accommodate haul trucks and provide for mine ventilation. De Beers proposes to use this portal for the development of the underground mine workings for SLDP.

Work required to bring the mine into production is proposed to begin during the pre-production phase. Underground tunnels will be extended, and underground rooms will be created to house operations such as a crushing plant where the kimberlite will be crushed before being sent by conveyor to the surface. The waste rock that is removed from underground will be hauled to the surface by truck, and deposited within the North Pile.

Before the mine is ready to produce diamonds, most of the above-ground facilities (mentioned above) must be built.

Kimberlite rock will be blasted from the deposit and hauled by truck to an underground crusher. From there, a conveyor will carry the crushed kimberlite to the surface, where it will go directly to the process plant or to an enclosed ore storage building.

### **1.7.4 Recovering the Diamonds**

Diamonds will be extracted from the kimberlite at an on-site processing plant. In the plant, the crushed kimberlite will be washed and screened, then mixed with a water/ferrosilicon mixture to create a slurry. The slurry mixture will be separated into layers. The layer that contains the diamonds will then be dried and put through diamond recovery machines. The rough diamonds that are recovered will be cleaned and sorted for valuation, and then transported off-site by aircraft.

### **1.7.5 Storing Waste Rock and Processed Kimberlite**

The North Pile will be built from waste rock that was produced during the advanced exploration and pre-production phases, and processed kimberlite. Processed kimberlite is the material that is left over once the diamonds are removed in the processing plant. Water is drained from the processed kimberlite to form a material with a consistency similar to toothpaste.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

About half of the 1.08 million tonnes of processed kimberlite that is produced each year will be mixed with a small amount of cement and pumped through a pipeline back into the underground mine workings to be used as backfill. The remainder of the processed kimberlite will be placed in the North Pile. The North Pile will be built primarily from processed kimberlite which will be pumped as a paste and deposited behind the containment berm built from non acid-generating rock.

Also located within the footprint of the North Pile is a landfarm for disposal and treatment of petroleum-contaminated soils, a landfill for non-hazardous materials, and quarries for site construction aggregate.

As the North Pile is built, it will be capped with about 0.5 m of granite rock for erosion protection. The North Pile will be progressively reclaimed during operations.

### 1.7.6 Water Management

Almost all water that comes into contact with the project during construction and operation will be treated before being released into Snap Lake. The exception is runoff from rain and snow on the airstrip, along some access roads, the esker quarry. Rain and snowmelt will be allowed to drain naturally into nearby low-lying areas near these locations.

Water comes into contact with the project in four ways:

- Water seeps into the underground workings;
- Water is withdrawn from Snap Lake to use in the diamond processing plant;
- Water is withdrawn from Snap Lake to use for domestic potable water; and,
- Surface water from rain and snow falls directly onto the site.

Water that seeps into the underground workings will be pumped to the surface into a water retention pond then the water will be treated in a water treatment plant, before being discharged back into Snap Lake. Underground mine water will account for most of the total water generated by the project.

The process plant used to extract diamonds from the kimberlite slurry will use water from Snap Lake to separate the diamonds from the kimberlite. Most of this water will be recycled back into the process plant once the diamonds are recovered but a portion of it will be included in the processed kimberlite paste. This portion will be replaced by water from Snap Lake.

Water will also be withdrawn from Snap Lake for use in the camp and other areas where potable water is required. Once used in the camp, this water will be treated in the sewage treatment plant before being released back into Snap Lake.

Drainage from the North Pile includes surface run-off from rainfall and snowmelt, as well as water that drains from the processed kimberlite before it becomes permanently frozen. Water from the North Pile will be collected in sumps and drainage ditches, and will then be directed to settling ponds where most of



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

the sediment in the water will settle out. From there, the water will be pumped to the water treatment plant and, once treated, will be released back into Snap Lake or used for dust suppression along access roads and at the airstrip. A water management pond will be located next to the water treatment plant. This pond will store excess water in case inflows exceed the water treatment facility's capacity or the treatment facility shuts down.



## 2. Impact Analysis

### 2.1 Review Board's Analysis Approach

#### 2.1.1 Structure of Analysis

This Impact Analysis covers the following topics:

- Geotechnical, Geochemical and Thermal Influences;
- Hydrogeology;
- Hydrology;
- Water quality;
- Aquatic Organisms and Habitat;
- Geology and Terrain;
- Ecological Land Classification (ELC) and Biodiversity;
- Wildlife and Wildlife Habitat;
- Air Quality;
- Noise;
- Economic;
- Socio-Cultural;
- Resource Uses;
- Environmental Health;
- Biophysical Cumulative Effects;
- Effects of the Environment on the Development;
- Accidents and Malfunctions;
- Project Alternatives and Opportunities;
- Abandonment and Reclamation; and,
- Follow-up Programs.

The impact analysis for each of the above noted topics is organized under the following headings::

- Summary of Developer's Submissions;
- Summary of Responses from the Parties; and,
- Key Issues.

The *Summary of Developer's Submissions* provides an overview of the evidence entered on the public record by De Beers over the course of the EA, the developer's findings and the position taken by De Beers on any issues which emerged during the proceeding. The *Summary of Responses from the Parties* similarly provides an overview of the evidence entered on the public record by the Parties to the EA and their positions on any issues related to that topic. Many issues were raised throughout the course of the EA, in which the public record documents a disagreement between the Parties to the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

EA and De Beers. Only issues considered to be critical to the Board's Report of EA are discussed in detail under the heading, *Key Issues*.

For each key issue the Review Board's analysis includes the following:

- **Description of Issue** – outlines both the position and evidence provided by De Beers and the Parties to the EA;
- **Conclusions** – provides the Board's rationale and final conclusion on the issue;
- **Suggestions or Recommendations** (where applicable) – suggested or recommended measures, over and above that which De Beers has considered.

For some of the analysis topics, the Review Board's analysis required no breakdown into key issues. In these cases, the Review Board presents its analysis and states a conclusion. For two of the components (i.e., Section 2.6, Geotechnical, Geochemical and Thermal Influences and 2.17, Socio-cultural) similar or identical suggestions or recommendations applied to several different, but related key issues. In these cases, to avoid repetition, a compiled set of suggestions or recommendations are provided following the key issues section.

A full listing of the Review Board's suggestions and recommendations on the Snap Lake EA are contained in Appendix C.

Project-specific effects on the biophysical environment are discussed under Sections 2.3 to 2.14. Cumulative effects on the biophysical environment are discussed under Section 2.15, Biophysical Cumulative Effects. Project-specific and cumulative effects are discussed together for the economic and socio-cultural environment under Sections 2.16 and 2.17.

### 2.1.2 Issue Identification

The Review Board's Report of EA is based on a discussion and analysis of issues raised through the EA process. An outline of the Board's approach to identifying the issues considered in this Report of EA follows.

A total of 217 issues were raised during the Snap Lake EA process. A comprehensive listing of the issues is contained in Appendix B, grouped by environmental component. Issues were included in Appendix B where:

- A matter was carried forward to the Public Hearing by one or more of the Parties;
- There was disagreement on the environmental impact, significance or mitigation of a project effect between De Beers and one or more Parties to the EA on a particular topic;
- The results of a technical discussion required resolution; and/or,
- A series of questions by a Party appeared to lead to a larger issue.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Issues were related to one or more of the following categories: baseline data, impact assessment, mitigation measures, follow-up, development design, and mine closure.

A number of the issues listed in Appendix B are not explicitly discussed in this Report of EA. The Board considered all listed issues in its deliberations and determined that many had been resolved or else did not require explanation or analysis in this Report of EA beyond the statement of the issue in Appendix B. In all such cases, the Board is satisfied with the conclusions reached by De Beers. These issues generally fell into one or more of the following categories:

- The evidence indicated that the issue was resolved to the satisfaction of De Beers and the interested Parties to the EA;
- The issue was not pursued or carried forward to the Public Hearing by the Parties to the EA;
- The issue was carried forward to the Public Hearing in combination with another issue;
- The issue was resolved by way of a commitment made by De Beers during the EA process; or,
- The issue was without foundation in the evidence on the public record.

Issues that did not fall into the above categories were identified as “key” issues. Consequently, the Review Board has narrowed its consideration of the issues for the purposes of this Report of EA to those matters which, in the Board’s opinion, required additional discussion, analysis and, in some cases, action by responsible Ministers. In all other cases the Review Board concludes that it is satisfied with the conclusions reached by De Beers.

### **2.1.3 Developer’s Commitments**

De Beers made a series of commitments throughout the EA process. In response to an April 4, 2003 request by the Review Board, De Beers summarized its commitments in a table submitted to the Review Board on April 14, 2003. This commitment table has been updated by the Board based on a review of the public record and transcripts from the Hearing to include additional commitments made by De Beers at the Public Hearing, as well as some commitments that De Beers did not identify. The final list of commitments is found in Appendix D of this Report.

The Board considered the list of commitments made by De Beers in drawing its conclusions about impacts and their significance, and setting out its suggestions and recommendations. The Board’s decisions have been made with the expectation that De Beers will fulfill all of its commitments. The Review Board’s determinations of impacts and the significance of those impacts therefore depends on De Beers fulfilling their commitments.







**Robin Johnstone, Senior Environmental Manager for De Beers Canada Mining Inc.; John Goyman, Operations Manager, and John McConnell, Vice-president, NWT Projects, for De Beers Canada Mining Inc. at the public hearing for the environmental assessment.**

## **2.2 Study Areas**

The following briefly describes the study areas defined by De Beers for examining the potential impacts on the environment from the SLDP. For most of the environmental components, De Beers conducted its impact assessment using local study areas (LSA) and regional study areas (RSA). The size and shape of the LSAs and RSAs varied depending on the environmental component. The LSAs were defined as areas that may be directly disturbed by the development. The RSAs were selected to assess and quantify impact areas that are situated outside the LSA but may still be affected by the SLDP. Further rationale was provided by De Beers in the selection of study areas for each environmental component.

For several of the environmental components the LSA was defined as the mine footprint plus a 500 m buffer, occupying an area of 1,407 ha. In this case, the LSA is principally situated on the northwest peninsula of Snap Lake but also includes the two vent raises on the north shore of Snap Lake. For several of the components, the RSA is defined as the area within a 31 km radius of the centre of the



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

active mine area. In this case, the RSA is about 180 km northeast of Yellowknife and is 301,907 ha in size.

Concern was expressed by some of the Parties to the EA regarding De Beers' selection of study areas. (see Sections 2.10, 2.11, 2.15). The Board, however, finds that the LSAs and RSAs selected by De Beers are reasonable and is satisfied with the rationale provided.

### **Hydrogeology, Hydrology, Water Quality and Aquatic Organisms and Habitat (Aquatic Resources)**

Hydrogeology, hydrology, water quality, and aquatic organisms and habitat, are discussed under the Aquatic Resources section of De Beers' EAR. These components are inter-related, such that changes to one may result in changes to another or others. For example, groundwater which seeps into the mine will ultimately be discharged to Snap Lake. This discharge may alter the water balance, mixing characteristics and chemical water quality of the lake. These changes may, in turn, alter the abundance or characteristics of the community of aquatic life which presently exists in the lake.

Given the interrelated relationship between hydrogeology, hydrology, water quality, and aquatic organisms and habitat, De Beers defined one LSA and one RSA for all four components.

The LSA for these components included the watershed of Snap Lake and the area of regional groundwater to which Snap Lake provides recharge. This area extends north of the project site towards two lakes, named North Lake and Northeast Lake. The RSA was defined as the Lockhart River Drainage, starting at the outlet of Snap Lake and ending where the Lockhart River flows into Great Slave Lake.

### **Geology and Terrain, ELC and Biodiversity, and Wildlife and Wildlife Habitat (Terrestrial Resources)**

Geology and terrain, ELC and biodiversity, and wildlife and wildlife habitat are discussed under the Terrestrial Resources section of De Beers' EAR, as these environmental components are closely linked. One LSA and one RSA were therefore defined for these components.

The LSA was defined by De Beers as the mine footprint within a 500 m buffer. The buffer ensures that the direct effects of activities near the edge of the footprint (e.g., dust from roads) will be included in the LSA. The RSA was defined as the area within 31 km radius of the centre of the active mine area. The selection of the RSA was most influenced by wildlife. De Beers reported that the RSA was designed to provide a biologically relevant measure of the distribution of habitat types available to wildlife species during their annual movements, while insuring that the study area remained within the Taiga-Shield ecozone. De Beers also noted that the RSA encompassed areas historically important migratory routes for Bathurst caribou herd.



# **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

## **Air Quality**

The air quality assessment used only one study area, the RSA, due to the mobility of air. The RSA was defined based on the distance pollutants can travel in one hour. Wind speed and direction data were used to define the RSA. The resulting area is irregularly shaped and extends between 29 km and 49 km from the centre of the site.

## **Noise**

The LSA for noise was equal to the mine footprint plus an additional 1.5 km. This distance was used as it corresponds to the distance at which a target sound level should be achieved. The RSA was defined as the area within 31 km radius of the centre of the active mine area. De Beers stated that sound impacts from traffic on the Snap Lake winter access road and air traffic will occur within the RSA.

## **Economic and Socio-cultural (Socio-economic)**

The socio-economic impact assessment conducted by De Beers considered two categories of communities: the primary communities and the employment catchment communities. Because the socio-economic study focuses on people, the study areas consist of primary communities and not a defined area of land.

The primary communities include the communities of Lutsel K'e, N'dilo, Dettah, Gameti, Wha Ti, Rae/Edzo, Wekweti, and Yellowknife (including the NSMA Alliance population). These are the communities that De Beers has determined are likely to experience the greatest impacts, due to their proximity to the project site and expected contribution to the project workforce.

The employment catchment communities are Fort Resolution, Hay River, Hay River Reserve (located in Hay River), Fort Smith, Fort Providence, and Enterprise, which are located further away from the project site. The northern workforce may be drawn in part from any or all of these communities.

## **Resource Use**

Resource use includes five subcomponents: heritage resources, traditional land use, non-traditional land use, aesthetic quality, and the Tibbitt-Contwoyto winter road.

The effects on these resource uses were examined both at regional and local levels, except for those associated with the Tibbitt-Contwoyto winter road. The RSA was defined as the area within a 31 km radius of the active mine site and the LSA was the mine footprint area, plus a 500 meter buffer (as for terrestrial resources). For heritage resources, the LSA was modified to include only those areas scheduled for direct land disturbance, while the LSA for the Tibbitt-Contwoyto winter road was limited to the area adjacent to the winter road from Tibbitt Lake to the point of exit onto the Snap Lake winter access road.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The RSA includes the major project elements such as gravel sources and winter access roads and is consistent with the area selected for terrestrial resources.

### **Environmental Health**

The LSA and RSA for environmental health were selected to be consistent with that selected for terrestrial resources, because of the relationship with wildlife and vegetation. Therefore, the LSA was defined by De Beers as the mine footprint with a 500 m buffer, and the RSA was defined as the area within 31 km radius of the centre of the active mine area.

### **Accidents and Malfunctions**

The LSA for accidents and malfunctions was defined as the mine footprint plus a 500 m buffer. The RSA includes the area adjacent to the Tibbitt-Contwoyto winter road from Tibbit Lake to MacKay Lake and the Snap Lake winter access road to the mine site. A 5-km buffer on either side of the road is included to encompass the lakes traversed by the winter roads.

## **2.3 Geotechnical, Geochemical, and Thermal Influences**

Predictions of geotechnical, geochemical and thermal (ground temperature) influences by the SLDP on the natural terrain were discussed under Section 10.2, Geology and Terrain EAR. Linkages were made between development activities and changes in the terrain. Development activities discussed specifically included:

- Quarrying;
- Winter road access;
- Site clearing and surface disturbance;
- Infrastructure construction and operation; and,
- Storage of processed kimberlite and waste rock in the North Pile.

Changes to the natural terrain and the influence of the natural environment on the development activities were assessed under the following subjects:

- Environmental impacts due to quarrying activities at the esker;
- Topographic or other changes in the terrain;
- Seismic effects on development;
- Impacts on permafrost integrity such as temporary increases in ground temperature and potential melting of ground ice;
- The long term impacts from climate change on the development; and,
- Introduction of porewater into Snap Lake from the North Pile.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Much of the existing and proposed infrastructure development at the SLDP will be founded directly on bedrock, which provides favourable structural support. Glacial till terrain units overlie bedrock for most of the development. Large scattered boulders transported by glacial ice and frost jacked rock fragments derived from shattered bedrock are dominant at ground surface. Poorly drained peat filled depressions are present in small isolated areas. These features are reported to be discontinuous with limited ground ice wedges and some layers of ice rich soil in the soil profile.

The Snap Lake area is reported by De Beers to occur in the zone of continuous permafrost. Beneath Snap Lake and in the nearshore environment there is Talik or thawed ground, which is typical for larger arctic lakes in continuous permafrost. Mean annual air temperatures are approximately -6°C.

Almost all of the discussions between the Parties to the EA and De Beers with respect to geotechnical, geochemical and thermal considerations at the proposed Snap Lake Mine have revolved around various geotechnical and geochemical aspects of the North Pile. The North Pile is the surface containment facility for processed kimberlite and potentially acid generating waste rock. A landfill and three granite quarries will also be located within the footprint of the North Pile.

De Beers predicts that approximately 22.8 million tonnes of processed kimberlite will be produced over the life of the mine. Approximately 50% of the mine waste would be pumped underground for use as mine backfill. The remainder will be disposed of above ground forming the North Pile. The processed kimberlite would typically be a blend of material from 3 waste streams described as, sand and gravel (36%), sand (35%) and silt to clay size (29%), respectively. The materials would be blended to what De Beers describe as “toothpaste” consistency and pumped from the process plant to the North Pile site. The proposed North Pile site is about 1.5 km in length and about 0.8 km wide. The north edge of the pile would lie 50 m or greater distance from the shoreline of Snap Lake.

De Beers predicts that metavolcanic rock will be encountered for a brief time at the start of mining. Although De Beers reports that the metavolcanic rock observed to date has little sulphide content, De Beers has chosen to manage the metavolcanics as potentially acid generating material. The processed kimberlite has been described by De Beers as geochemically stable and non-potentially acid generating.

De Beers proposes to place the potentially acid generating metavolcanic rock within a confined area that is much smaller than the footprint of the North Pile and thereby encapsulate the metavolcanic rock in processed kimberlite. The maximum height of the North Pile is designed to be approximately 35 m. This maximum pile height will be reached primarily on the north side of the North Pile.

### **2.3.1 Summary of Developer’s Submissions**

The position of De Beers with respect to geotechnical, geochemical and thermal aspects of the North Pile was stated by De Beers on April 28<sup>th</sup>, 2003 at the Public Hearing as follows:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*“Experts for De Beers, and the Intervenors, have reviewed the design of the facilities. The broad geotechnical issues have been resolved and only a few issues remain, all of which are related to the North Pile... These all relate to the rate at which the PK will freeze in the North Pile; specifically, the issues are:*

- 1. The prediction of the rate of freezing in the temperature model that was used;*
- 2. How the rate of freezing could impact cryoconcentration; and,*
- 3. How this could affect the quantity and quality of the seepage release from the North Pile.*  
(Terry Eldridge, Consultant to De Beers, Public Hearing Transcript Day 1, April 28, 2003, p. 162, 167-168.)

*”... we have listened to the concerns of the reviewers, and adjusted the design of the water collection system around the North Pile. We will be constructing the ditch so there will be a small flow from the lake into the ditch, and we confident that this breaks the pathway between the North Pile and Snap Lake. We will also be monitoring the performance of the North Pile, both the way the pile will be freezing, the way the cap will be performing, and we’ll be monitoring both the quantity and quality of the water collected from the North Pile. This information will allow we to refine the predictions of long-term performance, and adjust the operation in accordance with De Beers’ Adaptive Management Plan.”*

(Terry Eldridge, Consultant to De Beers, Public Hearing Transcript Day 1, April 28, 2003, p. 176-177)

### 2.3.2 Summary of Responses from the Parties

Parties that submitted evidence or questions with respect to the geotechnical, geochemical and thermal aspects of the North Pile include Indian and Northern Affairs Canada, NRCAN and the YKDFN.

#### 2.3.2.1 INAC’s Position

The following are excerpts from Day 1 (April 28, 2003) of the Public Hearing, which represent INAC’s position with respect to geotechnical, geochemical and thermal aspects of the SLDP.

#### David Livingstone, Director, Renewable Resources, INAC, NWT Region

*“Our presentation will cover several areas, geo-technical, geo-chemical, and geo-thermal permafrost issues will be covered in one presentation because they are closely interdependent...Overall, we feel that the mine plan proposed by De Beers is largely sound and we have little in the way of additional mine plan improvements to recommend at this time.*

*We feel that paste technology is a superior case to the more conventional approach of damming large surface areas or infilling lakes to dispose of processed kimberlite. That said,*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*there are some challenges associated with this paste technology and we'll get into those in more detail during our presentation.*

*Baseline and other information provided by De Beers is less than satisfactory in some key areas. While we've done our best to deal with this, it would have been much preferable had the information we requested been provided prior to this Hearing.*

*And while we agree with De Beers that there will be an impact on Snap Lake, we feel that the Company has significantly underestimated that impact. In our view, the combined effect of baseline uncertainties, groundwater uncertainties, paste water quality issues, geo-technical issues, geo-chemical concerns and mixing issues, lead us to conclude that the impacts on Lake will be two to three times greater Lake-wide, than predicted by De Beers, and perhaps higher locally.*

*Finally, our review indicates that there is a need for continued and better focused baseline monitoring programs that improve contingency planning as necessary, and that further consideration of water treatment options, including reverse osmosis, should be undertaken.*

(David Livingstone, Director, Renewable Resources, INAC, Public Hearing Transcripts, Day 1, April 28, 2003, p. 86-88.)

### **John Brodie, Consultant to INAC, NWT Region**

*"It's our opinion that the aggregate effect of the geotechnical, geothermal, and geochemical issues associated with the North Pile will be the discharge of total dissolved solid levels to Snap Lake, and levels which are 5 to 10% greater than that which has been predicted by the proponent."*

(John Brodie, Public Hearing Transcripts, Day 1, April 28, 2003, p. 194.)

### **Dr. Chris Burn, Consultant to INAC, NWT Region**

*"I'd like to point out to the Board that the proponent has made considerable progress on the issues that were brought to their attention at the technical Hearing in December. We received information by or shortly after February the 28th reacting to the points that we raised in December. We regard these reports as contributing towards resolution of the issues we identified. There are two (2) sets of issues: First, the quality of the thermal model and specification of the conditions applied to the outside of the pile. And, second, determination of the composition of the pile and its behaviour as it freezes." - - - "I suspect that the progress they reported to us was limited, in part, by the time available to them between the December Hearings and the February 28th deadline. I am sure that the issues I will now discuss can be resolved with thought and application of appropriate procedures."*

(Dr. Chris Burn, Consultant to De Beers, Public Hearing Transcripts, Day 1, April 28, 2003, p. 197.)



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### Dr. Peri Mehling, Consultant to INAC, NWT Region

*“In summary, DIAND's assessment of the North Pile, the paste technology, pH of PK paste, -- and some of the uncertainties with it, as well as some of the uncertainties with the thermal models and the properties used, suggests that there may be an underestimated release of salts from the North Pile...this release would occur over a longer period of time, decades after closure, with a result of delaying the recovery of Snap Lake. The increase isn't large, but it's...been scoped fairly well by De Beers, but we wanted to point out that there is a potential for more coming from that pile, probable.”*

(Dr. Peri Mehling, Consultant to INAC, Public Hearing Transcripts, Day 1, April 28, 2003, pages 208 and 209)

### 2.3.2.2 Yellowknives Dene First Nation

YKDFN requested “...clarification on this 10 centimetre level below the Snap Lake water level for the ditch (bottom).” (Tim Byers, YKDFN, Public Hearing Transcripts, Day 1, April 28, 2003, p. 192.)

YKDFN also raised a question about the 50 m buffer between the North Pile and Snap Lake. It reported that other diamond mine companies have been using 100 m setbacks between the shoreline of receiving lakes and any respective waste rock piles. YKDFN indicated that based on this, it was its opinion “that De Beers is not using the best method to protect the environmental integrity, the water quality, of Snap Lake if they're using a much narrower buffer zone.” (Tim Byers, YKDFN, Public Hearing Transcripts, Day 1, April 28, 2003, p. 192)

### 2.3.2.3 Natural Resources Canada

NRCAN outlined that the “...prediction of the thermal condition of the pile is required to facilitate the identification of potential problems related to pile stability, seepage and water quality, and also to help to determine what mitigation measures may be required.” (Dr. Sharon Smith, NRCAN, Public Hearing Transcripts, Day 1, April 28, 2003, p. 221)

NRCAN addressed the De Beers North Pile temperature model and design of the perimeter ditch system. NRCAN recommended a more conservative assumption of snow depth inputs to the model and the inclusion of a suitable climate warming rate. These factors could slow the predicted rate of freezing of the North Pile and influence the depth of the active layer.

NRCAN pointed out final design issues for the perimeter ditch system and prescribed the level of precision NRCAN would recommend for ground temperature monitoring of the North Pile and the seepage collection system. Specifically NRCAN recommended a thermal analysis be done of the ditch design and that ground temperatures be measured to an accuracy of 0.01 C°.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### 2.3.3 Key Issues

In the opinion of the Board, the following issues related to the geotechnical, geochemical and thermal aspects of the North Pile warrant discussion in the Report of EA:

- Temperature model for the North Pile;
- Cryoconcentration effects in the North Pile;
- North Pile seepage quantity and quality; and,
- North Pile seepage collection.

These issues and the Board's conclusions on these issues are described in Sections 2.3.3.1 to 2.3.3.4. The Board provides suggestions for all four issues in Section 2.3.3.5.

#### 2.3.3.1 Temperature Model for the North Pile

##### *Description of Issue*

Prediction of the influence of the SLDP North Pile construction on the permafrost terrain and potential impacts on water quality of Snap Lake requires an understanding of the existing thermal regime and expected changes in the thermal regime. At the November-December 2002 Technical Sessions, geotechnical concerns about pile stability and internal drainage, and geochemical concerns, arising from issues with the subsurface temperature prediction model for the North Pile were discussed. Much of the discussion about temperature modeling focused on differences in opinion regarding the method of application of the results of the model to the prediction of porewater geochemistry and geotechnical stability in the North Pile. The level of precision that is required from the model for accurate prediction of potential effects was debated.

Prior to the November-December 2002 Technical Sessions, De Beers indicated in their November 12, 2002 letter to the Review Board titled "Submission of De Beers' Written Comments on the Gartner Lee Ltd., Issues Rationale Document for the Public Registry" that it is committed to providing adequate instrumentation, monitoring and ongoing analysis of the North Pile slope stability, rate of freeze back and seepage pressures. De Beers indicated that it would "*provide details during the appropriate regulatory phase.*"

De Beers explained at the November-December 2002 Technical Sessions and again on April 28<sup>th</sup>, 2003 that "*Models allow us to ask, what if, questions, to test the behavior of the system before it is constructed. And the models help us to identify what we should monitor to determine performance in the field, where we can best monitor, and when action should be taken.*" (Terry Eldridge, Consultant to De Beers, Public Hearing Transcripts, Day 1, April 28, 2003, p. 168.)

At the November-December 2002 Technical Sessions the Parties questioned the precision of the temperature model. The Parties did not appear to share De Beers confidence in the utility of the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

model to help test the full range of geotechnical and geochemical behaviour of the North Pile system described above.

The questions about geotechnical and geochemical issues were explored further through correspondence between the Parties and De Beers.

INAC recognized in its Addendum Report dated March 14, 2003, the advances De Beers made in upgrading the geothermal model since the time of the November-December 2002 Technical Sessions and stated:

*“... the analyses and modelling give a reasonable indication as to how the pile may behave during and following operations... it may not be possible to significantly improve on the current thermal model predictions... The work to date suggests that the risk of adverse impacts is low. A key aspect of the current design is the allowance for contingencies.”*

At the Public Hearing De Beers expressed that:

*“Although there are still some unresolved issues with the temperature model, experts for INAC agree that the model gives a reasonable indication of how the pile will perform and that there will be a low risk of adverse impact. As previously mentioned, the North Pile will be developed in cells and we will be monitoring the temperature of the paste as it is placed in the starter cell so that ... we can refine our predictions during the mine life.”*

### **Conclusions**

When designing an earth structure such as the North Pile, engineers and scientists seek to understand the physics and chemistry of a complex system that is controlled by a combination of time-dependent parameters. These parameters relate to:

- Methods and rates of construction;
- Changes in mechanical and geochemical properties of the processed kimberlite;
- Changes in the way water infiltrates the materials; and,
- Changes in the processed kimberlite porewater chemistry and quality and the way it migrates through the pile. All of these systems either influence or are influenced by climate and specifically ground temperatures.

Based on De Beers' discussion on this subject and the Board's review of the EAR, it is apparent that De Beers used a commercially available temperature modelling computer program as a tool for conducting limited sensitivity analyses. De Beers used the model to predict rates of freezeback for different rates of disposal of processed kimberlite, then chose to design the pile and water management system based on the North Pile's geotechnical and geochemical parameters. This approach was considered conservative or low risk from a geotechnical perspective. For example, De Beers' analyses of the susceptibility of the North Pile to slope instability were based on unfrozen soil conditions using material strength parameters below the values De Beers expected. This means that although the De Beers analyses show some limited freezing within the North Pile,



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

their geotechnical design does not require freeze back to ensure overall stability of the North Pile. Thus, De Beers has designed the North Pile using a low risk or conservative approach for the short and long term stability of this structure.

Another example of the need to understand ground temperatures in the North Pile, relates to the impact of temperature on the estimated volume of water seeping from the pile. De Beers reported that it expected the North Pile to cool to ground temperatures approximately  $0.2\text{ C}^{\circ}$  below the freezing point two years after placement. At these temperatures the rate of seepage discharge from the processed kimberlite would be lower than it would be if the processed kimberlite temperatures were above freezing. Although De Beers expect seepage rates from the North Pile to be reduced by partial freezing, De Beers chose to estimate seepage volumes based on the assumption that the processed kimberlite in the North Pile would be unfrozen. By making this assumption, De Beers believed that the predicted seepage volumes were conservative and that their seepage analyses would also be useful to respond to questions about the potential of long-term influence on the North Pile due to climate warming.

The Board concurs with INAC's view that some progress was made in improving the thermal (temperature) model between the time of the November-December 2002 Technical Session and De Beers technical report submission on February 28, 2003. The Board also concurs with INAC's view that the risks of adverse impacts are [probably] low.

De Beers has committed to an adaptive approach to the management of the North Pile. An Adaptive Management Plan to assess and verify this approach was not filed during the EA.

The Board agrees with INAC that the temperature prediction model for the North Pile, as applied by De Beers, is adequate for the EA of the SLDP. It is the view of the Board that De Beers' commitment to an adaptive management provide the means to 1) design conservatively, so that the risk of an environmental impact is low, 2) monitor to confirm design assumptions and 3) modify the North Pile design, as needed over the life of the mine, so that the North Pile does not present a significant short term or long term risk to the environment.

The Board concludes that:

1. De Beers carried out adequate ground temperature modeling for predicting the freeze back response of the North Pile during and after construction.
2. De Beers did not rely on any of the positive effects of freeze back of the North Pile to determine the geotechnical integrity of the North Pile over the long term.
3. The risk of adverse environmental impacts due to North Pile instability is low.
4. Positive effects of freezing were not relied upon for estimating maximum seepage rates, seepage volumes and overall quality of this water either in the short term or the long term.

Finally, the Board concludes that the temperature effects on the SLDP North Pile construction have been adequately considered by De Beers during design. The integrity of the North Pile and related



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

seepage containing dissolved solids are not likely to have a significant adverse impact on the terrain including the permafrost regime and down gradient Snap Lake water quality. However, the Board is of the opinion that suggestions (listed in Section 2.3.3.5) should be considered to ensure that the environmental risk of this structure over the life of the mine is managed in an effective manner.

### 2.3.3.2 Cryoconcentration Effects in the North Pile

#### *Description of Issue*

Discussions about cryoconcentration effects arose from INAC's review of the predicted chemical composition of dissolved solids in seepage water emerging from the North Pile.

Dissolved solids including sodium, potassium and other ions exist in the porewater (any water that fills the voids of the PK) of the processed kimberlite. Due to the presence of ions and the particle size composition of the processed kimberlite, the phase change from liquid water to solid ice is gradual as temperatures drop below 0°C. Therefore, in processed kimberlite, ice and liquid water can exist at temperatures below 0°C.

Cryoconcentration is a term used to describe the change in porewater chemical concentrations that occurs due to freezing. At temperatures above freezing, a unit volume of porewater in the liquid phase within the North Pile will have an initial concentration of dissolved solids. As the temperature drops and ice forms the unit volume becomes part water and part ice. Dissolved solids are expelled from the water as it freezes with an overall effect of raising concentrations due to the reduced volume in the remaining liquid water. The liquid water with higher concentrations of chemicals either becomes entrapped within the pile or emerges from the pile as seepage.

The March 14, 2003 addendum prepared by INAC concludes, "*... that the issue of appropriate estimates of contaminant loads is unresolved, but that the uncertainty may be within tolerable ranges, particularly given the proposed commitment to collect seepage and runoff, monitor early trends, and modify mitigation measures on the basis of field observations.*" At the Public Hearing INAC described the sources of their uncertainty with respect to this issue.

De Beers acknowledged at the Public Hearing that:

*"...cryo-concentration is important because it will lead to a higher dissolved solids concentration in the (seepage) water that comes from the paste in the North Pile. However as a result of the freezing process, less water can come from the North Pile since more water will remain in the North Pile as ice. The result will be a smaller amount of water with higher concentration of dissolved solids but the total load of dissolved solids will be about the same. So, you can see that cryo-concentration relates to the quality of the water seeping from the paste."*

(Terry Eldridge, Consultant to De Beers, Public Hearing Transcripts, Day 1, April 28, 2003, p. 171-172.)



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

### ***Conclusions***

The Board notes that INAC advised De Beers of the potential for cryoconcentration effects in the North Pile and that De Beers' scientists and engineers acknowledged and responded to this concern. The predicted concentrations of dissolved solids were described in the EA by De Beers and include allowances for loading from the effects of cryoconcentration. De Beers has described the water treatment technologies planned for use in the Snap Lake Diamond Project based on predictions of worst case water quality from the entire mine operation. If the quality of water discharged from the SLDP becomes an issue, the Board understands that there are existing technologies that would allow De Beers to treat the water. The Board anticipates that regulatory approval of this project, principally through the terms and conditions of the Production Water Licence, will provide for management of water quality issues for discharge water.

In view of this, the Board concludes that seepage water from the North Pile is not likely to have a significant adverse impact on the Snap Lake water quality. However, the Board is of the opinion that additional measures should be considered to ensure that the impacts on the water quality of Snap Lake remain within acceptable levels and can be managed effectively in the future.

The Board understands that De Beers has already made a commitment (Response to Review Board's Q.9 by De Beers dated April 14, 2003; see also Appendix D) to monitor and assess water quality of seepage emerging from the North Pile during all phases of the project to validate the EA predictions and, if needed, to adapt management practices to achieve water quality objectives.

### **2.3.3.3 North Pile Seepage Quantity and Quality**

#### ***Description of Issue***

Seepage quantity and quality from the North Pile is strongly influenced by the frozen and unfrozen hydraulic properties of the processed kimberlite. Unfrozen processed kimberlite conducts more water than frozen processed kimberlite. In the unfrozen condition, processed kimberlite with a higher coefficient of permeability will allow water to pass more freely than a processed kimberlite with a very low coefficient of permeability. The intrinsic coefficient of permeability of the processed kimberlite is one of the fundamental material properties needed to evaluate the volume of water through the North Pile. Seepage rates and volumes are also pertinent to the assessment of loads of dissolved solids in the water draining from the pile.

Through the discussion on temperature modeling, it was INAC's opinion that the North Pile mass will likely be at temperatures that result in the pile behaving hydraulically more like an unfrozen mass (Section 2.3.3.1 of this report).

A discussion of the technical communications regarding to estimates of seepage quantities based on hydraulic properties of unfrozen processed kimberlite used in the seepage model follows (see Technical Review of Hearing Discussion below). It is important, however, to put the technical



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

discussion about seepage quantities from the North Pile into perspective relative to the overall water balance for the mine.

### *Water Balance*

It was reported by De Beers and agreed to by INAC that in Year 2 of mining operations, the North Pile and above ground facilities (airstrip, roads, etc.) will be the source of about 10% (plus or minus 5%) of the water that is managed at the Water Treatment Plant. The remaining 90% of the water (plus or minus 5%) will be from the underground mine operations beneath Snap Lake.

De Beers reported at the Public Hearing that in terms of the total quantity of water managed at the site, at about year ten (10), when the entire North Pile footprint has been developed, there would be about:

- 8 million m<sup>3</sup>/yr of water pumped from the mine to the treatment plant;
- 110,000 m<sup>3</sup>/yr of surface runoff from the general site;
- 160,000 m<sup>3</sup>/yr of surface runoff from the North Pile that will be collected in the ditch and sent to the water treatment plant; and,
- 70,000 m<sup>3</sup>/yr of seepage from the paste that will be collected in the ditch and sent to the treatment plant.

Therefore, in the context of the overall project, it is apparent that with time, the proportion of water that De Beers is collecting from the North Pile is a small (less than 1% in Year 10) component of the water being managed on-site during operations.

### *Technical Review of Public Hearing Discussion*

Technical discussions between De Beers and the Parties about seepage rates and quantities from the North Pile stemmed from differences in opinion regarding material properties of the processed kimberlite and the operational use of water. At the Snap Lake Public Hearing, INAC described the processed kimberlite to be a “coarse, freely-draining material”. This implies a material with a coefficient of permeability of  $1 \times 10^{-4}$  cm/s or greater. This characterization of the processed kimberlite was derived by INAC estimating hydraulic properties indirectly from an unfrozen water content curve. INAC also discussed a number of hypothetical operational factors that led them to conclude that water usage for processing and disposal of the processed kimberlite would be greater. It followed that the proportion of water from the North Pile will be “greater than expected” by De Beers. INAC suspects the “paste” will be wetter than De Beers describe and that the pile will not be as “frozen” as De Beers describes. INAC estimated that more water will discharge from the pile and for a longer time.

In the EA, De Beers describes processed kimberlite as a manufactured material using waste from the extraction of diamonds from kimberlite. Although coarse, free-draining kimberlite will be used in the containment shell of the North Pile, in which the material properties of the majority of the processed



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

kimberlite to be deposited in the North Pile will be a full mix processed kimberlite which is a different material than assumed by INAC. De Beers has reported the material to be a blended mix of fine gravel, sand and fine particles (silt and clay sizes). The proportions of full mix processed kimberlite are from three waste streams described as: 36% sand and gravel, 35% sand and 29% silt and clay, respectively. Hydraulic conductivity properties determined by laboratory analysis reported in supporting documents to the Snap Lake EA (SDLP Surface Engineering Optimization Study North Pile Management, December 2001, prepared for AMEC Simons Mining and Metals by Golder Associates Ltd.) show the paste material to have a low coefficient of permeability ( $10^{-6}$  to  $10^{-7}$  cm/s), meaning practically impervious, the opposite of the “freely-draining material” assumed by INAC.

INAC’s semi-quantitative prediction of the pile seepage and drainage behaviour, which was predicated based on assumed hydraulic properties, contrasts strongly with the material properties measured by De Beers. De Beers’ modeled the seepage behaviour from the pile based on steady state seepage conditions, assuming the pile is unfrozen. The paste consistency and hydraulic properties that De Beers used are at least an order of magnitude higher than determined by laboratory analysis and laboratory trials, but are still an order of magnitude less permeable than the coarse, free-draining material predicted by INAC.

Some of INAC’s concerns regarding North Pile water quality are based on the expectation of volumes of seepage water higher than predicted by De Beers. These larger volumes were based on the assumption of a higher coefficient of permeability of the processed kimberlite than assumed by De Beers. Verification of the processed kimberlite hydraulic properties including the intrinsic coefficient of permeability could be done during construction of the pile as part of the quality control.

In De Beers’ Technical Memorandum entitled *North Pile Seepage Collection System, February 28, 2003*, De Beers agreed to design and construct a water collection system to intercept “all” of the water from the North Pile. This has been an important commitment made by De Beers that has resulted from the correspondence between De Beers and the Parties after the February 2002 EAR. This system is discussed in Section 2.3.3.4 of this report.

### ***Conclusions***

The Board concludes that the predicted North Pile seepage water quantity and quality reported by De Beers has been based on conservative assumptions of the hydraulic properties of the materials in the pile and are supported by hydraulic properties for the processed kimberlite measured in a laboratory setting.

The Board concludes that seepage quantities and water quality of the water emerging from the North Pile are not likely to have a significant adverse impact on the Snap Lake water quality. However, the Board is of the opinion that suggestions should be considered to ensure that the environmental risk over the life of the mine is managed in an effective manner.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The Board understands that De Beers has already made a commitment (Re: Response to Review Board Q.9 by De Beers dated April 14, 2003; see also Appendix D) to monitor and assess the water quality of seepage emerging from the North Pile and assessed during all phases to validate the EA predictions and, if needed, to adapt management practices to meet water quality objectives.

### **2.3.3.4 North Pile Seepage Collection Ditch**

#### ***Description of Issue***

At the November-December 2002 Technical Sessions, the Parties noted that De Beers had assumed in their design and water balance projections, that 10% of the North Pile water would bypass the ditch and flow directly to the west arm of Snap Lake without treatment. The Parties indicated that it is prudent to collect all of the seepage water for treatment.

In response to this concern, De Beers proposes to capture all of the water that emerges from the North Pile and mine development and treat the water at the Water Treatment Plant before it is discharged to Snap Lake. This water includes surface runoff due to precipitation and seepage discharge from the North Pile.

Some of the improvements to the ditch design by De Beers, include:

1. Construction of an embankment parallel to the ditch and on the downstream side of the ditch which will facilitate aggradation of the permafrost above the elevation of the ditch bottom to create a frozen cutoff to the flow of water from the ditch toward Snap Lake;
2. De Beers has also described in a February 28<sup>th</sup>, 2003 memo a program of identifying and grout infilling of joints or fissures in the active layer of the rock base of the ditch; and,
3. De Beers has also proposed to construct the ditch bottom below the lowest elevation of Snap Lake to create a gradient toward the ditch from the Lake.

#### ***Conclusions***

The Board notes that the revised seepage collection system was one of the positive results of the interaction between the Parties and De Beers during the Board's technical process.

The Board concludes that the North Pile seepage collection system is a technically feasible solution to reduce the possibility that seepage water from the North Pile will escape directly to Snap Lake, provided the collection system is properly operated and maintained.

The Review Board concludes that the North Pile seepage collection system proposed by De Beers is a responsible approach to managing water from the North Pile. The Board further concludes that the North Pile is not likely to have a significant adverse impact on the water quality of Snap Lake. However, the Board is of the opinion that the suggestions outlined below should be considered to ensure that the environmental risk over the life of the mine is managed in an effective manner.





### **2.3.3.5 Geotechnical Suggestions for North Pile**

**Based on the conclusions made in Sections 2.3.3.1 to 2.3.3.4 on the issues of temperature model, cryoconcentration, seepage quality and quantity and seepage collection ditches related to the North Pile, the following suggestions should be considered for implementation:**

- (S2) The Board suggests that geotechnical monitoring be required in the terms and conditions of the Production Water Licence to verify EA predictions over the life of the mine, including reclamation and closure of the mine.**
  
- (S3) The Board suggests that an Adaptive Management Plan be prepared for approval as part of the Production Water Licence to ensure that contingency plans are in place in terms of geotechnical performance of the North Pile.**

## **2.4 Hydrogeology**

### **2.4.1 Summary of Developer's Submission**

De Beers submitted descriptions of the groundwater flow regime in the LSA and RSA, predictions of the quantity of groundwater that will enter the mine workings over the operational period, and predictions of the quality of groundwater that will enter the mine during operations. Its EAR also described the quality of groundwater following mine closure and its movement away from Snap Lake and into surface water away from the site. The EAR prepared by De Beers described changes in groundwater resulting from underground mining activities and construction and operation of surface facilities.

In the original EAR submission, De Beers predicted effects on water quality and aquatic resources in the North and Northeast Lakes as a result of groundwater moving away from the underground mine workings often the closure of the mine. Some of these project-related effects were based on limited data and conservative assumptions. The North Lakes Report (Golder Associates, October 2002) provided revised predictions for groundwater impacts based on additional field programs and analyses carried out in 2002.

There are no users of groundwater in the study areas and thus no reasonable potential for groundwater use. Groundwater was assessed only as a pathway which could potentially change the quality and quantity of surface waters in the LSA and RSA.

De Beers' regional conceptual groundwater model described a radial flow pattern moving outward away from Snap Lake during baseline and post closure conditions because Snap Lake is a headwater lake. During operations, groundwater would flow to the mine workings due to dewatering of the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

mine. De Beers developed and tested a model to describe the quantity and quality of groundwater that would report to the mine workings during each stage of the mine's life. This water would interact with mine activities and would be pumped to the surface for treatment and discharge to Snap Lake.

Following closure of the mine the original regional flow pattern would be re-established. The quality of some groundwater would be altered by reaction with the paste backfill in the mine, increasing the pH and the concentration of certain trace metals. De Beers' analysis "forced" all groundwater that interacted with the closed mine to the Northeast Lake as a conservative assessment of worst case impact. De Beers concluded that the volumes of groundwater were small such that environmental impact was negligible. De Beers also refined its original conservative model assumptions to account for attenuation of contaminants in the groundwater plume by interaction with host rock or lake sediments. De Beers predicted negligible or low impacts if the plume discharged to the Northeast Lake.

During operations, groundwater entering the mine would vary over time but typically would be a mixture of 30% deep, old groundwater (i.e., connate groundwater) and 70% shallow, new groundwater, which has recently infiltrated downwards from Snap Lake. The deep, old groundwater contains high levels of dissolved solids (most notably calcium and chloride). The shallow, new groundwater originating from Snap Lake is very dilute, with low levels of Total Dissolved Solids (TDS), chloride and calcium. The combined mine inflow of shallow and deep groundwater is predicted to increase to approximately 24,000 m<sup>3</sup>/day after Year 10 of mining operations, with a predicted range of 16,000-32,000 m<sup>3</sup>/day (2,900 to 5,900 US gallons per minute).

The mine water quality was estimated from the composition of groundwater sampled during the AEP, plus contributions from underground sources such as blasting, paste backfill and grouting as well as recycling of the Snap Lake water altered by the mine water discharge. Of these components, the connate groundwater was the most important contributor as accounting for 65-75% of the TDS loadings to Snap Lake, and 85-90% of the loadings of chloride. De Beers' model used results from its AEP to determine a median mine discharge water quality of 600 mg/L of TDS and 240 mg/L of chloride.

De Beers completed a Technical Memorandum entitled *Snap Lake Diamond Project Mine Water Assessment and Variability*, February 28, 2003 (February 28, 2003). In it, De Beers concluded that its EA predictions of groundwater and TDS loadings to Snap Lake were conservative. A reasonable worst case assessment of mine water discharge quality lay somewhere between the values used in its EA and variability scenarios provided by Parties to the EA. De Beers' conclusions were guided by an understanding that, in cases where flows to the mine were greater than expected, most of this increased flow would come from Snap Lake rather than connate groundwater and would therefore have lower values of TDS. De Beers concluded that its assessment was conservative and that high flows of highly saline connate groundwater into the mine are not likely.



### 2.4.2 Summary of Responses from the Parties

The response of Snap Lake water quality from the mine is dominated by the discharge of mine water. As a result, the mine water discharge model was the subject of much discussion during the EA. The debate focused mainly on two unresolved issues: 1) mine groundwater discharge quantity, and 2) mine groundwater discharge quality. Both factors interact to produce the chemical mass load to Snap Lake and the mass loading, in turn, determines the water quality response of the lake. The critical parameters for consideration are the TDS and chloride in the connate groundwater.

The Dogrib Treaty 11 Council noted uncertainties in the characterization of the regional groundwater flow, the estimation of mine water quantities and a general lack of groundwater quality data, particularly from deeper zones of bedrock.

The NSMA noted that De Beers demonstrated a limited understanding of the hydrogeology of the RSA, largely due to limited baseline data on groundwater levels, hydraulic conductivity, seepage volumes and connate groundwater quality. These perceived deficiencies led to uncertainty in the validity of the conceptual groundwater model that was proposed, in the opinion of the NSMA.

NRCan also noted that the lack of adequate baseline data on hydrogeology also limited the validity of predictions from De Beers' models of groundwater flow, quantity and quality. NRCan initially identified the potential for diffusion of dissolved chemicals upwards from the closed mine into Snap Lake, but later provided its own analysis indicating that this was unlikely. This agreed with De Beers' findings.

Environment Canada noted that De Beers' groundwater samples from the AEP may not have been representative of connate groundwater seepage to the mine. Concerns were expressed about various aspects of the groundwater model, relating to TDS loadings to Snap Lake. Environment Canada resolved these concerns upon review of De Beers' *Snap Lake Diamond Project Mine Water Assessment and Variability, February 28, 2003* technical memorandum, which was submitted in response to the November-December 2002 Technical Sessions and discussions with various Parties to the EA. Environment Canada suggested using the EAR predictions of TDS loadings, plus one standard deviation for a worst case prediction of the impacts on Snap Lake.

INAC was concerned about lack of baseline deep groundwater quality data. INAC also noted that some of the available deep groundwater results were diluted with shallow groundwater inflows during the AEP. INAC indicated that the upwelling of deep saline groundwater could increase mine inflow TDS concentrations, and further, that deep saline groundwater quality from a well near the Northeast Lake was not used in the De Beers' analysis.

INAC concluded that the TDS concentrations of connate groundwater inflow to the mine would be substantially higher than those predicted by De Beers.



### 2.4.3 Key Issues

The linkage between connate groundwater quality and quantity, loadings of TDS to Snap Lake and the potential for impacts to the aquatic community in Snap Lake means that it is critical to resolve the uncertainties in De Beers' groundwater model identified by the Parties to the EA. The degree of uncertainty expressed by some Parties, and their conclusions of significant adverse impacts to the Snap Lake aquatic community, were considered in the Board's analysis. Quality and quantity of connate groundwater are discussed below.

#### 2.4.3.1 Mine Groundwater Discharge Quantity

##### *Description of Issue*

De Beers estimated that the mine inflows would constitute 95% of the volume of water discharged to Snap Lake, based on the groundwater model developed and tested during the AEP. The predicted volume of mine inflows during peak operations ranged from 16,000-32,000 m<sup>3</sup>/day, with an average of 24,000 m<sup>3</sup>/day. In the final analysis, Parties to the EA accepted the estimates of volumes of groundwater provided by De Beers and felt that uncertainties of TDS loading impacts could be better addressed through better definition of connate groundwater quality.

De Beers stated at the Public Hearing that mine inflow will be monitored during development and operations of the mine and the model will be refined. Grouting was identified as the only feasible means of mitigating higher than anticipated inflows. The Board notes correspondence from De Beers to Environment Canada (February 4, 2003) which clarifies a commitment to install reserve water treatment capacity and to improve estimates of water inflow rates to the mine during operations. The pollutants of most concern, however, are dissolved ions and metals which will not be treated in the water treatment plant.

The Board accepts De Beers' position that flows which exceed EA predictions are more likely to consist of dilute Snap Lake inflows rather than of saline connate groundwater, so higher inflows will not significantly influence loadings of TDS to Snap Lake. The Board also notes De Beers' commitment that it would cease operations and allow the mine to flood to avoid discharging untreated volumes in the event of catastrophic inflows.

The issue of mine inflow quantities was well summarized by the consultant to the Dogrib Treaty 11 Council in its February 14, 2003 Technical Report to the Review Board as:

*“De Beers has stated that they would flood mine workings before discharging untreated volumes. Thus, if these values are underestimated, De Beers is at a higher risk. This suggests that De Beers would be conservative as a general rule to protect their economic interests and actually overestimate inflows. ... De Beers would have more at stake (economic viability) if mine inflows were much higher than expected than there is risk to the environment.”*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

(Plain Language Summary Report by Dogrib Treaty 11 Council for submission to the Mackenzie Valley Environmental Impact Review Board Assessment of the Proposed De Beers Snap Lake Diamond Project, paragraph 4, p. 1)

### *Conclusions*

The Board accepts De Beers' predictions of groundwater inflow quantities. Limited baseline data means, however, that there is some uncertainty associated with these predictions. Implications of this uncertainty can be addressed by improving baseline data, grouting, or flooding the mine. Based on De Beers' predictions, the Board concludes there will likely be no significant adverse impacts to Snap Lake associated with groundwater quantity and that the mine water balance can be managed with the mitigation measures outlined by De Beers.

Although the Board concludes that the SLDP is not likely to have significant adverse impacts associated with groundwater quantity, the Board is of the opinion that additional measures should be considered to ensure that groundwater quantity can be assessed and managed throughout the life of the mine.

### *Suggestions*

**The Board anticipates that regulatory terms and conditions will be prepared that will include requirements to verify De Beers' EA predictions of mine groundwater discharge quantity. The Board therefore suggests that the additional information on groundwater quantity set out below be secured under the terms and conditions of the Production Water Licence:**

- (S4) The Board suggests that De Beers monitor the quantity of mine inflow and provide an annual update to its mine water discharge model to verify EA predictions of groundwater inflow, anticipate the need for mitigation, and manage groundwater quantities within the range of De Beers' EA predictions. The monitoring program should, where appropriate, include boreholes drilled in advance of mine development in order to provide advance warning of unanticipated changes in hydraulic conductivity.**
- (S5) Monitoring results should be reported, at a frequency to be determined by the Mackenzie Valley Land and Water Board, and used as input to the loading calculations to determine the need for additional mitigation ( e.g., grouting) or cessation of water discharge if TDS loadings exceed the Production Water Licence limit which is recommended by the Mackenzie Valley Land and Water Board.**
- (S6) The Board suggests that the groundwater quantity monitoring program be included among the terms and conditions in a Production Water Licence.**





The entrance to the underground workings of the Snap Lake Diamond Mine in winter.

### 2.4.3.2 Mine Groundwater Discharge Quality

#### *Description of Issue*

This key issue was raised by many Parties but thoroughly discussed in the intervention filed by INAC. The INAC submission concluded that deep connate groundwater quality would be more saline (2-3 times higher TDS, chloride and calcium) than predicted by De Beers based on the AEP. Higher salinity connate groundwater inflows to the mine will increase the loadings of TDS into the mine water discharge to Snap Lake and hence the potential adverse impact of the project on aquatic life.

INAC concluded that the TDS and chloride concentrations in mine water inflows would be two to three times the concentrations predicted by De Beers due to:

- De Beers' AEP groundwater samples were likely diluted with lake water;
- The mine will extend to a depth of 460 m, AEP groundwater samples were from the upper third (82 to 164 m) of the mine and TDS increases with depth;



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- More reliable data from deeper wells installed by De Beers in the North Lakes study were ignored. TDS values were 1,100 to 1,600 mg/L (De Beers used 902 mg/L in its assessment) and chloride values were 380 to 610 mg/L (De Beers used 330 mg/L in its assessment);
- Upwelling of high TDS groundwater from below the mine will increase connate groundwater contributions of TDS; and,
- Incomplete mixing within Snap Lake would produce a high TDS layer at the bottom of the lake that would seep down into the mine.

INAC pointed out that the North Lakes data from well MW02-03 showed a TDS value of 1,600 mg/L and a chloride concentration of 610 mg/L, which are higher than the EA values of 902 mg/L TDS and 330 mg/L chloride used by De Beers. This well is located 2 km north of the mine at a depth of 190 to 215 m (similar to average mine depth of 210 m). This well has a hydraulic conductivity of  $1 \times 10^{-6}$  m/s, which is similar to the values used by De Beers for this depth. This data suggests that mass loadings from the connate groundwater from this depth could be greater than predicted by De Beers.

De Beers stated that it did not use data from this well because it is in a discharge zone (i.e., deep groundwater is discharging upward) whereas the mine will be located in a recharge zone where groundwater will flow downward and be dominated by the influence of Snap Lake. However, the difference between lake levels (equivalent to shallow groundwater elevations) and deep groundwater elevations are within 0.05 and 0.2 m of each other and were measured a month apart. This is considered by INAC to be only weak evidence of groundwater discharge. The Board notes that chloride concentrations in the North Lakes (and other surrounding lakes) are generally 1 mg/L or less, which suggests that the entire area may be a regional recharge area for the deep groundwater flow system, not a discharge area as implied by De Beers. The Board notes, however, that low chloride levels may also reflect the dominance of surface runoff in the water budget for these lakes.

The water quality issue is the size of the chemical mass load of TDS (concentration times flow rate) to Snap Lake. The critical parameters are the TDS and chloride that are in the deep, connate groundwater. De Beers reasoned that, while deeper groundwater has much higher concentrations of TDS and chloride, the anticipated flow rates should be much slower in high TDS zones because the rate of old groundwater flow in the regional flow system is predicted to be low. De Beers concluded that inflow of low TDS water from Snap Lake would form most of the underground mine water. De Beers claimed that its predictions are conservative because it assumed that Snap Lake connate groundwater has higher TDS values than groundwater at similar depths at the Diavik site. De Beers also used higher groundwater flow rates than reported for high TDS waters at other sites.

De Beers submitted a *Snap Lake Diamond Project Mine Water Assessment and Variability, February 28, 2003* technical memorandum in response to the November-December 2002 Technical Sessions and engaged in subsequent discussions with various Parties to the EA. De Beers concluded that the scenario used in the EA was conservative and was similar to values obtained using a scenario where concentrations increased with depth and groundwater flows decreased with depth.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Environment Canada suggested that the uncertainty in worst case predictions could be addressed by using the scenario of “expected concentration plus one standard deviation” used in the Mine Water Assessment and Variability report while keeping the flow rates the same. This results in approximately 50% increase in mine inflow concentrations of TDS with concentrations about 1.5 times higher than values predicted by De Beers.

It is unclear why De Beers chose not to consider the high TDS and hydraulic conductivity data from the North Lakes Study. Inclusion of this data, or the drilling of deeper boreholes during the AEP for collection of water quality and flow data, could have improved predictions of the loadings of TDS to Snap Lake from groundwater. The Board also notes that groundwater TDS ranged from 190 – 1,700 mg/L in the North Lakes study of 2002 with a median of 1,020 mg/L. Only the deepest borehole had the high values. Other boreholes were drilled to the average depth of the mine and TDS levels were in the same ranges as those used for De Beers’ analyses.

De Beers’ predictions of mine water quality and mass loadings are considered by the Board to be reasonable estimates of the average conditions that are likely to occur. De Beers includes some conservative assumptions such as 65% of mine inflows are lake water from an anticipated range of 62 to 95% which predicts less dilution of connate groundwater with lake inflows than is likely to occur. However De Beers’ predictions are not considered to be sufficiently conservative to be considered the worst case.

A scenario where mine water TDS and chloride mass loadings were 1.5 times higher than in the EA (expected plus 1 standard deviation as calculated by De Beers and accepted by Environment Canada) is a reasonable worst case prediction. A worst case scenario in which TDS and chloride mass loadings are two to three times higher than predicted was not convincingly substantiated, and required combinations of high groundwater discharge volumes and correspondingly high TDS concentrations, which are considered unlikely by the Board. The conclusions of De Beers, and of the Parties, cannot be confirmed due to the lack of deep groundwater data in the vicinity of the mine.

The TDS and chloride concentrations in mine inflows are predicted to be highest during the initial years of mine operation when the mine inflow will be dominated by connate groundwater. At the same time, the volumes of groundwater will be low in the initial years of mine development such that connate mass loadings and the impact to Snap Lake will also be minimal. The volumes of mine water discharge will increase over time, mostly due to the input of Snap Lake water, but the Snap Lake water will have low levels of TDS. The Board accepts that increases of groundwater inflow volumes to levels exceeding predictions are more likely to be dominated by seepage of low TDS water from Snap Lake.

TDS and chloride loadings will not increase concentrations in Snap Lake to levels of concern until eight years into operations. The peak concentrations of TDS in Snap Lake are not predicted to occur until year 19 of mine operations. This lag time allows for the monitoring of mine inflows, the revised predictions and mitigation and the development and implementation of contingency plans early in the





## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

life of the mine, if required. De Beers committed to “apply new data and revise the groundwater flow model as the project moves forward”. (November-December 2002 Technical Sessions).

The Board notes that technology is available to remove TDS from mine water through reverse osmosis or ion exchange. Costs are high, volumes are large and the processes are energy intensive that will generate residual sludges that will require disposal. Treatment of TDS was not considered feasible or cost effective in briefs submitted by De Beers (see Section 2.20, Project Alternatives and Opportunities)

### ***Conclusions***

Although De Beers’ model included some conservative assumptions, it did not represent a worst case analysis. Better baseline data would have added certainty to De Beers’ assessment of TDS loadings to Snap Lake and would have assisted all Parties in achieving a higher level of confidence in EA predictions. Nevertheless, De Beers’ interpretation of TDS loadings to Snap Lake is considered to be a likely scenario and with appropriate monitoring and refinement of the model can provide advance warning should if the baseline data prove to be inaccurate.

The Board concludes that, taking into consideration mitigation measures proposed by De Beers, there still remains the potential for significant adverse impacts on aquatic life in Snap Lake, if TDS levels in the mine water discharge exceed those levels predicted by De Beers. This potential must be considered in any suggestions or recommendations pertaining to hydrogeology.

De Beers has not provided sufficient evidence to completely satisfy the Board and demonstrate that TDS loadings will not exceed EA predictions. If EA predictions are exceeded, there is potential for a significant adverse impact on the aquatic life in Snap Lake. Without additional data, sufficient for model verification, the Board concludes that precautionary measures must be implemented to prevent such a significant adverse impact.

### ***Recommendations***

**The Board anticipates that regulatory terms and conditions will be prepared that will include the requirement to verify EA predictions of mine groundwater discharge quality. In order to ensure that significant adverse impacts on aquatic life do not occur, and to ensure implementation of the commitments made by De Beers during the EA process, the Board recommends that the following measures be implemented through the Production Water Licence as a means of implementing an annual loading limit for the discharge of TDS to Snap Lake:**

**(R1) The Board recommends that De Beers monitor TDS and flow of the mine water discharged to Snap Lake. Continuous conductivity recordings can be made as a surrogate upon verification of a quantifiable and statistically significant relationship between TDS and conductivity. The monitoring program should, where appropriate, include boreholes**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

**drilled in advance of mine development in order to provide advance warning of unanticipated changes in water quality.**

**(R2) The Board recommends that De Beers track loadings of TDS, Ca and Cl discharged to Snap Lake as a condition of the Production Water Licence and that De Beers file reports at a frequency to be determined by the Mackenzie Valley Land And Water Board. The reports shall, at a minimum, include:**

- **TDS concentrations in discharged water;**
- **Volume of water discharged;**
- **Cumulative annual loading of TDS to Snap Lake; and,**
- **Comparisons of these observed loadings to the EA predictions.**

**(R3) These reports shall be compared to predicted loads to determine the need for additional mitigation (e.g., grouting) or cessation of water discharge if loads exceed the Production Water Licence limit.**

## 2.5 Hydrology

### 2.5.1 Summary of Developer's Submissions

De Beers implemented a baseline surface hydrology monitoring program to collect snow course, streamflow and water level data in the Snap Lake watershed. Local measurements taken during baseline studies were linked to long term regional data sets to synthesize long term local data sets on runoff, flood magnitude and frequency. This information was used, in turn, to assess project-related changes in the natural hydrologic system and to size water management structures and facilities on the mine site.

De Beers' impact assessment predicted project-related impacts on water quantity, including changes in timing, volume and deviation of peak and minimum flows. The assessment focused on two key areas:

- Impacts to near-surface water tables and flows, and water levels in receiving streams, lakes and wetlands; and,
- Impacts on sediment yields and concentrations in receiving streams, lakes and wetlands.

The SLDP will change surface runoff patterns on the northwest peninsula in the immediate area of the process plant and the North Pile. Construction of roads and the airstrip will also alter surface runoff patterns. Drainage from these areas will be intercepted and diverted to the Water Management Pond, treated and discharged to Snap Lake during all phases of the mine until post-closure water quality is considered to be acceptable and the original overland runoff to Snap Lake can be restored.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The largest change in the hydrologic cycle will be the storage, treatment and discharge of large volumes of water which have seeped into the mine workings underground. This mine water will consist of connate (old and saline) groundwater (~5-30%) and seepage from Snap Lake (70-95%). Recycling of Snap Lake water will not alter the hydrologic balance, but the discharge of groundwater will increase flows out of Snap Lake.

The discharge from the Snap Lake Outflow will increase by 8.8% (Year 1), 14.4% (Year 6) and 7.4% (Years 17-22). These changes represent increases of average annual outflow of 16-30 L/sec. Increased volume in Snap Lake will increase average lake levels by 4.2cm or 0.84% (Year 1), 5.3cm or 1.06% (Year 6) and 3.3 cm or 0.66% (Years 17-22). The largest monthly increase is expected to occur in April of each year when the lake level will be 14 cm higher than in baseline conditions.

De Beers assessed changes in discharge volume as low to moderate in magnitude, but concluded that impacts to stream channel characteristics were negligible, as the changes were within the natural range of variation and the flood event flows which determine stream channel characteristics. Changes in lake level were considered to have negligible environmental consequences.

De Beers originally predicted reductions in the outflow from the North Lake and the Northeast Lake due to interception of the regional groundwater flow in the mine workings and subsequent discharge to Snap Lake as mine water. De Beers concluded that the impact was low for North Lake and negligible to the Northeast Lake, but later revised this prediction, when further analysis (North Lakes Report, Golder Associates, October 2002) showed that groundwater from the mine did not interact with the North Lake and that the volumes potentially interacting with the Northeast Lake were only 5-20% of those predicted in the EA. Potential project effects on aquatic life due to contaminants in the groundwater were therefore considered negligible.

De Beers predicted negligible project-related changes in sediment yield and delivery to Snap Lake as changes were considered to be within the range of natural variation. Environmental consequences were predicted to be considered low.

De Beers proposes to monitor hydrological responses, including:

- Stream discharge and lake elevation;
- Inflows to the water management pond from underground workings and surface drainage;
- Quantity of North Pile seepage; and,
- Total suspended solids levels in mine discharge, Snap Lake and on-site.

Concerns regarding mixing of mine effluent in Snap Lake were raised by hydrological experts to the Parties during the EA process. These are discussed in Section 2.6, Surface Water Quality.



## 2.5.2 Summary of Responses from the Parties

Parties to the EA did not dispute any aspects of De Beers' hydrological assessment. Questions during the November-December 2002 Technical Sessions addressed the need for further clarification of:

- Shoreline and spawning areas of Snap Lake which may be influenced by changes in lake level. (De Beers did not provide this information); and,
- The availability of reserve water storage capacity in the water management system for the mine. De Beers responded to this question in a letter to Environment Canada (February 4, 2003) which committed De Beers to early construction of reserve water treatment capacity in the plant. However, De Beers, in response to questions from the Board during the November-December 2002 Technical Sessions (November 26, 2002), stated that there is little need for, and did not have the physical footprint available, to increase storage in the Water Management Pond.

## 2.5.3 Conclusions

The Board concludes that there are no key issues related to mine site hydrology. The Board accepts De Beers' predictions of the hydrologic response of the environment to the project and acknowledges De Beers' proposed monitoring program for hydrology. The Board concludes that the SLDP is not likely to have significant adverse impacts on the natural hydrology system at the Snap Lake site.

However, the Board is of the opinion that additional measures should be considered to ensure that impacts on hydrology remain within acceptable levels and/or can be managed effectively in the future

## 2.5.4 Suggestions

**The Board anticipates that regulatory terms and conditions will be prepared that will include the requirement to verify EA predictions and to ensure implementation of the commitments made by De Beers during the EA process. The Board therefore suggests that the following information on surface water quantity be secured under the terms and conditions of the Production Water Licence:**

**(S7) The Board suggests that De Beers monitor:**

- **Lake elevation of Snap Lake;**
- **Discharge of water from Snap Lake;**
- **Inflows to the water management pond from underground workings and surface drainage;**
- **Quantity of North Pile seepage; and,**
- **Quantity of water discharged to Snap Lake from the mine.**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

**(S8) The Board suggests that these monitoring parameters be included among the terms and conditions in a Production Water Licence.**

### 2.6 Surface Water Quality

De Beers' EAR provided a description of effluent streams, an analysis of mixing in Snap Lake and predictions of water quality and recovery in Snap Lake.

The surface water quality assessment focused on the description of the baseline water quality conditions, the prediction of the quality of the liquid effluent streams produced by the SLDP, the interaction of the effluent streams with receiving waters, and the predicted condition of surface waters during mine operations and after closure.

As outlined by De Beers, water will be released to Snap Lake from a variety of sources during mine operations. Treated mine water will make up 98.9% of the water released to Snap Lake during peak discharge. This will consist of a mixture of connate groundwater and Snap Lake water which will seep into the mine and interact with mine operations such as explosives and grouting residues. Treated sewage from the mine will make up 0.8% of the water released to Snap Lake. Runoff from disturbed areas of the site will be captured and controlled and will make up 0.1% of the water released. Seepage from the North Pile will make up 0.1% of the discharge water by volume. De Beers made a commitment to intercept this seepage by means of a ditch around the North Pile and direct it to the water treatment plant, in response to concerns raised by the Parties to the EA (see Section 2.3.3.4). Small portions (0.1%) of water will seep into Snap Lake from the Water Management Pond.

Following closure, De Beers stated that it will restore natural drainage on site such that water will flow to Snap Lake.

De Beers stated that it will treat all mine water, sewage and North Pile runoff prior to discharge to Snap Lake. Treatment of mine water will consist of settling in a Water Management Pond followed by flocculation and filtration to remove solids and discharge to Snap Lake through a diffuser to promote initial mixing of effluent and lake water. Sewage will be treated by a tertiary treatment system, including phosphorus removal and discharge along with the mine water. No specific treatment processes for dissolved metals in mine water were proposed by De Beers, as dissolved metal concentrations are predicted to be below treatment levels. Particulate metals will be removed as part of the solids removal process. De Beers concluded that treatment of mine water to remove or reduce TDS was not feasible (see also Section 2.20, Project Alternatives and Opportunities).



## **2.6.1 Summary of Developer's Submissions**

De Beers described the baseline water quality in Snap Lake and in reference lakes and streams from of surveys carried out between 1998 and 2001. Profiles of temperature and dissolved oxygen were obtained from Snap Lake in 1999 and were augmented by a detailed survey of under-ice dissolved oxygen in March of 2003 in response to concerns raised by the Parties at the November-December 2002 Technical Sessions. These surveys concluded that Snap Lake has low levels of TDS, is mildly acidic, has low to moderate productivity and low levels of trace metals. The lake is generally shallow, with several deep holes. Snap Lake does not undergo seasonal thermal stratification and exhibits under-ice declines in dissolved oxygen in its deeper portions. Lake sediments are predominantly sand and silt with natural enrichment of some trace metals. Overall, baseline water and sediment quality showed no impact from human activities and met guidelines for protection of human and aquatic life. Baseline water quality within the RSA was stable over the time period of 1969-2001. Water qualities characterized by very low to low levels of TDS, very low to low levels of nutrients, slightly acidic to slightly basic conditions, high sensitivity to acidic deposition and low levels of trace metals. Sediment quality in the RSA was similar to that of the LSA.

De Beers' assessment took note of the water quality concerns expressed by elders, as noted in the following quotations taken from pages 9-209 and 9-210 of its EAR:

*“Even if the ground is contaminated, it can be fixed. But if water is contaminated, everything will be affected. We need to watch (monitor) even the smallest streams.”*

(J.B. Rabesca, LKDFN, May 25, 2001, EAR, p. 9-201)

*“You should protect the areas and waterways that flow into the Lockhart River ... it all flows to Great Slave Lake.”*

(P. Catholique, LKDFN, January 20, 2001, EAR, p. 9-201)

De Beers' assessment compared predicted changes in water and sediment quality against general guidelines and site-specific benchmarks for the protection of aquatic life and drinking water quality – most notably the Canadian Water Quality Guidelines and Canadian Sediment Quality Guidelines of the Canadian Council of Ministers of the Environment (CCME). For some parameters such as TDS or phosphorus, Canadian Guidelines do not exist and so assessment was made by comparison against Guidelines of the United States Environmental Protection Agency (USEPA), or in consideration of scientific literature or other case studies. The assessment process by De Beers for identifying contaminants of concern and potential effects on water quality was as follows:

- All parameters in the treated mine water discharge that were present at levels exceeding guideline were carried forward to the next step of the assessment process.
- All parameters in the treated mine water discharge with predicted concentrations that exceeded guidelines after initial mixing in the receiving water were carried forward to the next step in the assessment. Parameters below guidelines in the receiving water were considered to have a negligible potential to impair water quality. Site specific water quality



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

benchmarks were developed for all parameters which exceeded guidelines in the receiving water. The benchmarks considered the risk of effects to aquatic life in Snap Lake from effluent constituents. Benchmarks were derived from the results of published laboratory toxicity tests on the basis of the lowest observable effects concentrations for the parameters of interest.

- The final step in the analysis considered specific impact criteria such as the duration of impacts, their geographic extent, frequency, reversibility and magnitude.

The magnitude of impact from changes in water quality was expressed as:

- Negligible if the water quality change would affect less than 5% of the aquatic community throughout Snap Lake or would affect more than 20% of the aquatic community in less than 1% of Snap Lake;
- Low if the water quality change would affect less than 10% of the aquatic community or would affect more than 10% of the aquatic community in less than 10% of Snap Lake;
- Moderate if the water quality change would affect more than 10% of the aquatic community in more than 10% of Snap Lake; and,
- High if the water quality change would affect more than 20% of the aquatic community in more than 20% of Snap Lake.

De Beers concluded that:

*“The magnitude of the impacts to the water quality and the organisms range from negligible to low. The geographic extent of all impacts is local, as it is limited to Snap Lake and all impacts are reversible.... The overall environmental consequence of the project was assessed as low for water quality and each of the communities and organisms at Snap Lake.”*

(Dr. Robin Johnstone, De Beers, Public Hearing Transcripts, Day 1, April 28, 2003, p. 39.)

De Beers' analysis focused on the mine water discharge, as 99.7% of the surface water (from mine water, treated sewage and most overland runoff) reported to Snap Lake by that route. De Beers provided a prediction of water quality in the mine water discharge. A total of ten water quality parameters exceeded guideline levels in the discharge and were carried forth for further assessment.

De Beers modelled the maximum predicted concentrations of these parameters in Snap Lake and summarized these concentrations as the percentage of Snap Lake which exceeded the toxicity benchmarks.

Cadmium, copper, hexavalent chromium and chronic toxicity of the whole effluent were carried forward for further assessment. De Beers developed site specific toxicity benchmarks, modelled concentrations in Snap Lake under ice covered and ice free conditions and concluded that:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Maximum predicted chronic toxicity of whole effluent would occur in 1.1% of Snap Lake and no acute toxicity therefore the impact magnitude was considered low;
- Maximum predicted hexavalent chromium concentrations would exceed the toxicity benchmark for the most sensitive 10% of aquatic species in <1% of Snap Lake and so the impact magnitude was considered low;
- Maximum predicted cadmium concentrations would exceed the toxicity benchmark for the most sensitive 5% of aquatic species in <1% of Snap Lake and so the impact magnitude was considered negligible; and,
- Maximum predicted copper concentrations did not exceed the toxicity benchmark for the most sensitive 5% of aquatic species in the discharge or in Snap Lake and so the impact magnitude was considered negligible.

Overall, the maximum magnitude of impacts to Snap Lake was considered low, based on the maximum predicted concentrations of hexavalent chromium and whole effluent chronic toxicity. The affected areas were centered around the immediate discharge area in Snap Lake.

TDS from the mine water cannot be removed by the proposed water treatment system and therefore will be present at high concentrations in the mine water discharge. De Beers predicted that TDS concentrations would increase 22-fold: from baseline concentrations of 15 mg/L in Snap Lake to a maximum average whole lake concentration of 330 mg/L in Year 19 of mine operation. Peak concentrations of <450 mg/L were predicted within 250 m of the effluent diffuser (<1% of Snap Lake). No guidelines or site specific benchmarks exist for TDS and so TDS were carried forward for a detailed assessment of potential effects on aquatic life. De Beers identified this impact as reversible in the short term but did not provide an assessment of the time required for Snap Lake to revert to baseline conditions of TDS, beyond its calculation of a water replacement time of 13 years for Snap Lake.

Ammonia nitrogen from blasting residue will be added to Snap Lake and will reach peak predicted concentrations of 2 mg/L in <1% of the lake. The impact was considered negligible, because concentrations were predicted to be well below published criteria for chronic toxicity.

Total phosphorus will be added to Snap Lake from discharge of mine water and this will stimulate increased primary production. De Beers predicted phosphorus and chlorophyll “a” concentrations in <1% and in all of Snap Lake using a eutrophication model. De Beers determined that predicted total phosphorus concentrations in the mine discharge were within the same range as baseline levels in Snap Lake but that most of the phosphorus was in the form of biologically active ortho-phosphate. As a result, algal uptake and growth would increase the chlorophyll concentration in Snap Lake by up to 40%. The total phosphorus concentration would decrease by up to 60% due to settling of the increased algae growth and its phosphorus load to the lake bottom sediments. No guidelines or site specific benchmarks exist for phosphorus and chlorophyll “a” so they were carried forward for a detailed assessment of potential effects on aquatic life. De Beers identified this impact as reversible in the short term but did not provide an assessment of the time required for Snap Lake to revert to baseline conditions of phosphorus and chlorophyll “a”.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers predicted losses of dissolved oxygen in Snap Lake due to nitrification of ammonia in the mine effluent and the decomposition of the increased primary production. Winter dissolved oxygen concentrations were predicted to decrease by 1.0-2.2 mg/L at the bottom of Snap Lake and by <1.0 mg/L near the surface. The impact was classified as negligible upon comparison with under ice conditions measured in the winter of 1999 and in February of 2003. Predictions that the affected areas were small (<10% of the lake area) and decreases were unlikely to alter fish spawning shoals or impair benthic invertebrates further supported this finding.

De Beers predicted maximum chemical concentrations in runoff and seepage from the North Pile using the Mine Site Water Quality Model, and geochemical characterization of host rock and processed kimberlite. De Beers concluded that the mixtures of host rock and processed kimberlite to be placed in the North Pile would contain excess neutralization capacity, such that runoff will be neutral and will contain low concentrations of metals. Although maximum predicted concentrations of some metals (*i.e.* Al, Cd, Pb, Hg and others) are expected to exceed water quality guidelines in North Pile runoff, the flows from the North Pile are small. Consequently, loadings to Snap Lake are low and the maximum predicted concentrations in Snap Lake, within 100 m of the point of release and in <0.5% of the lake, were below water quality guidelines. De Beers concluded that the impact magnitude of runoff and seepage sources during construction, operations and post-closure would be negligible. Prior to the Public Hearing, De Beers committed to construct and maintain a ditch to collect seepage and runoff from the North Pile and discharge it to the mine's water treatment system, thus eliminating any impact of seepage on water quality (see Section 2.3.3.4 of this report).

De Beers predicted that groundwater from the mine workings would "break out" to lakes north of Snap Lake 80 years after mine closure. Interaction of groundwater with the cemented paste mine backfill would carry trace metals (chromium, aluminum, copper, molybdenum) and have a high pH groundwater into a thin layer of water above the sediment at the bottom of these lakes. Impact magnitude ratings were considered negligible to moderate, depending on lake size and location. De Beers later revised its groundwater model, using additional information from its 2002 field program (North Lakes Report, October 2002). De Beers predicted that mine-impacted groundwater would not enter the North Lake and discharge to the Northeast Lake would be less than 20% of that predicted in the EA, and may impair water quality in 1.5% of the lake bottom area where fine sediments were present. The magnitude of this impact was considered negligible. The 2002 analysis also concluded that contaminants in groundwater would be attenuated as they moved from Snap Lake to the Northeast Lake.

De Beers predicted increases in TDS for lakes in the RSA downstream of Snap Lake in the Lockhart River watershed and carried the assessment forward for consideration. No other water quality changes were identified.

De Beers concluded that the release of acidifying emissions, from diesel fuel combustion on-site would increase the critical load of acidity to lakes in the LSA. The resulting loads did not exceed critical loading thresholds, however, so no acidification was predicted for lakes. For streams, critical



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

loading thresholds were predicted to be exceeded in two locations. The response of these streams was not assessed because the thresholds indicate risk of acidification and cannot be translated into a predicted effect.

Overall, impacts to Snap Lake were dominated by the characteristics of the mine water, specifically the contribution of connate groundwater to the mass loading of TDS in the mine water discharge. De Beers will treat the mine water discharge to a level of 5 mg/L of Total Suspended Solids, but most of the loading will be in the form of non-treatable dissolved constituents of the mine water. De Beers will use a multi-port diffuser to maximize initial mixing of the mine water discharge in Snap Lake.

The only mitigation proposed by De Beers was grouting of connate groundwater inflows to the mine but this was not considered this to be particularly effective. Treatment of mine water to remove Total Suspended Solids is part of the mine plan. Treatment to remove TDS by reverse osmosis or ion exchange is possible but not feasible, due to given the high energy requirements, high costs and the large volumes of sludge produced as a by product (see Section 2.20, Project Alternatives and Opportunities). Mitigation of surface runoff and seepage was proposed in the form of a commitment to ditch the North Pile, direct runoff to the Water Management System and limit the project footprint of disturbed land.

During the EA process, De Beers also made commitments to monitor the quality of mine water discharges, the accuracy of their EA predictions and the responses of Snap Lake. Monitoring actions proposed by De Beers include:

- An Aquatic Effects Monitoring Program (AEMP) for water quality and aquatic life, including thresholds trigger management action;
- Testing of acute and chronic toxicity of mine water discharge;
- Trace metal content in sediments from deep areas of Snap Lake;
- A Surveillance Network Program for effluent streams and seepages on-site and the mine water discharge;
- Water quality analyses of reference lakes as a comparison to Snap Lake;
- Water quality analyses of Snap Lake adjacent to the diffuser;
- Water quality analyses of the Lockhart River watershed; and,
- Evaluating the response of regional water bodies to acidifying emissions from the project.

### 2.6.2 Summary of Responses from the Parties

De Beers' water quality assessment was the focus of many Information Requests and technical discussions by the Parties. The linkages between the hydrogeological assessment, water quality assessment and the response of the aquatic life in Snap Lake were key elements of the discussion. The accuracy of De Beers' predictions of mine water quality from its hydrogeological assessment were central to the discussion, given the predicted 20-fold increase in TDS levels for all of Snap Lake as a result of connate groundwater contributions to the mine water discharge. The groundwater issues



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

are discussed in Section 2.4 of this Report of the EA and should be consulted to properly interpret of the concerns of Parties regarding the water quality assessment.

Four rounds of Information Requests, two full days of Technical Sessions and dedicated technical meetings explored of issues relating to the water quality responses and effects to aquatic life in Snap Lake. During the November-December 2002 Technical Sessions De Beers explained the rationale behind its predictions and Parties presented detailed explanations of their concerns. Break out meetings on hydrogeology and the phosphorus model were held during the November-December 2002 Technical Sessions and through the winter of 2003. These discussions involved experts from De Beers and the Parties. The discussions were useful to clarify understanding and to focus and refine requests for follow up analyses from De Beers. Few issues were resolved by this process but the results helped to focus the final submissions to the Board by each Party for the Public Hearing.

The responses of the Parties to the EA were well summarized in the opening comments on Day 1 of the Public Hearing by INAC.

*“Few developments, if any, come without impact on the environment. The Snap Lake project is no exception. Our intention is to provide for the Board our assessment of the likely impact of the project on water quality and aquatic life of Snap Lake. The environmental cost of doing business, so to speak...*

*Our goal, and I believe the goal of most, if not all, people in attendance here today, is to ensure that if Snap Lake proceeds its effects on the environment are minimized...*

*Baseline and other information provided by De Beers is less than satisfactory in some key areas. While we’ve done our best to deal with this, it would have been much preferable had the information we requested been provided prior to this Public Hearing. And while we agree with De Beers that there will be an impact on Snap Lake, we feel that the Company has significantly underestimated that impact...*

*However, and this is important, our conclusion is that while the project is very likely to have environmental effects greater than those predicted by De Beers, we believe that Snap Lake will largely recover thirty to forty years after mining ceases. Changes in the species numbers, composition and ecosystem structure will occur, and while recovery is not likely to be to pre-development conditions, these effects are tolerable in our view...*

***We feel that, based on what we know now, and subject to the Board’s recommendations, that the Snap Lake project can proceed to the regulatory phase.”*** (emphasis added)

(David Livingstone, Director, Renewable Resources, INAC, Public Hearing Transcripts Day 1 (April 28, 2003), pages 43-45).



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Although the Parties presented approximately 75 unresolved issues related to surface water quality and aquatic resources in their Technical Reports to the Board prior to the Public Hearing, common themes could be drawn from the individual issues. As a result, the responses of the Parties and individual issues have been grouped by themes below, centered on the key issues to be discussed in Section 2.6.4.

### **Phosphorus Enrichment – Eutrophication**

Many Parties expressed initial concerns with De Beers' eutrophication model and its EA conclusion that increasing the loading of phosphorus to Snap Lake through the mine water discharge would cause overall concentrations of phosphorus in the lake to decrease. De Beers' presentation at the November-December 2002 Technical Sessions clarified that the conclusion was driven by a dynamic eutrophication model and that most of the phosphorus was in the form of biologically active orthophosphate. As a result, algal uptake and growth would increase the chlorophyll concentration in Snap Lake by up to 40%. The total phosphorus concentration would decrease by up to 60%, however, as a result of settling of the increased algae growth along with its phosphorus load to the sediments of the lake. Further elaboration was presented in a break out session of technical experts on November 28, 2002, and at a dedicated meeting on February 10, 2003. During the February 10 meeting, experts agreed on a variety of reasonable worst case scenarios of phosphorus loading. De Beers agreed to model these and provided the results in a Technical Memo on February 28, 2003.

The YKDFN identified concerns with localized areas of eutrophication in addition to the whole lake changes predicted by De Beers, and whether these areas may stimulate the growth of blooms of toxic cyanobacteria.

INAC expressed an initial concern that De Beers had underestimated the concentrations of dissolved phosphorus and orthophosphate in the mine water discharge. These concerns were addressed upon review of De Beers Technical Memoranda on Phosphorus Loading (February 4, 2003) and Algal Modelling (Feb. 28, 2003). (See INAC *An Evaluation of the Environmental Assessment and Associated Documentation Submitted by De Beers Canada Incorporated for the Proposed Snap Lake Diamond Project*, February 2003).

### **Dissolved Oxygen Response in Snap Lake**

The YKDFN and the Dogrib Treaty 11 Council expressed concern that De Beers had not provided a complete and accurate assessment of the extent of dissolved oxygen depletion in Snap Lake.

The Dogrib Treaty 11 Council further concluded that depression of dissolved oxygen to levels below 5.5 mg/L in deep parts of Snap Lake represented an alteration of fish habitat and cited TK that fish go deeper in the winter when water is colder, such that alternative habitats in shallower water may not be available.

Comments from Parties are also presented in Section 2.7, Aquatic Organisms and Habitat.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### Total Dissolved Solids and Effluent Mixing in Snap Lake

The Dogrib Treaty 11 Council concluded that TDS in Snap Lake may be 1.5 times greater than the levels predicted by De Beers and that spatial differences in concentration may occur. The Dogrib Treaty 11 Council expressed the same concerns regarding concentrations of chloride. These concerns were related more to De Beers' assessment of TDS loadings from groundwater than the predictions in Snap Lake itself.

The Dogrib Treaty 11 Council also expressed concerns with the accuracy of the effluent mixing model in Snap Lake, particularly for under ice mixing and mixing of the main lake with the North Arm.

DFO concluded that inclusion of a 250 m mixing zone for effluent treatment was unacceptable as it resulted in impacts to 1-10% of Snap Lake and that better effluent treatment would remove the need for a mixing zone. DFO requested that modelling of the TDS consider a reduced lake volume to account for lack of mixing with the North Arm and small bays in the lake and noted that the effluent plume will settle with depth in winter.

Environment Canada asked De Beers to provide details on the nature of the water treatment systems which had been considered for the project. Environment Canada was satisfied that the best options had been explored, that the size of the area in Snap Lake impacted by mine effluent was minimized and recommended that De Beers periodically re-evaluate treatment technologies.

INAC did not support De Beers' conclusions regarding effluent mixing in Snap Lake. INAC noted that lack of baseline information on water currents in Snap Lake limited the validity of De Beers' assumptions of complete vertical mixing of the higher density TDS plume from mine water discharge with the lake, and that the degree of mixing was expected to be significantly reduced under ice cover. INAC suggested that incomplete mixing would increase the TDS concentrations in mine water inflow from Snap Lake beyond those used by De Beers, and concluded that:

*“Given the underestimation of connate groundwater concentrations by factors of 2 to 3, the expectation that density separation effects could increase maximum mine water discharge concentrations by 25 to 50%, the limitations of the GoldSim models and the limitations of the RMA models, it is estimated that concentrations of TDS, chloride, other major ions and dissolved phosphorus in Snap Lake may be underestimated in the EA report by factors of 2 to 4.”*

(An Evaluation of the Environmental Assessment of the Proposed Snap Lake Diamond Project Submitted by Water Resources Division, Indian and Northern Affairs Canada, Technical Report, February 14, 2003, Executive Summary p. 21)

INAC recommended that De Beers run a full 3-D model of mixing, calibrated to the measurements of lake currents under ice cover and in ice free conditions.



# Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

## Baseline Data Collection

The Dogrib Treaty 11 Council expressed concerns about the adequacy of baseline data collected by De Beers and the resultant implications to the uncertainty of EA predictions and follow up programs. The NSMA recommended that the full monitoring program be developed prior to construction and include full consultation with Aboriginal communities.

INAC commented on the lack of baseline data for the project and recommended that De Beers undertake a statistical Power Analysis to guide the collection of additional data on water quality, sediment quality and aquatic biology.

## Site Specific Water Quality Benchmarks

INAC challenged De Beers' development and the use of site specific water quality benchmarks to assess toxicity of mine water discharge to aquatic life in Snap Lake. INAC concluded that De Beers' use of USEPA methods may have underestimated effects of mine water discharge to aquatic life and recommended that De Beers use procedures developed and used by CCME. INAC further requested that De Beers provide maps of concentration isopleths for key Contaminants of Potential Concern so that independent assessments of areas of impact could be conducted by other Parties.

## 2.6.3 Key Issues

This discussion of the key water quality issues draws on the final submissions made by De Beers and the Parties at the Public Hearing. In all cases, this additional information is used to determine the status of the issue, the likelihood that impacts have been correctly estimated and to make conclusions regarding project-related effects on water quality.

An important consideration guiding the Board's analysis was the likelihood that the concerns raised by the Parties would result in different conclusions than De Beers regarding impacts and their magnitude. In many cases, issues were related to the certainty or likelihood that De Beers had correctly estimated the impact of project related changes in water quality. All Parties that spoke to water quality issues were represented by experts at the Public Hearing or in earlier submissions to the Board.

The Board must distinguish between professional differences in interpretation and the implications of these differences to the assessment of project related effects on water quality. In short, the Board must consider whether or not the differences in opinion are of substance to the final assessment of significance. This distinction was well characterized by Dr. Stella Swanson, speaking on behalf of De Beers:

*“How sure are we, refers to the fact that whenever you get more than one scientist in the room there will be disagreements. That does not mean that the Board cannot make a*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*decision. Rather, it means that the scientists must be sure that they are clear in how they—in their explanation of judging how sure we are. Usually it comes down to a discussion of the worst thing that could happen . . .”*

(Dr. Stella Swanson, Consultant to De Beers, Public Hearing Transcripts, Day 3  
(April 30, 2003), p. 17.)

The following are discussed in subsequent subsections as key issues:

- Aquatic Effects Monitoring Program;
- Phosphorus and dissolved oxygen;
- Effects of TDS in Snap Lake - accuracy of predictions;
- Certainty of mixing of TDS in Snap Lake; and,
- Site specific water quality benchmarks.

Adequacy of the baseline data collected by De Beers with respect to surface water quality was also considered by the Board as a key issue. Due to the dependence of aquatic life on water quality, the adequacy baseline data with respect to water quality is discussed under the Aquatic Organisms and Habitat section (Section 2.7.4.1) in the context of the aquatic environment.

### 2.6.3.1 Aquatic Effects Monitoring Program (AEMP)

#### *Description of Issue*

All Parties to the EA spoke to the need for aquatic resource monitoring programs for the SLDP. In some cases, Parties requested monitoring programs as a response to their concerns regarding inadequate baseline information. In other cases, requests for monitoring programs were made in the absence of any identified shortcoming to the EAR, but as a general suggestion. De Beers supports the need for and has committed to develop environmental monitoring programs. De Beers outlined a proposed program in a technical memorandum, entitled *Overview of Project Milestones and Management Programs for the Snap Lake Diamond Project, February 28, 2003*. The elements of an AEMP are contained within this technical memorandum..

There were two over-riding concerns that guided all discussion of potential project impacts. These are:

- The need to verify the accuracy of EA predictions; and,
- The need to identify unpredicted responses of the aquatic system to the project in a timely manner so that remedial or mitigative measures can be implemented to prevent a significant adverse environmental effect.

This can be accomplished by the development of an AEMP as a component of the Production Water Licence issued for the SLDP. An AEMP is a routine requirement that does not address compliance of mine water discharges and effluent streams within the terms and conditions of a Production Water



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Licence. This goal is achieved by a Surveillance Network Program . Instead, the AEMP is focused on documenting the response of Snap Lake to permitted mine discharges in a timely manner.

### *Conclusions*

The Board concludes that the uncertainties in EA predictions for surface water quality effects requires the development and implementation of a comprehensive AEMP for application through the Production Water Licence. The Board concludes that taking into consideration the mitigation measures proposed by De Beers and the uncertainties around EA predictions, there remains the potential of significant adverse impacts on surface water quality in Snap Lake. Implementation of an AEMP will allow for the identification of unforeseen adverse impacts over the life of the mine.

### *Recommendations*

**Based on the above conclusions, the Board recommends that the following measure be implemented:**

**(R4) The Mackenzie Valley Land and Water Board shall develop the terms and conditions of an AEMP as part of the Production Water Licence for the SLDP. The AEMP shall include the commitments made by De Beers during the EA process and specific recommendations made in other parts of this report.**

### **2.6.3.2 Phosphorus and Dissolved Oxygen**

#### *Description of Issue*

The SLDP will add phosphorus to Snap Lake through the discharge of mine water. The concentrations will be below levels that can be reliably removed by the treatment plant, although De Beers committed to provide for phosphorus removal from sewage in its EAR. Phosphorus is an algal nutrient and will stimulate the productivity of the lake. Increased productivity will reduce dissolved oxygen concentrations in the deep waters in winter when the algae decompose, reducing habitat available for fish and benthic invertebrates.

During the technical review of the EA, the Parties challenged De Beers' predictive model for phosphorus enrichment and EA predictions. The November-December 2002 Technical Sessions and additional analyses improved the understanding of the forms of phosphorus in mine water and identified various conservative modelling scenarios for De Beers to assess.

De Beers predicted that Snap Lake will become enriched with phosphorus as a result of water discharge from the mine. Average total phosphorus concentrations in Snap Lake will increase from 4-12 ug/L to 13-23 ug/L, with corresponding increases in algal growth. De Beers' assessment focused on bio-available phosphorus and on lake classification into categories of nutrient enrichment.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Although concentrations will increase by factors of 2-3 over the life of the mine, the lake is not likely to change from its current category of moderate enrichment. Predicted changes were limited to a slight increase in algal numbers and, to a lesser extent, invertebrates. No species losses were predicted and the changes in community structure were not predicted to alter the supply of fish food in the lake.

De Beers did not carry the revised phosphorus model forward into the impact analysis for dissolved oxygen. In response to questioning from the Board, De Beers stated that nitrification, another significant factor reducing dissolved oxygen, had not changed from its original assessment. The introduction of a revised oxygen model was considered, to be new information at this point. De Beers maintained that its eutrophication model was still conservative, but somewhat less conservative than it had originally thought. (Public Hearing Transcripts, Day 3, April 30, 2003, p. 80).

Dissolved oxygen levels were predicted to decrease by 1-2.2 mg/L in deep portions of Snap Lake. These changes would reduce optimal lake trout habitat volume from 95% of the lake to 92% of the lake, and deep water benthic habitat from 98% to 96% of the lake volume. De Beers did not indicate specific areas of the lake that would be affected. No significant adverse impacts were identified.

The Parties to the EA accepted that Snap Lake would become enriched with subsequent alterations in the structure of the aquatic community and oxygenated habitat would be reduced. INAC's analysis concluded that productivity could increase beyond De Beers' predictions, and thus reductions in dissolved oxygen may exceed EA predictions. Possible proliferation of toxic cyanobacteria was identified as a potentially significant adverse response to enrichment by the YKDFN.

No other direct adverse effects were identified. Parties to the EA were most concerned about losses of dissolved oxygen in Snap Lake as a secondary effect of enrichment and the implications of this for invertebrates and fish. No Parties concluded that enrichment and the depletion of dissolved oxygen represented a likely significant adverse impact to Snap Lake. INAC concluded that De Beers had underestimated the effects of eutrophication on Snap Lake and the <10% of Snap Lake which was predicted to be affected by low dissolved oxygen "may well be significant." INAC did not provide an evaluation to support its conclusion of significance.

### **Conclusions**

The Board's conclusions regarding cyanobacteria are presented in the analysis of aquatic effects in Section 2.7.4.2.

The Board concludes that no significant adverse impacts to water quality or aquatic life are likely to be associated with the nutrient enrichment of Snap Lake. The Board notes DFO's conclusion in its April 30, 2003 presentation to the Public Hearing that "*Predicted dissolved oxygen decline may be within the natural range observed for Snap Lake*". Although there is some uncertainty associated with the dissolved oxygen response of the lake, the Board is satisfied that any such effects will be seasonal, short term and confined to small portions of the lake which already experience natural



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

declines of dissolved oxygen under the ice. However, the Board is of the opinion that additional measures should be considered to ensure that impacts on water quality and aquatic life remain within acceptable levels and/or can be managed over the life of the mine.

### *Suggestions*

**Based on the above conclusions, the following suggestions should be considered for implementation:**

**(S9) The AEMP which was recommended as a component of the Production Water Licence (Section 2.6.4.1) should include the requirement to verify EA predictions of changes in trophic and dissolved oxygen status of Snap Lake by the monitoring of:**

- **Dissolved oxygen concentrations in profiles at deep portions of Snap Lake with monitoring occurring under the ice in winter conditions and in late summer;**
- **Concentrations of total phosphorus, orthophosphate and organic phosphorus in connate groundwater and mine effluent on a regular basis and in Snap Lake under the ice in March and in early summer;**
- **Concentrations of chlorophyll “a” in Snap Lake in early summer after the loss of ice cover and in mid summer; and,**
- **Algal biomass and species community composition for phytoplankton and periphyton in Snap Lake in mid-summer. The monitoring should include measures of cyanobacteria biomass and species composition and cyanotoxins in the event that algal community composition shifts to favour cyanobacteria.**

**(S10) Monitoring results should be used to assess the need for mitigation (e.g., grouting of mine water inflows, enhanced waste water treatment or reduced waste water discharge).**

### **2.6.3.3 Effects of TDS in Snap Lake - Accuracy of Predictions**

#### *Description of Issue*

De Beers predicts that concentrations of TDS in Snap Lake will increase from approximately 15 mg/L at present to 350 mg/L on a whole lake average basis and 444 mg/L in 1% of the lake. Calcium and chloride ions will increase to 88 and 137 mg/L respectively on a whole lake average and to 113 and 177 mg/L in 1% of the lake. Peak concentrations are close to levels which may impair the aquatic community of Snap Lake.

The Board notes that these ions are necessary to the survival of aquatic life, that very high concentrations are required to cause direct toxicity to aquatic life, and that lakes in other parts of Canada contain naturally high TDS concentrations and support productive and desirable aquatic communities. The concerns heard by the Board related to the degree of change predicted in Snap



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Lake, the accuracy of the predictions and, only at worst case scenarios proposed by some Parties, toxicity to aquatic life.

Parties questioned the accuracy of De Beers' predictions of TDS in connate groundwater. The Board has concluded that De Beers' prediction of mine water quality and mass loadings are reasonable estimates of average conditions that are likely to occur. However, De Beers' predictions are not considered sufficiently conservative to be considered worst case. A worst case scenario in which mine water TDS and chloride mass loadings were 1.5 times higher than in the EA (expected plus 1 standard deviation as calculated by De Beers) is considered to be a reasonable precaution. A worst case scenario in which TDS and chloride mass loadings are two to three times higher than predicted was not clearly substantiated by the evidence on the record but cannot be totally ruled out due to the lack of deep groundwater data in the vicinity of the mine.

### *Conclusions*

The Board notes that there was no agreement among the Parties and De Beers regarding predicted whole lake concentrations of TDS. The aquatic effects assessment (see Section 2.7.4.3) shows that all Parties support a conclusion of no significant effects to aquatic life if De Beers' predictions are accurate, but that effects are likely if TDS exceeds De Beers' predictions. The hydrogeological assessment (see Section 2.2.1) concluded that the important factor driving TDS levels in the mine water discharge was not concentrations of TDS, but loading. Loading was, in turn, driven by the concentrations of TDS in connate groundwater and the proportion of connate groundwater to Snap Lake inflow from the mine water discharge.

The Board concludes that the analysis of effects to aquatic life (See Section 2.7.4.3) should be guided by De Beers' predictions, but should consider the toxicological significance of a 50% increase in the whole lake average TDS concentrations, in recognition of the worst case scenario proposed by Environment Canada.

Given these interpretations, the Board concludes that:

1. The response of Snap Lake to TDS additions will depend on the loadings of TDS to the lake;
2. The accuracy of De Beers' predictions and certainty in TDS levels in Snap Lake can be assured if the Production Water Licence for the SLDP specifies a TDS limit in terms of total annual loading to Snap Lake; and,
3. TDS levels in excess of those predicted by De Beers are likely to generate significant adverse impacts to the aquatic community in Snap Lake.

In summary, the Board concludes that, taking into consideration mitigation measures proposed by De Beers, there remains a potential for significant adverse impacts on aquatic life if TDS levels in Snap Lake exceed concentrations predicted by De Beers.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### *Recommendations*

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

- (R5) The Production Water Licence for the Snap Lake project shall specify that the whole lake average TDS concentration in Snap Lake not exceed 350 mg/L at any point in the mine life. This shall be achieved through a total annual load which will not exceed the loads used by De Beers to drive its EA predictions in each year of the mine life.**
- (R6) The Board further recommends that the Production Water Licence provide for the calculation of the total annual TDS load to Snap Lake, for every year of the project, on the basis of the data De Beers used to compile Figure 9.4-13 in Section 9.4 of its EAR.**
- (R7) The Board further recommends that the Production Water Licence require De Beers to monitor TDS levels and the quantity of the mine water discharged to achieve compliance with the loading limit for TDS. Details pertaining to this were given in the recommendation made in Section 2.4 (Hydrogeology).**

### **2.6.3.4 Certainty of Mixing of TDS in Snap Lake**

#### *Description of Issue*

Parties also expressed concern about the mixing of the high TDS discharge in Snap Lake, and the potential for density stratification. They questioned the validity of the model used by De Beers if it included the North Arm of the lake which is functionally isolated from the main body of Snap Lake. De Beers concluded that density stratification of high TDS discharge water will occur under the winter ice, but that wind will mix the lake in summer preventing stratification during the ice free period.

De Beers confirmed, in its April 30 presentation to the Public Hearing (p. 13 of the presentation by M. Digel of Golder Associates) that the whole lake model of TDS concentration did not allow for mixing in the North West Arm and other bays. It allowed for a conservative lowering in the volume available for mixing. The presentation also noted that its whole lake model was also conservative by not including initial near field mixing from the diffuser. TDS levels in the 1% of the lake adjacent to the diffuser were therefore likely to be lower than predicted.

The issue of density stratification was also raised at various times in the process by other Parties to the EA. INAC suggested that settling of denser mine water in the far field portions of the lake may cause a high TDS layer of mine water (and associated metals) to settle into the deeper holes of the lake near the diffuser and that wind effects may not reach these areas and mix them:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*“And my final concluding point is that I believe there will be many large pockets in our lake in which a stratification layer will form, and progressively deepen, and which will be beyond the capacity of the currents to remove them”.*

(Eugene Yaremko, Consultant to INAC, Public Hearing Transcripts, Day 3 (April 30, 2003), p. 178)

### ***Conclusions***

The Board concludes that the concerns regarding the potential lack of mixing, particularly in the deeper portions of Snap Lake have some validity, even in the absence of detailed analysis by the Parties. The Board notes that De Beers could have clearly addressed the issue by providing a 3-dimensional model of whole lake mixing or providing confirmation of currents in Snap Lake as recommended by INAC (*An Evaluation of the Environmental Assessment of the Proposed Snap Lake Diamond Project Submitted by Water Resources Division, Indian and Northern Affairs Canada, February 14, 2003*). De Beers did not conduct this analysis. Loss of mixing in deep areas of Snap Lake may lead to the accumulation of TDS and associated discharge constituents such as metals may exceed predictions by De Beers for the whole lake. If that occurs, then habitat losses may exceed predictions, and may be significant. Unfortunately De Beers did not provide sufficient information to determine the magnitude of this impact.

The Board notes, however, that there are mitigation techniques to improve mixing of higher density waters in Snap Lake, or to break down stratification layers which may form. These include “tempering” of high density mine discharge water by introducing ambient Snap Lake water to the effluent stream before discharge through the diffuser. This will reduce the density of the effluent and the likelihood of the high density plume settling in the far field of the lake. Destratification is a well known lake management technique that involves physically moving high density water by agitation or aeration. Both tempering and destratification can mitigate density stratification as part of an Adaptive Management Plan for water quality. The need for either can be assessed through monitoring programs using easily measured surrogates for density or TDS such as conductivity.

The Board concludes that De Beers has not provided sufficient evidence to demonstrate that significant adverse impacts on the mixing regime of Snap Lake and subsequent effects to aquatic life are not likely to occur as a result of the SLDP. Without additional analysis or evidence, the Board concludes that precautionary measures must be implemented to prevent significant adverse impacts from occurring.

### ***Recommendations***

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R8) De Beers develop a monitoring and Adaptive Management Plan to address uncertainty in lake mixing and density stratification. This shall include a monitoring program sufficient**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

**to provide early warning of persistent density stratification and a description of thresholds and mitigation measures such as tempering of the effluent stream or mechanical mixing. This recommendation could be implemented through the Production Water Licence AEMP recommended earlier in this report.**

**(R9) The Board further recommends that the Production Water Licence include requirements to implement an Adaptive Management Plan to mitigate density stratification in Snap Lake.**

### 2.6.3.5 Site Specific Water Quality Benchmarks

#### *Description of Issue*

The mine water discharge will contain trace metals, specifically chromium and cadmium, in concentrations which exceed those in the receiving environment of Snap Lake. The concentrations of some metals in Snap Lake may exceed toxicity thresholds for sensitive species and impair growth or reproduction in sections of the lake where the effluent first enters lake water in immediate mixing zone around the diffuser.

De Beers used AEP data and geochemical test results to predict the concentrations of metals in its mine effluent. Particulate forms of metals in the effluent stream will be removed in the treatment plant but dissolved metals are predicted to be below concentrations for which removal in the treatment plant is effective. De Beers therefore assumed that all dissolved metals in the mine effluent would enter Snap Lake.

De Beers calculated that maximum predicted concentrations of cadmium and hexavalent chromium could be toxic over the long term to sensitive aquatic life in 1% (Cd) and 3% (Cr) of Snap Lake and provided the opinion that these effects levels were based on conservative assumptions. De Beers concluded that the most sensitive species of water fleas may grow more slowly in these portions of the lake but expressed confidence in the conservatism of its results. De Beers provided toxicity test results in support of its predictions and concluded that chronic toxicity may occur in 1.1% of the lake if it were assumed that the effluent was discharged directly to the lake, without the diffuser. Bioaccumulation of trace metals in fish flesh was not predicted to result in concentrations of concern to consumers. De Beers also discounted the possibility that dissolved metals would react with solids and enrich sediments in Snap Lake. Effects due to the discharge of metals into Snap Lake were considered to be negligible to low in magnitude.

The Parties provided opinions that De Beers did not conduct a sufficiently conservative analysis of trace metal effects. INAC and DFO challenged De Beers' use of USEPA methods to determine toxicity benchmarks instead of the more conservative methods of CCME. The agencies concluded that adverse effects such as impairment or mortality could occur to sensitive species. Discussion centered on direct use of chronic toxicity data (De Beers approach) or ratios of response between



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

acute toxicity data and estimated thresholds of chronic toxicity (INAC). DFO concluded that bioaccumulation of metals in fish flesh would not exceed guidelines for consumption and recommended monitoring of metals accumulation. Environment Canada noted that some trace metals may be removed from the effluent stream at the treatment plant if they were present in colloidal form, further decreasing the potential for effects. No significant adverse impacts were predicted by any Parties to the EA.

### *Conclusions*

The Board concludes that De Beers and the Parties differed only in their opinions of how to assess trace metal effects on aquatic life in Snap Lake. In the end, all Parties, including De Beers, concluded that effects were possible in a small portion of Snap Lake. Neither De Beers nor any Parties concluded that significant adverse impacts to water quality or aquatic life were likely.

The Board concludes that the SLDP is not likely to have a significant adverse impact on aquatic life as a result of the discharge of trace metals to the lake. However, the Board is of the opinion that additional measures should be considered to address monitoring of mine discharge water and water within the mixing zone of Snap Lake to assess EA predictions of metal concentrations and ensure that any effects can be identified in a timely fashion for effective management over the life of the mine.

### *Suggestions*

**In order to ensure early detection of problems, to prevent adverse impacts from occurring, and to ensure implementation of the commitments made by De Beers during the EA process, the following suggestion should be considered for implementation:**

**(S11) The AEMP should include assessment of cadmium and chromium levels in fish in Snap Lake.**

## **2.7 Aquatic Organisms and Habitat**

The aquatic organisms of Snap Lake include a variety of species of fish invertebrates and plants. Invertebrate species include zooplankton, small planktonic or free floating animals which are relatives of shrimp and are important in the diet of small fish. Invertebrates also include “benthos”, which are bottom dwelling animals such as clams, snails and the immature stages of insects such as chironomid worms. These too are important fish food items. Plant forms include rooted plants growing in the sediments of nearshore areas, planktonic algae which form the base of the food chain and are consumed by zooplankton and periphyton, algae which grow attached to rocks or sediments in shallow areas of the lake. All of these life forms are important to Snap Lake and most were considered in the EA for the SLDP.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The potential effects of the SLDP on aquatic life relate to:

- Toxicity of chemicals discharged in the mine water or site runoff;
- The enrichment of nutrients in Snap Lake and changes in lake productivity;
- Secondary effects of nutrient enrichment such as loss of dissolved oxygen from portions of the lake;
- Direct physical removal of fish habitat by project-related structures in the lake; and,
- Interactions between the above activities.

The Board notes that important elements of the assessment of aquatic organisms and habitat are described in Sections 2.4 to 2.6 of this report. These described the chemical composition of mine water, the most important component of mine discharge to Snap Lake, and the predicted chemical and physical responses of the lake to addition of these chemicals. The conclusions on the predicted chemical response of Snap Lake to the project guides the interpretation of the response of aquatic life.

### 2.7.1 Summary of Developer's Submissions

De Beers reported the results of baseline surveys of aquatic organisms initiated in 1998 and continued in 1999 and 2001. Surveys were conducted in Snap Lake, small lakes and streams in the project vicinity, two reference lakes (only one of which proved to be physically comparable to Snap Lake), and in Mackay Lake as an example of a regional fish population. Surveys included zooplankton, phytoplankton, benthic invertebrates, aquatic sediment quality, fish habitat and bathymetric mapping and information on fish populations, lake trout spawning, contaminant (trace metal) burdens, and fish health. Results were summarized while sampling methods and data are presented in appendices to the De Beers EAR.

De Beers' aquatic biology assessment was prefaced by its understanding of relevant physical and chemical processes where mine discharge interacts with the aquatic community of Snap Lake. De Beers concluded that chemical transport mechanisms and density stratification would concentrate chemicals from the mine discharge near the bottom of Snap Lake for most of the year. De Beers concluded that metals discharged in the mine water would have a low level of bioavailability. Significant accumulation of metals in the lake sediments was determined unlikely by De Beers. In its EAR, De Beers concluded that zooplankton and phytoplankton would overwinter at depth in Snap Lake. The toxicological implications of the increased chemical concentrations in these areas would be reduced by the near-dormancy of the organisms in winter. During the summer, zooplankton and phytoplankton would migrate to surface waters where chemical concentrations were lower. Benthic invertebrates would be exposed to bottom waters year round.

De Beers indicated that its assessment was guided by concerns expressed by the LKDFN and the NSMA regarding fish health and the importance of fish as a food source. The EAR addressed four issues relating to aquatic biology:





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Impacts to the quality and quantity of non-fish aquatic organisms due to altered quality of water, sediment or physical habitat;
- Impacts to fish habitat due to blasting, construction, changes to hydrology or indirectly by changes to food organisms;
- Acute or chronic impacts to fish health from changes to water quality; and,
- Impacts on fish abundance as a result of changes to habitat, fish health or from blasting and increased harvest.

Where the potential impacts were related to chemical exposure, the impacts to aquatic biota followed the assessment for water quality. Chemicals released to the aquatic environment from the project were screened against relevant guidelines and the technical literature to assess toxicological thresholds. The volumes of water exceeding thresholds were calculated to determine the magnitude of potential impacts.

Increased concentrations of hexavalent chromium in Snap Lake water and sediments were predicted by De Beers to have a negligible impact on phytoplankton, zooplankton and benthos based on the analysis that concentrations would be less than the chronic effect threshold in less than 1% of Snap Lake and changes in water quality would be seasonal.

Increased concentrations of TDS in Snap Lake were predicted to have a negligible impact on phytoplankton, zooplankton and benthos by De Beers. Impacts were also predicted for Ca and Cl, the major constituent ions of TDS at Snap Lake. Increased Ca levels in Snap Lake were predicted to have a negligible impact on phytoplankton and low level impacts (seasonal increases to concentrations exceeding chronic effects thresholds in <10% of Snap Lake) on zooplankton and benthos. Negligible effects were predicted for increased Cl levels.

De Beers originally predicted impacts to phytoplankton, zooplankton and benthos relating to migration of chromium, copper, molybdenum, alkaline pH, nitrate and aluminum in groundwater from the mine to the north and northeast lakes after closure. The assessment was revised after concluding that the groundwater would not interact with the North Lake, that volumes of groundwater potentially interacting with the Northeast Lake were <20% of the volumes assumed for the EA, and after accounting for attenuation of groundwater contaminants between the mine and Northeast Lake (2002 North Lakes Program Report, October 2002).

All predicted effects to non-fish aquatic life in Snap Lake were considered reversible because mine water discharge would cease at the end of operations and the lake would recover as natural runoff displaces lake water impacted by mine water discharge.

De Beers' analysis discounted any effects of blasting on fish habitat because all blasting will take place underground and residual ammonia compounds in runoff water will be treated prior to release. Stream crossings on-site and the development of seepage and runoff collection ponds were discounted as links to changes in fish habitat on the basis of prior authorizations or the absence of fish habitat in the water features. Aquatic habitat disturbed by construction of the mine water intake and the mine



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

water discharge diffuser was considered negligible during operations. Mitigation (fish habitat compensation) produced a net positive gain in fish habitat following closure. De Beers is conducting separate negotiations with DFO on compensation for fish habitat as part of the approvals process for the SLDP. Dust deposition and hydrological changes during construction and operations were assessed as negligible impacts to fish habitat, as were changes to non fish aquatic organisms.

Overall, De Beers concluded that project effects on fish habitat were negligible.

All potential impacts of the project on fish health due to changes in water and sediment quality were assessed as negligible by De Beers. Predicted concentrations of chromium and TDS were below or at toxicity thresholds for sensitive fish species and fish food organisms. Any potential effects were considered reversible following the cessation of mine water discharge.

De Beers made a commitment that fish harvest by mine personnel would not be allowed, thus removing a large potential direct effect on fish abundance. Analyses of fish habitat and fish health concluded that project-related effects were negligible with no predicted linkage to fish abundance. De Beers predicted that the DFO guidelines for blasting will be met in all parts of Snap Lake and fish bearing inland lakes and so blasting effects on fish abundance were considered negligible.

Overall, De Beers concluded in its EAR that project effects on the aquatic life were either negligible or of low magnitude. In its technical memorandum, *Overview of Project Milestones and Monitoring and Management Programs for the Snap Lake Diamond Project, February 28, 2003*, De Beers proposed elements of an AEMP intended to verify impact predictions. These elements include:

- A program based on Environment Canada's Environmental Effects Monitoring methods and requirements;
- A focus on benthic invertebrates and sediment quality;
- Include zooplankton and phytoplankton;
- Include Snap Lake and reference lakes;
- Total suspended solids and fish habitat monitoring;
- Water quality and hydrology monitoring;;
- Fish health monitoring;
- Monitoring of blasting activities; and,
- Baseline data collection for the Northeast Lake.

### 2.7.2 Summary of Responses from the Parties

#### Adequacy of Baseline Data – Aquatic Biology

The YKDFN noted inadequate baseline data for zooplankton, in particular De Beers' assumptions of zooplankton presence in some inland lakes in the absence of sampling and implications for assessment of future changes in fish health or feeding relationships. The YKDFN also noted that the use of their TK would have helped to define baseline conditions of fish health and parameters of fish



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

health may change as a result of mine operations. The Dogrib Treaty 11 Council were not satisfied that the baseline data collection by De Beers was sufficient to assess future changes to the aquatic community. DFO concluded that the absence of baseline data on the deep water benthic invertebrate community prevented assessment of impacts to this community and any subsequent effects on fish. The NSMA did not express concerns with baseline information but requested that the monitoring program details be developed prior to the project, with input from Aboriginal organizations. DFO originally provided a detailed conclusion that De Beers had done an inadequate assessment, or demonstration of assessment, of baseline fish habitat and had not assessed all areas of potential fish habitat or conducted a thorough accounting of No Net Loss. DFO and De Beers resolved most of their differences, however, meetings and additional submissions from De Beers. DFO also noted that De Beers' assessment of spawning habitat in the vicinity of the diffuser was limited to lake trout and did not include other fish species. INAC concluded that the baseline data were sufficient to characterize the baseline environment but insufficient to evaluate the accuracy of EA predictions of impact. INAC recommended that additional sampling be guided by the results of a statistical Power Analysis.

### **Dissolved Oxygen and Eutrophication**

The Dogrib Treaty 11 Council and the YKDFN noted the need for more detailed assessment of changes in dissolved oxygen, and the relationships between oxygen depression and areas of Snap Lake used by fish and benthic invertebrates, particularly in the winter. DFO expressed concern regarding effects of depressed dissolved oxygen on aquatic life but, in the end, concluded that oxygen levels would remain within the range of natural variability such that no significant impacts were expected. INAC concluded that the EAR underestimated the direct and indirect effects of dissolved oxygen depressions on aquatic life but did not provide their own predictions of effect.

The NSMA concluded that the assessment of eutrophication in Snap Lake was inhibited by the lack of guidelines and should have included an assessment of food web linkages, cyanobacteria and, in particular, potential stimulatory effects of changes in nitrogen and phosphorus in the lake. DFO noted that the eutrophication assessment did not consider changes to the zooplankton community resulting from changes in algal biomass and that the analysis of depressed dissolved oxygen levels was inadequate. In the end, major community shifts were determined unlikely but that benthic monitoring was required to verify predictions.

### **Effects of Elevated TDS**

The Dogrib Treaty 11 Council argued that the assessment of TDS effects to aquatic life was incomplete and should have included risk analyses for individual species, communities and habitats, with reference to case studies and the possible use of sublethal toxicity testing. DFO and Environment Canada originally raised concerns about potential effects of elevated TDS on aquatic life but later revised their opinion, concluding that any biological effects would be of low magnitude at the concentrations predicted by De Beers. INAC provided a detailed assessment in support of its conclusion that TDS levels in Snap Lake were underestimated by De Beers. INAC predicted that



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

TDS levels would be two to three times higher, and would result in adverse effects such as loss of sensitive species, changes in food chains and reduced growth and reproduction in remaining species.

### Assessment Methods and End Points

The Dogrib Treaty 11 Council challenged De Beers' conclusion that effects on up to 20% of the aquatic community would not affect the aquatic ecosystem because: a) simplified Arctic systems may not be as resilient as the more southerly systems which guided De Beers analyses; and, b) organisms may not be evenly distributed in Snap Lake. The Dogrib Treaty 11 Council proposed that De Beers redo its assessment but provided no evidence to show that the analysis was flawed. DFO expressed concern that De Beers had assessed impacts in the 230 m mixing zone around the mine water discharge as a substitute for effluent treatment and that use of the whole lake concentrations of TDS to determine negligible impacts was not an adequate representation of potential effects. DFO recommended that TDS be monitored so that adaptive management can be triggered as required.

INAC concluded that the procedures used by De Beers to develop its site specific water quality benchmarks were not appropriate for use at Snap Lake or elsewhere in the north, and that its analysis of effects to aquatic life should have used CCME procedures and not those of the USEPA. INAC also disagreed with the criteria for impact magnitude developed by De Beers, noting that the analysis did not address sensitive "keystone" species which may be of particular ecological relevance to Snap Lake. INAC recommended that the analysis use more conservative criteria for the effects assessment.

DFO expressed a concern that the assessment had underestimated effects due to uptake of metals from the mine water discharge and recommended that metal bioaccumulation in fish and invertebrates be monitored.

### Multiple Stressors and Interactive Effects

Some Parties, including INAC and the Dogrib Treaty 11 Council, concluded that De Beers' assessment should consider the possibility of interaction between various changes in water quality (or "multiple stressors") in the vicinity of the mine site. They felt that elevated levels of chromium, TDS and nutrients, as well as reduced concentrations of dissolved oxygen may act together to produce effects where analysis of individual stressors produced a conclusion of no impact. Various elders expressed opinions relating to the need to evaluate the system as a connected whole and not as a series of small changes.

The YKDFN expressed this opinion as:

*"Because we need to know, that's our food chain, we need to know if the foods are healthy. If there's studies being done, and there's no results back to us, and that may cause some kind of health concern for us. We...have to be aware of it. So, if you're going to be developing a mine in the territories, you're going to have to observe all the different changes in fish, and other wildlife."*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

(Alfred Baillergeion, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, p. 142)

### 2.7.3 Key Issues

The following summarizes key issues drawn from the final submissions to the Board during the Public Hearing plus the technical documentation submitted by Parties to the EA. Many Parties expressed differences of opinion about the approaches used by De Beers in its assessment of aquatic organisms and habitat, or expressed concern with uncertainties in the assessment. None of the Parties, however, presented evidence that lead to a conclusion that the SLDP would result in significant adverse impacts to aquatic life. The interventions of the Parties were focused more on challenging the accuracy of De Beers' predictions of negligible to low impacts. This is highlighted in the following discussion of issues related to:

- Adequacy of baseline data;
- Phosphorous and dissolved oxygen;
- Effects of total dissolved solids;
- Effects of trace metals;
- Assessment endpoints and keystone species;
- Toxicant interactions; and,
- Fish habitat.

#### 2.7.3.1 Adequacy of Baseline Data – Aquatic Environment

##### *Description of Issue*

De Beers provided baseline descriptions of the aquatic environment (including surface water quality) at Snap Lake but acknowledged that additional data collection may be warranted in the future.

*“For an Environmental Assessment, the purpose is to understand enough about Snap Lake to allow confident predictions. We believe that we have enough understanding of Snap Lake to allow that confident prediction. However, future monitoring programs may require the collection of additional data to make sure that we understand enough about the natural variations in measurements,”*

(Dr. Stella Swanson, Consultant to De Beers, Public Hearing Transcripts, Day 3, April 30, 2003, p. 18)

With respect to surface water quality, De Beers concluded that *“The baseline gave us enough of an understanding of Snap Lake to allow predictions to be made”* (Public Hearing Transcripts, Day 3, April 30, 2003) but acknowledged that *“Future monitoring programs may require additional baseline data”*. In February of 2003, for example, De Beers collected dissolved oxygen profiles at 50 sites in Snap Lake in winter to improve the assessment of nutrient effects on dissolved oxygen.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Many of the Parties concluded that De Beers' baseline data were not sufficient to support the assessment or to provide a valid baseline for evaluating project effects in monitoring programs:

- DFO noted that the absence of benthic invertebrate data from deep areas of the lake provided a low level of confidence in impact prediction;
- INAC challenged the validity of future statistical comparisons against the baseline information. INAC noted that no current measurements were taken in Snap Lake to support the effluent mixing model but did not conclude that the model was invalid;
- The YKDFN noted insufficient fisheries baseline data for one inland lake; and,
- The Dogrib Treaty 11 Council and the NSMA documented concerns with the adequacy of baseline data.

The Board notes in De Beers presentation at the Public Hearing, changes in the Snap Lake aquatic community in the context of keystone species such as important fish food items and the “menu” for fish were discussed. At no point in the assessment, however, was baseline information provided on fish feeding habits to substantiate these impact predictions.

Concerns expressed by the Parties to the EA reflected the need to collect sufficient baseline information to:

- Describe the aquatic environment;
- Provide accurate inputs into any assessment models; and,
- Provide a baseline for comparison in order to identify project effects revealed through monitoring programs.

### ***Conclusions***

The Board recognizes the need for quality baseline information. Upon review of the evidence provided by De Beers, the Board concludes that the baseline information for aquatic environment (including surface water quality) was inadequate to provide confidence in all of De Beers' predictions or to provide a sound base from which to monitor project-related changes in aquatic biology. None of the deficiencies which were identified introduce unreasonable uncertainty into the assessment, but they do limit the ability to *detect* project-related effects on the aquatic environment. These deficiencies can be addressed by the terms of the AEMP which is recommended for the Production Water Licence (Section 2.6.4.1) and programs implemented at early stages of the development to correct these deficiencies. The Board recognizes De Beers' commitment to monitor water quality at the Snap Lake site and that De Beers has proposed a monitoring program in its technical memorandum, *Overview of Project Milestones and Management Programs for the Snap Lake Diamond Project, February 28, 2003*. The elements of an AEMP are contained within this document.

The Board concludes that the inadequacies identified in the baseline aquatic environment data collected for the SLDP are not so serious as to prevent the *prediction* of project-related effects on aquatic environment. However, the Board is of the opinion that additional measures should be



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

considered to enhance this baseline information to ensure that any project-related effects can be identified in a timely fashion and can be managed effectively in the future.

### *Suggestions*

**In order to supplement baseline data on aquatic biology, ensure early detection of problems, prevent adverse impacts from occurring, and to ensure implementation of the commitments made by De Beers during the EA process, the following suggestions should be considered for implementation:**

**(S12) The Board suggests that De Beers develop a draft comprehensive AEMP for the SLDP to support its Production Water Licence Application. The Program design should include a statistical power analysis to determine the sampling intensity required to identify the changes De Beers has predicted for Snap Lake. This proposal should be reviewed by the Mackenzie Valley Land and Water Board for consideration as part of the licence AEMP.**

**(S13) The program should address characterization of baseline conditions and detection of responses in the:**

- **Algal community (taxonomy and biomass of phytoplankton, including cyanobacteria);**
- **Zooplankton community composition;**
- **Benthic community in deep areas where dissolved oxygen is predicted to decline;**
- **Fish diet; and,**
- **Fish growth.**

**(S14) The Board also suggests that the AEMP design incorporate Traditional Knowledge gained through consultations with TK holders.**

### **2.7.3.2 Phosphorus and Dissolved Oxygen**

#### *Description of Issue*

De Beers' assessment looked at the manner in which the project affected Snap Lake in terms of categories of nutrient enrichment. Although De Beers predicts that phosphorus concentrations will increase by factors of two to three over the life of the mine, the lake is not likely to change from its current category of moderate enrichment. Predicted changes were limited to a slight increase in algal numbers and, to a lesser extent, invertebrates. No species losses were predicted and the changes in community structure were not predicted to alter the supply of fish food in the lake.

Dissolved oxygen levels were predicted by De Beers to decrease by 1-2.2 mg/L in deep portions of Snap Lake. These levels are predicted by De Beers to reduce optimal lake trout habitat volume from 95% of the lake to 92% of the lake, and deep water benthic habitat from 98% to 96% of the lake



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

volume. No significant adverse impacts of these reductions in oxygenated habitat on aquatic life were identified by De Beers.

The Parties to the EA who spoke to the phosphorus and dissolved oxygen issue accepted that Snap Lake would become enriched, changes in the structure of the aquatic community were likely and oxygenated habitat would be reduced. INAC's analysis concluded that productivity could increase by more than De Beers predicted and that reductions in dissolved oxygen may exceed predictions such that reductions "may well be significant".

Proliferation of toxic cyanobacteria was identified as a potentially significant adverse response to lake enrichment by the YKDFN. It provided reference to a scientific paper<sup>6</sup> (Prepas *et al.* 2001) in support of its concerns. The paper reported the results of a study done in northern Alberta. It was reviewed by the Board who highlighted the following observations:

- The algal community in the study lakes was dominated by cyanobacteria, which made up 43% of the biomass of the algal community when total phosphorus concentrations averaged 61 µg/L;
- After portions of the watershed of the lakes were disturbed by logging, total phosphorus increased by approximately 30% over two years, to 79 µg/L, and cyanobacterial dominance increased to 67% of the algal community biomass in several lakes. Cyanotoxins increased by up to ten times;
- These changes were most pronounced in, and the Prepas study cited above were taken from, lakes which were weakly stratified.

Based on the above observations from the Prepas *et al.* (2001) paper, the following points can be made regarding the SLDP and De Beers' predictions relative to these observations:

- Snap Lake is weakly stratified. In comparing the predictions by De Beers and to that of the Alberta study, the Board makes the observation that total phosphorus concentrations in Snap Lake are approximately 10-15%, and will increase to levels 15-20%, of those in the Alberta study lakes. These levels are well below the concentrations which produced cyanobacterial dominance in the Alberta study.
- De Beers baseline data for the summer of 1999 showed that cyanobacteria made up 14.6%, 4.1% and 19.2% of the algal biomass in Snap Lake in July, August and September, respectively. These are well below the dominance levels reported in the Alberta study. The algal community contained some of the same species (i.e., *Aphanizomenon*, *Anabaena* and *Microcystis*) found on the Alberta study lakes (EAR, Table IX-10-2, Appendix IX-10).

The Board considered this information in reaching its conclusion below.

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<sup>6</sup> Prepas, E.E., B. Pinel-Alloul, D. Planas, G. Methot, S. Paquet and S. Reedyk. 2001. Forest harvest impacts on water quality and aquatic biota on the Boreal Plain; Introduction to the TROLS lake program. *Can. J. Fish. Aquat. Sci.* 58: 421-436.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Parties to the EA were most concerned with losses of dissolved oxygen in Snap Lake as a secondary effect of enrichment and the implicate this change to invertebrates and fish. No Parties expressed a conclusion that enrichment or depletion of dissolved oxygen represented a significant adverse impact to Snap Lake.

### *Conclusions*

Although there is some uncertainty associated with the dissolved oxygen response, the Board recognizes that effects are short term (*i.e.* seasonal) may occur at later stages of the mine life and are reversible. The Board notes De Beers' evidence that reduced dissolved oxygen concentrations occur naturally in some parts of the lake and that avoidance and adaptation have occurred, and DFO's conclusion that "*Predicted D.O. decline may be within the natural range observed for Snap Lake*".

The Board concludes that it is likely that cyanobacteria will increase in Snap Lake in response to the mine activities, but not to levels that will pose a threat to water use by humans or wildlife. Nevertheless, increases may be greater than predicted by De Beers near the mine water discharge. The concerns raised by the YKDFN are worthy of monitoring to alert water users to potential harmful changes in water quality.

The Board concludes that no significant adverse impacts on aquatic life or human health are likely to result from the nutrient enrichment of Snap Lake to the levels predicted by De Beers. The Board is of the opinion, however, that additional measures should be considered to address monitoring of the response of Snap Lake to phosphorus loading, to ensure implementation of commitments made by De Beers and to ensure that any effects can be identified in a timely fashion and managed effectively in the future.

### *Suggestions*

**Based on the above conclusions, the following suggestions should be considered for inclusion in the AEMP as indicators of nutrient enrichment in Snap Lake:**

**(S15) The AEMP should include the following as indicators of nutrient enrichment in Snap Lake:**

- **Total phosphorus, orthophosphate and organic phosphorus in Snap Lake;**
- **Nitrate, nitrite, ammonia and Kjeldahl nitrogen in Snap Lake;**
- **Chlorophyll "a" and algal biomass and composition of the phytoplankton community; and,**
- **Quantification of baseline levels of cyanobacterial toxins in Snap Lake and a requirement for routine monitoring of cyanotoxins if cyanobacterial species increase**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

to 30%<sup>7</sup> of the algal community biomass. The Board notes that the figure of 30% does not represent a critical threshold of effect..

- Under ice dissolved oxygen profiles in deep areas of Snap Lake.

**(S16) The AEMP should be linked to an Adaptive Management Plan and mitigation activities such as grouting, phosphorus abatement programs on site, enhanced sewage treatment, or artificial aeration.**

### 2.7.3.3 Effects of TDS on Aquatic Life

#### *Description of Issue*

De Beers concluded that the peak whole lake concentrations of 350 mg/L of TDS, 88 mg/L of calcium and 137 mg/L of chloride in Snap Lake would not likely have direct effects on aquatic life and provided evidence that these levels are within the range acceptable to aquatic life. De Beers predicted indirect effects – gradual shifts in the community structure of invertebrates in Snap Lake due to differences in tolerances between species. Increased calcium levels in the lake could benefit water fleas and small clams as well as provide more food for fish. The potential changes were compared to a dinner buffet in which the menu did not change but the size of the portions did. In De Beers' opinion, no significant adverse impacts to aquatic life were likely as a result of increased levels of TDS in Snap Lake.

INAC provided a summary table of effects thresholds for TDS, Calcium and Chloride at the Public Hearing on April 30. This table showed that effects to sensitive aquatic life may become apparent at concentrations of 500 mg/L of TDS, 116 mg/L of calcium and 372 mg/L of chloride. INAC referred to a manuscript of toxicity testing results from studies carried out in Alaska<sup>8</sup> (Stekoll *et al.* 2003), which showed that sensitive fish species would respond at TDS concentrations of 500 mg/L or greater. INAC also referenced to a British Columbia Guideline of 150 mg/l of chloride for protection of freshwater aquatic life for long term exposure, and its supporting documentation. These documents were reviewed by consultants to the Board to assist with its assessment.

De Beers concluded that Snap Lake would not reach TDS concentrations that would threaten aquatic life. This conclusion was confirmed in the evidence of Dr. Peter Chapman (INAC's expert). On Day 3 of the Public Hearing, De Beers asked him to confirm his assessment of the response of the aquatic community to De Beers' predictions of TDS in the lake. Dr. Chapman's response was

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<sup>7</sup> The study by Prepas *et al.* (2002) did not identify a critical threshold of effect. That study, however, did document a ten-fold increase in cyanotoxins when cyanobacteria increased by approximately 50% - from 43% to 67% of the algal community biomass. A trigger of 30% is therefore suggested by the Board as an indicator of change, in that it represents more than a 50% increase from the existing cyanobacterial contribution to algal biomass of <20% in Snap Lake.

<sup>8</sup> Stekoll, M.S., W.W. Smoker, I.A. Wang and B.J. Failor. 2003. Final Report for ASTF Grant #98-012. Salmon as a bioassay model of effects of Total Dissolved Solids. Prepared for Alaska Science and Technology Foundation. February 3, 2003. 89pp.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*“I don’t see that there would be major changes. I think that would be tolerable to the organisms. I have some quibbles about not looking at interactive effects, but TDS would be the main driver. So, I don’t substantially disagree with you.”*

(Dr. Peter Chapman, Consultant to INAC, Public Hearing Transcripts, Day 3, April 30, 2003, p. 105)

YKDFN stated that:

*“And Mr. Chapman... answered my question because I had to ask him on behalf of an elder, is there going to be the same kind of fish in the lake after the mine closes and the man said, yes, which made me happy to hear that.”*

(Rachel Crapeau, YKDFN, Public Hearing Transcripts, Day 5, May 2, 2003, p. 294)

Environment Canada and DFO concluded that any responses to TDS at the predicted levels would involve slight species shifts and would not be of high magnitude.

The interventions by the Parties indicate agreement on the conclusion that no significant adverse impacts to aquatic life are likely at the TDS levels predicted for Snap Lake by De Beers.

The question thus reverts back to the adequacy of De Beers' predictions of TDS levels in mine water discharge and in Snap Lake. The Parties agreed that detrimental effects, perhaps loss of sensitive zooplankton species or community shifts, would be expected if TDS were two to three times higher than predicted by De Beers. This prediction was supported by the toxicity thresholds provided by De Beers and INAC. De Beers did not speculate on the implications of two to three fold increases in TDS to aquatic life, as De Beers did not think such increases were credible. This was drawn out in an exchange between consultants to INAC and consultants to De Beers during the Public Hearing:

*“... "worst thing that could happen" scenario, what would that look like if total dissolved solids, TDS concentrations from the lake, were two times higher than your maximum predictions?”*

(Peter Chapman, Consultant to INAC, Public Hearing Transcripts, Day 3, April 30, 2003, p. 76)

*“..., as we carefully explained, we are convinced that the maximum total dissolved concentrations that we've presented, of three hundred and fifty (350) milligrams per litre incorporate more than enough layers of safety, and represent a very credible, worst thing that could happen example. I really have a hard time even thinking about or discussing anything even higher than that, because as I explained in my talk, we get beyond the description of what is a reasonable worst case that can happen, and we are in the territory of having to combine things that don't make sense scientifically.”*

(Stella Swanson, Consultant to De Beers, Public Hearing Transcripts, Day 3, April 30, 2003, p. 76-77)



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

INAC's final submission at the Public Hearing concluded that significant adverse impacts were likely and challenged the Board to address this likelihood:

*“With respect to water quality, there remains the likelihood of significant adverse environmental effects primarily to increased TDS concentrations in Snap Lake. TDS, including calcium and chloride at concentrations two to threefold above the levels De Beers considers among, “the worst things that could happen”, will likely result in loss of species, changes in food chains and other effects such as reduced growth and reproduction in the remaining species. . . . I'd suggest, though, that it may be less important to bridge the gap, to try to develop a consensus on the degree of significance of the adverse effects, **than it is to develop the mitigation measures necessary to ensure the impacts are the minimum possible in the circumstances...**” (emphasis added by Board)*

(David Livingstone, Director, Renewable Resources, INAC, Public Hearing Transcripts, Day 5, p. 362)

The Board notes that this conclusion is driven by the uncertainty in De Beers' predictions of mine water discharge quality.

### **Conclusions**

The Board concludes that peak whole lake concentrations of 350 mg/L of TDS, as predicted by De Beers, are not likely to generate significant adverse environmental effects to aquatic life in Snap Lake. The Board concludes that effects of TDS, at the levels predicted by De Beers, will be confined to chronic toxicity of sensitive aquatic life within the immediate mixing zone of the mine water discharge (~1.1% of Snap Lake). This is considered a reversible impact of low magnitude, in a small portion of the lake.

The Board concludes that any change in the aquatic community after closure and recovery will be negligible. Although INAC concluded that the aquatic community would not be identical to the baseline, even after TDS reverted to baseline levels decades after closure, no evidence was offered to support this conclusion. However, it is reasonable to conclude that the community will shift. Aquatic communities show variable composition from season to season, year to year and with the methods used to sample them.

The Board concludes, that toxicity to sensitive members of the aquatic community in Snap Lake may occur if TDS levels are two to three times greater than those predicted by De Beers. Toxic conditions for sensitive aquatic life throughout Snap Lake would represent a significant adverse impact, in the opinion of the Board. This conclusion is substantiated by the Board's review of the toxicity tests conducted by De Beers (Appendix IX-8 of EAR) on untreated and treated mine water samples which showed chronic toxicity responses at TDS levels of 1000 mg/L, and of the technical manuscript submitted by INAC which showed toxicity thresholds of 500 mg/L (see Footnote 2 above).



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The Board's conclusions are dependent, however, on the accuracy of De Beers' water quality model. If De Beers' models are incorrect, and the TDS in Snap Lake rises to the levels predicted by INAC, then significant adverse impacts are likely throughout Snap Lake. Uncertainties in the model were addressed by Recommendations made in Section 2.4.3.2 – namely, the application of an annual loading limit for TDS through the Production Water Licence for the Snap Lake Mine. The Board therefore concludes that there remains a potential for significant adverse impacts on aquatic life if TDS levels in Snap Lake exceed the levels predicted by De Beers.

### *Recommendations*

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R10) In order to ensure that the response of the Snap Lake aquatic community remains within the range predicted by De Beers and to prevent significant adverse impacts to the aquatic community of Snap Lake the Board recommends that the Production Water Licence for the SLDP shall specify that the whole lake average TDS concentration in Snap Lake not exceed the 350 mg/L in the EA predictions by De Beers. This can be achieved by an annual loading limit for TDS which is not to exceed the annual load used by De Beers to conduct its impact assessment.**

**(R11) The AEMP shall be comprehensive enough to verify De Beers' EA predictions that changes to the aquatic community of Snap Lake will be of low magnitude. The monitoring program should incorporate the results of a statistical power analysis to guide sampling and interpretation of changes.**

**(R12) The Production Water Licence for the SLDP shall also include a requirement for routine testing of the acute and chronic toxicity of the final mine effluent to aquatic life to confirm testing done by De Beers in the earlier stages of the project and to ensure that significant adverse impacts do not occur.**

### **2.7.3.4 Effects of Trace Metals**

#### *Description of Issue*

Based on the EA predictions by De Beers, the mine water discharge will contain trace metals in concentrations above those in the receiving environment of Snap Lake. Concentrations of some metals in Snap Lake could exceed toxicity thresholds for sensitive species and kill them or impair their ability to grow or reproduce.

De Beers used data collected during its AEP and geochemical tests to predict the concentrations and toxicity of metals in the mine effluent. Particulate forms of metals in the effluent stream are proposed to be partially removed by the treatment plant but dissolved metals are predicted to be below



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

concentrations for effective removal in the treatment plant. De Beers therefore assumed that all dissolved metals in the mine effluent would enter Snap Lake. De Beers calculated that maximum predicted concentrations of cadmium and hexavalent chromium could be toxic over the long term to sensitive aquatic life in 1% (cadmium) and 3% (chromium) of Snap Lake. De Beers concluded that the most sensitive species of water fleas may grow more slowly in these portions of the lake but expressed confidence in the conservatism of its results.

De Beers provided toxicity test results in support of its predictions and concluded that chronic toxicity may occur in 1.1% of the lake if it were assumed that the effluent did not mix with the lake:

*“...chronic toxicity may occur in 1.1% of the lake, if no mixing is assumed. In fact, the diffuser will create rapid mixing and rapid reduction in the potential to cause toxicity.”*

(Dr. Stella Swanson, Consultant to De Beers, Public Hearing Transcripts, Day 3, April 30, 2003, p. 49)

Bioaccumulation of trace metals in fish flesh was not predicted by De Beers to result in significant adverse impacts to consumers of fish.

The Parties provided opinions that De Beers did not conduct a sufficiently conservative analysis of trace metal effects. INAC and DFO challenged De Beers' use of USEPA toxicity benchmarks instead of the more conservative benchmarks of CCME and concluded that adverse effects to sensitive species such as mortality or impairment could occur. De Beers noted that INAC's conclusions were based on the application of a ratio to predict chronic toxicity from measured acute toxicity. De Beers expressed more certainty in its own approach of using a measured chronic toxicity threshold.

DFO concluded that bioaccumulation of metals in fish flesh would not exceed guidelines and recommended that metals accumulation be monitored. Environment Canada noted that additional trace metals may be removed from the effluent stream at the treatment plant if they were present in colloidal form, further decreasing the potential for effects. No significant adverse impacts of trace metals on aquatic life or on consumers of aquatic life were predicted by DFO or Environment Canada.

All Parties that spoke to this issue concluded that effects were likely in a small portion of Snap Lake. Although the predicted volumes of the lake which may be impaired differed, no significant adverse impacts on aquatic life were predicted by any of the Parties or De Beers.

### ***Conclusions***

The Board concludes that although metals concentrations may exceed toxicity thresholds near the mine water discharge, the small volumes of Snap Lake potentially affected and the reversibility of any effects at mine closure mean that significant adverse impacts to aquatic life are unlikely. However, the Board is of the opinion that additional measures should be considered to address



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

monitoring of mine discharge water and aquatic life within and adjacent to the mixing zone of Snap Lake to verify EA predictions of metal concentrations and ensure that any effects can be identified in a timely fashion and managed effectively in the future.

During the EA process De Beers made commitments to monitor the quality of mine water discharges, the accuracy of their EA predictions and the responses of Snap Lake.

### *Suggestions*

**In order to ensure early detection of problems, to prevent adverse impacts from occurring, and to ensure implementation of the commitments made by De Beers during the EA process, the following suggestion should be considered for implementation:**

**(S17) The AEMP should include assessments of trace metal burdens in fish and invertebrates collected near the diffuser; at the start of the project and at five year intervals throughout the mine life to confirm EA predictions.**

### **2.7.3.5 Assessment Endpoints and Keystone Species**

#### *Description of Issue*

INAC and the Dogrib Treaty 11 Council raised concerns that the assessment methods used were not designed for simplified Arctic ecosystems and further, that a functional approach to species losses may underestimate effects by ignoring keystone species, those which were particularly important to the energy flow or food web in Snap Lake. INAC expressed concerns that De Beers' determinations of magnitude for ecological significance required the entire lake to exceed a toxicological threshold which would impair 20% of the species present before an impact was classified as "high" in magnitude. The Board notes, however, that no Parties predicted impacts of that magnitude so the question of impact classification had no bearing on the determination of significance.

The Board recognizes the sensitivity of northern aquatic systems and how assessment and ecological principles for more southerly systems may not be applicable at Snap Lake. The concept of a keystone species is valid but was applied to the Snap Lake assessment by the Dogrib Treaty 11 Council and by INAC on a hypothetical basis. No Party identified such a species in Snap Lake, but the Parties did speculate that any keystone species was most likely a zooplankton species and that loss of a sensitive species may "destabilize" the community. De Beers' derivation of toxicity benchmarks included zooplankton species (*Cladocera*): three of the four most sensitive species used to derive the benchmark for Cd, and the four most sensitive species used for chromium, were *Cladocera*. Although the species tested were not the same as those found in Snap Lake (EAR, Appendix IX-8 and IX-10) the tests and procedure were representative and appropriate to the assessment.

Finally, the Board also considered De Beers conclusion that any effects of metals were negligible to low in magnitude, and that 1-3 % of Snap Lake, in the vicinity of the diffuser, may be enriched to



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

levels which may be chronically toxic to sensitive zooplankton species. As such, any effects to keystone species would be confined to a very small area of Snap Lake and would pose no risk of destabilizing the aquatic community. Therefore, even if the functional assessment were flawed, the implications to the aquatic community are considered negligible by virtue of the magnitude of the predicted impact.

### ***Conclusions***

The Board concludes that the assessment methods and criteria used by De Beers to assess aquatic effects of the SLDP were sufficient to conclude that no significant adverse impacts to the ecological stability of the Snap Lake system are likely. The Board makes no suggestions or recommendations regarding assessment methods or criteria.

### **2.7.3.6 Toxicant Interactions**

#### ***Description of Issue***

The issue of toxicant interaction and multiple stressors was first raised at the November-December 2002 Technical Sessions in the context of Cumulative Effects Assessment. INAC and the Dogrib Treaty 11 Council felt that elevated levels of chromium, TDS and nutrients, plus reduced concentrations of dissolved oxygen may act together to produce effects where analysis of individual stressors produced a conclusion of no or negligible impact.

The Board recognizes that toxicant interaction is a valid consideration for an individual project assessment (Public Registry entry no. 798, memo from A. Ehrlich, April 23, 2003). The Board also recognizes the absence of a formal scientific framework to guide assessment of toxicant interactions.

De Beers responded to these concerns in a technical memorandum *Snap Lake Diamond Project – Potential Overall Effects of the Changes in Water and Sediment on the Aquatic Communities of Snap Lake, February 28, 2003*). In De Beers' final submissions at the Public Hearing, a "Weight of Evidence Approach" was used, in which the impact magnitudes of five potential water quality stressors were classified for eight different metrics of aquatic ecological integrity. Although this method does not truly account for interactions between stressors, or between ecological groups, it did provide evidence that individual effects were of neutral to low magnitude. De Beers also clarified that it had conducted tests of chronic toxicity of whole effluent samples and that these had also provided reassurance that effects predictions were valid. No Parties offered evidence that conflicted with De Beers' interpretation.

### ***Conclusions***

The Board recognizes that the scientific lines of inquiry which guided De Beers' effects assessment address individual project effects but do not address the ecosystem as a whole. However, it is the Board's understanding that a scientific framework does not exist to guide prediction of toxicant





## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

interactions. The YKDFN elders expressed the same concern that the system be evaluated as a whole and not by a series of small changes.

The Board recognizes that these concerns are valid but concludes that no evidence was provided by any of the Parties to support the conclusion that significant adverse impacts are likely as a result of toxicant interactions and their effects on aquatic life in Snap Lake.

The Board therefore concludes that the SLDP is not likely to have a significant adverse impact on the aquatic environment as a result of interactions between multiple stressors in the mine water discharge. However, the Board is of the opinion that additional measures should be considered to validate the predictions of the EA, to assess the response of Snap Lake to all aspects of the SLDP and to ensure that effects remain within acceptable levels or can be managed effectively in the future.

### ***Suggestions***

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S18) The Board suggests that design and implementation of the AEMP include a broad range of indicators of water quality and aquatic biology sufficient to assess the response of Snap Lake to all aspects of the SLDP and that it incorporate Traditional Knowledge to assist in the design, implementation and interpretation of results.**

### **2.7.3.7 Fish Habitat**

#### ***Description of Issue***

Concerns regarding fish habitat focused on three related issues;

- Adequacy of De Beers' baseline data on fish habitat,
- Relationship and coordination between EA requirements and DFO's regulatory requirements to assure No Net Loss (NNL) of fish habitat; and,
- Details pertaining to NNL accounting.

No Parties concluded that significant adverse impacts to fish habitat from the project were likely. Issues centered on the adequacy of the assessment and the EA process.

#### ***Adequacy of Baseline Data***

Adequacy of baseline data was covered elsewhere in this report (see Section 2.7.4.1) but issues specific to fish habitat were first raised during the November-December 2002 Technical Sessions (Day 4 Summaries – Aquatic Habitat and Aquatic Organisms). INAC expressed a concern that federal departments had not efficiently provided their expectations on baseline data requirements to



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers. DFO was concerned that De Beers had not assessed lakes thoroughly enough to determine whether or not they contained fish and noted that non-fish-bearing lakes could be considered fish habitat. De Beers expressed a concern that DFO provide assessment guidelines to assist developers in meeting their requirements. The YKDFN and NSMA noted that there had been little community involvement with the fish surveys and the NSMA noted that TK had not been incorporated into fish surveys. The Review Board requested clarification on the habitat assessment for Lake S-27 but verbally confirmed that his concern was resolved by De Beers. The Dogrib Treaty 11 Council and YKDFN expressed concerns that baseline information was limited to the fish community and did not consider fish food organisms. DFO expressed concern about the level of detail with which De Beers collected baseline information on invertebrates.

### *Coordination of EA and No Net Loss (NNL) Accounting Requirements*

During the November-December 2002 Technical Sessions, DFO and De Beers discussed whether or not the assessment of the No Net Loss (DFO)/habitat compensation policy is covered in the Terms of Reference for the EA for Snap Lake or whether or not it is a separate process. DFO did not see it being a separate process for two reasons:

1. The Terms of Reference required that the NNL principle be utilized for NNL accounting - and the information was to be provided within the EA. This involves quantifying habitat that is likely to be lost and compensated.
2. The NNL information requirements are similar to that of the EA regarding habitat loss and the proposal to offset of these. DFO requires this information before entering the permitting phase and from their point of view, the EA is the best place to do this.

De Beers understood the processes to be separate. It was their interpretation that, under the Terms of Reference, De Beers was asked to provide an overview of how the project related to the NNL policy and how De Beers would work with the NNL policy. De Beers' understanding was that the issue of compensation and incorporation of NNL policy was not included in the Terms of Reference.

This issue was resolved at the Technical Session of November 28, 2002. Board staff and DFO entered into an agreement to harmonize requirements early in the EA Process.

*“Also the Board, at least the Board staff, and DFO entered into an agreement -- I don't remember the exact date -- in an attempt to harmonize the processes so as to make the environmental assessment and regulatory process more efficient, and essentially it says that to the extent possible the environmental assessment will attempt to capture the assessment requirements of DFO so as to make the entire process more efficient for developers.”*

(Review Board Staff, Technical Session Transcripts, November 28, 2002, p. 17)

The agreement stated that, to *the extent possible*, the EA will attempt to capture DFO assessment requirements to make the process more efficient for developers. The issue is the interpretation the Terms of Reference.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The Parties concluded that, since the Terms of Reference specifically asked how NNL will be achieved and it is pertinent to the EA impacts and, since the EA process is the same as what DFO requires for NNL determination, the processes should not be separate. DFO and De Beers worked to clarify additional information requirements throughout the process and De Beers provided additional information to meet the needs of DFO. The process issue was therefore resolved.

### *Details of No Net Loss Accounting*

DFO raised two issues regarding the NNL accounting in their February 14, 2003 Technical Report (Fish and Fish Habitat Issues and the Snap Lake Diamond Project) and March 14, 2003 addendum that the first issue was De Beers had not provided adequate baseline habitat assessment or adequate accounting for inland lakes and streams in their EAR. De Beers submitted a Technical Memorandum entitled “Fish Habitat Assessment of Inland Lakes” (February 11, 2003) for DFO to review. The second issue was that De Beers had confined their accounting of habitat near the mine water discharge and the North Pile to lake trout only, with no consideration of other species.

In their February 23, 2003 report *Fish Habitat Information and Loss Accounting for Waterbodies Situated on the Northwest Peninsula of Snap Lake*. De Beers provided a rationale for inclusion of waterbodies for NNL accounting. DFO stated that it was in general agreement with most of De Beers’ conclusions (March 14, 2003 Addendum to Technical Report) and indicated that differences in assessment of habitat compensation units remained (Julie Dahl, DFO, p. 226 of Day 3 Hearing Transcripts). De Beers and DFO agreed that De Beers had committed to resolve outstanding issues on habitat compensation (Robin Johnstone, De Beers Canada, p. 236 Day 3 Hearing Transcripts). DFO indicated, in their April 30 presentation to the Public Hearings, that their outstanding issue regarding habitat assessment for all species in the zone of influence from the mine water discharge was considered resolved.

*“The first item was that of the identification of fish habitat in areas in the effluent zone of influence; that being in Snap Lake. De Beers had provided information as in response to an Information Request on this topic that DFO had submitted. And we have determined that all species were considered in the assessment, and the determination was that there would be negligible impacts to habitat in that zone of influence. “*

(Julie Dahl, DFO, Public Hearing Transcripts, Day 3, April 30, 2003, p. 222-223)

The adequacy of baseline issue is discussed in Section 2.7.4.1.

### **Conclusions**

The Board concludes that the SLDP will not likely cause significant adverse impacts on fish habitat, subject to the successful negotiation of a Compensation Agreement between De Beers and DFO. The Board recognizes that these arrangements are covered by policies under the *Fisheries Act* which



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

ensures No Net Loss of Productive Fish Habitat and that De Beers made commitments to meet all regulatory requirements, including No Net Loss of Fish Habitat.

### *Suggestions*

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S19) DFO and De Beers should negotiate an agreement to ensure No Net Loss of fish habitat and ensure that the results are communicated to Aboriginal groups who were Parties to this proceeding.**

## 2.8 Geology and Terrain

### 2.8.1 Summary of Developer's Submissions

De Beers described terrain units in the LSA as boulder (moraine veneer), moraine, organic (shallow, deep), and deep water. This classification of terrain in the LSA is based on satellite imagery analysis with field investigations as part of an overall ELC mapping approach. An esker within the RSA was assessed for quarry extraction purposes. Approximately 25,000 m<sup>3</sup> of esker material will be required during construction of the SLDP with an additional 50,000 m<sup>3</sup> required over the mine life of the SLDP. The surficial geology within the project area is generally described as a thin veneer of till containing cobble and boulders that is typically less than 2 m thick. The bedrock geology is described as, "*granitic and metavolcanic rock cut by two east-west trending faults*". The orebody for the SLDP is a kimberlite dyke that "*subcrops in metavolcanic host rocks on the northwest peninsula, directly beneath overburden till, and then dips beneath Snap Lake*". De Beers described the SNDP in an area where there are no recorded seismic events within 500 km of the site and further stated, "*little or no ground deformations and rock displacements*" would be anticipated if a seismic event did occur. The SLDP is described as being in an area of continuous permafrost to a depth of approximately 140 m to 180 m in areas that are not influenced by lakes. However, a talik or unfrozen zone beneath Snap Lake is present at the SLDP. De Beers installed a number of thermistor cables in boreholes to monitor ground temperatures. Measurements from these thermistors have shown that active layer depths range from 5 m to 7 m at most locations.

The impact assessment concluded that:

1. A total area of 559.5 ha or 30 % of the LSA will be lost or altered as a result of the SLDP. De Beers concluded that the SLDP will not result in the complete removal of any terrain units within the LSA and there is a high possibility that the impacts will be less than predicted due to the conservative assumptions used in the impact assessment (e.g., assuming loss or alteration of the entire footprint when the area of the active mine site is much less). Mitigation of impacts on terrain includes limiting the size of the mine footprint, avoiding or



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- reducing impacts to terrain units by re-using previously disturbed areas, re-contouring terrain units and placement of reclamation materials upon closure to “equivalent capability” and using adaptive management approaches over the life of the mine, including reclamation upon closure of the mine.
2. A total of 0.5 ha of the esker will be disturbed, which is approximately 0.09% of the total esker landforms within the RSA. In terms of the one esker that will be used for quarry materials, 0.5 ha will be impacted which represents 5.6% of the total surface. Proposed mitigation includes reducing the need for esker material by developing quarry sites within the project footprint, access via an existing winter road alignment, reclamation and re-vegetation with monitoring upon closure and management of impacts by a Quarry Management Plan.
  3. A seismic event is unlikely to occur at the SLDP.
  4. The construction of heated structures at the SLDP will result in a general warming of ground temperatures and the removal of natural overburden will result in a change in the thermal conductivity of the area. Construction of site infrastructure such as roads, the airstrip, the mill, the North Pile will require the placement of fill materials. The impact analysis carried out by De Beers demonstrated that the impact on ground temperatures will occur over the life of the mine but upon closure the permafrost regime will be re-established (including the North Pile). De Beers also concluded that there is no substantial zones of massive ground ice within the site footprint and as a result, is not an issue.
  5. Climate change will not be a factor for the SLDP as the North Pile has been designed to be stable if the material is unfrozen, the site roads and the airstrip are constructed with non-frost susceptible materials and the mill and other facilities are not supported by permafrost surfaces.

### 2.8.2 Summary of Responses from the Parties

A series of IRs were submitted dealing with terrain and geology including:

1. Location, depth and extent of taliks in the areas of the Water Management Pond, North Pile and Explosives Storage areas.
2. Provision of geological maps (both regional maps for the RSA and detailed geology of the LSA), cross sections for the project area and structural geological analyses of the RSA.
3. Plans and cross sections for underground workings, logged rock types and fault zones, and locations and logs for diamond drill holes.
4. Details for the Quarry Management Plan, including development plans until closure, quantity and quality of esker material available for quarrying and maps/photos delineating the quarrying area and esker locations.
5. Provision of terrain maps for the project area.
6. Regional geochemistry of surficial sediments within the project area.
7. A discussion on the Snap Lake and EKATI kimberlites and how the similarities and differences affect the management of the Snap Lake kimberlite.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Permafrost was discussed at the December 4, 2002 Technical Session at length. De Beers indicated at this session that there is ground ice in the esker but there had been no work conducted on the volume of ice in the esker. INAC's consultant, Dr. C. Burn commented that Diavik has: "*encountered more than they expected (ground ice). Therefore, the assumption that there is very little ground ice in the esker is an assumption which in the field evidence from other projects in the region suggests is not a conservative assumption.*" (Dr. C. Burn, Consultant to INAC, Technical Session Transcripts, Day 8, December 4, 2002)

The Board recognizes De Beers' commitment made at the November-December 2002 Technical Sessions to carry out a geophysical program, including ground penetrating radar to delineate ice before any future work is done on the esker(s).

### 2.8.3 Conclusions

The Board concludes that De Beers has adequately responded to each of the IRs listed above. The Board is satisfied that De Beers has put in place adequate mitigation measures for impacts on geology and terrain and that significant adverse impacts are not likely.

### 2.8.4 Suggestions

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S20) The Board suggests that land use approvals require the assessment of ground ice conditions in the esker prior to excavation activities during the construction phase and for incorporation in De Beers' Quarry Management Plan .**

## 2.9 Ecological Land Classification and Biodiversity

This section examines the comments and issues specifically related to potential impacts on ecological land classification or ELC units and biodiversity. ELC units are integrated units that describe terrain, soils and vegetation, but were largely used in De Beers' EAR to describe the various vegetation units within the LSA and RSA.

Biodiversity was not explicitly stated in the Terms of Reference as a component that was required to be assessed in De Beers' EAR. De Beers nonetheless included biodiversity in its EAR, and noted that:

*"The literature emphasizing resiliency of ecosystem structure stresses the importance of conserving biodiversity. For this reason, biodiversity is included as a key question in the EA, because [it] assesses one of the foundations of ecological resilience"* (EAR, p. 10-12).



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Ecological resilience was one of the parameters outlined in the Terms of Reference that De Beers was to use in describing residual impacts. However, De Beers did not explicitly use this parameter to describe residual impacts due to the lack of consensus in the literature on ecological resilience and the lack of scientific knowledge on the resilience of arctic and Subarctic ecosystems. However, De Beers considered ecological resilience as it relates to biodiversity, as outlined in the quote above.

Issues related to revegetation and reclamation are discussed under Abandonment and Reclamation (Section 2.21).

### 2.9.1 Summary of Developer's Submissions

The RSA and LSA were mapped using ELC units developed for the SLDP in consultation with GNWT (Resources, Wildlife and Economic Development). Eighteen ELC units were identified in the RSA and of those 18 units, seven were found in the LSA. A total of approximately 1,400 ha were mapped in the LSA, and approximately 301,900 ha were mapped in the RSA. The heath/boulder unit was dominant in the Snap Lake area, comprising approximately 55% and 46% of the LSA and RSA, respectively. De Beers characterizes the heath/boulder unit as an open mat plant community that transitions between boulder fields. Deep water was the next most dominant unit comprising approximately 31% and 36% of the LSA and RSA, respectively. The deep water unit is characterized by De Beers as deep, clear lakes and major river systems, usually at least 2 m in depth.

ELC units were used to measure and describe baseline biodiversity at the landscape and ecosystem level. Each of the ELC units were also ranked based on their potential to support biodiversity and rare and traditional plants. Rare plant potential and traditional plant potential were selected by De Beers to be VECs, and provided rationale for this in IR 1.4.

To assess the potential impacts on ELC units and biodiversity, De Beers examined:

- Direct impacts of the project on ELC units;
- Direct impacts of the project on biodiversity;
- Indirect impacts of air emissions (potential acid input road dust) on vegetation health; and,
- Indirect impacts of water release from the project on vegetation (ELC unit) health.

In the short-term (during pre-construction and construction phases), De Beers predicts a loss or alteration of 39% or 559.5 ha of the baseline ELC unit area within the LSA, due primarily to site clearing and disturbance. De Beers notes, however, that it expects only two-thirds of the 559.5 ha will be directly impacted. In addition to the 559.5 ha of ELC units predicted to be lost or altered in the LSA, an additional 83.7 ha is predicted to be lost or altered in the RSA due to direct disturbance of winter access roads. De Beers points out that the underground design of the mine minimizes the footprint of the proposed mine.

De Beers has committed to monitoring, throughout the construction and operation phases, whether the actual impacts to ELC units exceed or differ (*i.e.* area or type) from those predicted in the EAR. The



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

losses or alteration of ELC units due to the development of the Snap Lake Diamond Project will be mapped annually and the aerial extent of change compared to predicted impacts.

In the long-term (after closure), De Beers predicts that in applying appropriate mitigation methods and allowing for adaptive reclamation management that the ELC resources will return to pre-development equivalent capability. De Beers defines adaptive management as a management method that incorporates change resulting from new research and reclamation approaches that have been developed and that it is an iterative and ongoing process. The term pre-development equivalent capability is not defined by De Beers<sup>9</sup>. De Beers committed to a program of progressive reclamation and it is an integral part of the mine design plan. Reclamation is further discussed in Section 2.21 of this report.

De Beers ranked the environmental consequence on each of the potentially disturbed ELC units as low. It ranked the environmental consequence of rare and traditional plant potential to be moderate and low, respectively. Only one rare plant was identified during field investigations, but is outside the area to be disturbed by the SLDP. De Beers notes that it is possible that other rare plants may occur in the LSA and RSA that were not identified during field investigation.

De Beers predicts that loss or disturbances to ELC units will result in changes to both local and regional biodiversity. However the environmental consequence was ranked as low by De Beers. Mitigation proposed to minimize disturbance to biodiversity is focused on re-establishing ELC units to pre-development equivalent capability following closure.

De Beers concluded that there was no linkage between potential impacts of air emissions (sulphur dioxide, oxides of nitrogen, and potential acid input) on vegetation. However, a linkage was found between dust exposure and potential effects on vegetation. The total dust exposure area within the LSA and RSA was predicted to be 116.5 ha and 956.0 ha, respectively. However, the majority of the dust exposure is expected to occur on the deep water ELC unit. De Beers notes that because dust exposure will primarily occur during the winter months when the deep water or lakes are frozen and the only potential dust source is local traffic, the impacts on this ELC unit are expected to be minimal. De Beers concluded that the environmental consequence to each of the potentially affected ELC units is low, but De Beers also notes that the level of confidence in this prediction is considered low since the extent and nature of the effects of dust on arctic plant health are continuing to be studied. De Beers committed to monitor the level of dust and potential effects on plant health to better quantify and describe all site-specific effects. De Beers implemented a dust fall monitoring program in July 2001. De Beers' wildlife and human health predictions related to dust are discussed in Sections 2.10 and 2.14.

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<sup>9</sup> It is noted however that Alberta Environment defines "equivalent land capability" as the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers predicts negligible effects on vegetation due to changes to existing drainage patterns during construction and operations of the SLDP. De Beers states that the potentially affected ELC units can tolerate fluctuations in water levels.

### 2.9.2 Summary of Responses from the Parties

Few concerns were raised in response to De Beers' assessment of ELC units (vegetation) and biodiversity.

At the Hearing, the LKDFN summed up the importance of land and vegetation to its people:

*“De Beers Canada Ltd. has said that their project will have an insignificant impact on the land and vegetation in the Na Yague region. However, we do not feel that these predictions can be guaranteed. We therefore recommend that ongoing monitoring based on traditional ecological knowledge...of the project and its effects on the land and vegetation be carried out, and that monitoring should focus on key landscapes.”*

(Pat Catholique, LKDFN, Public Hearing Transcripts, Day 2, April 29, 2003, p. 19).

Elders from Dogrib Treaty 11 Council (Harry Simpson, Jimmy Rabesca) and YKDFN (Michel Paper, Isadore Tsetta) at the Public Hearing also stressed the traditional importance of the land and vegetation to their people.

Several IRs developed by the Board were devoted to questions of clarification of ELC and biodiversity. However, in the Board's synthesis of IRs on this topic, the Board identified only one outstanding issue at the end of the IR phase of the EA process. In the *Rationale of Technical Issues* document (November 1, 2002) prepared prior to the November-December 2002 Technical Sessions, the Board sought clarification on De Beers' rationale for its approach to characterizing biodiversity. It was clarified at the November-December 2002 Technical Sessions that the intent of the biodiversity characterization was to look at components of biodiversity that De Beers felt weren't addressed in other parts of the report. It was not meant to encompass all disciplines, but rather was used to describe the biodiversity of plant species and vegetation and wildlife habitat. A February 3, 2003 Meeting Record prepared by De Beers provided the results of a meeting between Golder Associates and the Board. The Meeting Record provided additional information on the methodology used for ranking ELC units as to their potential to support biodiversity, as requested by the Board. No further issues or comments were raised in relation to biodiversity.

Concerns regarding vegetation were largely related to revegetation of disturbed areas and environmental health effects from the consumption of contaminated vegetation or consuming meat from animals that may have consumed contaminated vegetation. Sections 2.21 and 2.14 discuss revegetation and environmental health effects, respectively. The Parties to the EA also recognized the function of vegetation in providing wildlife habitat and this is considered in Section 2.10.



### 2.9.3 Conclusions

Few concerns were raised regarding ELC and biodiversity throughout the EA process. The Board is convinced that the footprint of the proposed mine has been minimized to the extent possible, such that the direct disturbance to vegetation (including rare and traditional plants) and biodiversity will also be minimized. De Beers' commitments to progressively reclaim the areas of disturbance and to implement a reclamation monitoring program are recognized by the Board.

The Board also concludes that the potential for indirect effects to vegetation from dust exposure will be minimized by the design of the mine and mitigation and monitoring measures proposed and committed to by De Beers.

The Board, therefore concludes that no significant adverse impacts are likely to occur on ELC units and biodiversity as a result of the activities associated with the SLDP. The Board is satisfied with De Beers' impact assessment of ELC units and biodiversity and its responses to the Board's concerns raised throughout the EA process.

### 2.10 Wildlife and Wildlife Habitat

In the Terms of Reference, De Beers was instructed that the EAR for the SLDP should provide an analysis of the proposed development's impacts, (both direct and indirect), on wildlife and wildlife habitats, including migratory birds, giving consideration to and demonstrating linkages between predicted physical and biological changes resulting from the proposed development.

The analysis was required to include consideration of the following:

- Impact of loss of terrestrial habitat, and the quality of lost habitat for relevant species;
- Disturbance of feeding, nesting, denning or breeding habitats;
- Wet-land habitat alteration, loss;
- Physical barriers to wildlife;
- Disruption, blockage, impediment and sensory disturbance, of daily or seasonal wildlife movements (e.g., migration, home ranges, etc.);
- Direct wildlife mortality;
- Indirect wildlife mortality;
- Reduction in wildlife productivity; and
- Implications of the proposed development acting as an attractant for particular species.

De Beers was asked to provide its informed view of "ecologically representative areas" in the ecoregion, as defined in the *NWT Protected Areas Strategy*, that may be required for any adequate monitoring of impacts. It was further asked to report potential impacts of the SLDP on those ecologically representative areas.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The EA for wildlife and wildlife habitat was to give special consideration to species identified by the Committee on the Status of Endangered Wildlife in Canada as "Endangered," "Threatened" and of "Special Concern."

### **2.10.1 Summary of Developer's Submissions**

The wildlife component of the EAR focused on impacts on wildlife habitat, wildlife movement and behaviour, and wildlife abundance.

Eight Valued Ecosystem Components (VECs) were chosen to represent public, traditional, and scientific values in the EA. VECs were also chosen for consistency with monitoring programs at the EKATI and Diavik diamond mines. Impact assessments were performed for the following species and their habitats:

- Bathurst Caribou Herd;
- Barren-ground grizzly bears;
- Wolves;
- Foxes;
- Wolverines;
- Upland breeding birds (passerines, shorebirds, ptarmigan);
- Raptors (Peregrine Falcon, Gyrfalcon); and,
- Waterfowl.

Baseline data were collected and analyzed for the LSA and RSA. Sampling intensity within the RSA was generally greater closer to the SLDP footprint. Wildlife baseline data were collected in 1999 and 2000.

For the Bathurst Caribou Herd, seasonal abundance and distribution data within the RSA were collected using aerial and ground survey techniques. During aerial surveys, the number of animals observed and their corresponding behaviour were recorded along predetermined transects. Snow-track densities and historic trail densities were also determined from data collected during aerial surveys. These data were used to provide information on the distribution of caribou movement through the RSA during the northern and southern migration periods. A ground survey was used to measure track occurrence and distribution along the Snap Lake winter access road between the mine and the junction with the Tibbitt-Contwoyto winter road.

The collection of baseline data for grizzly bears, wolves, and foxes focused on denning habitat along eskers. The main eskers within the RSA were surveyed from a helicopter to identify potential denning sites for each species. A ground survey for carnivore dens was also conducted along a large esker in the southern portion of the RSA. The location of all wolf and fox dens were recorded and plotted on 1:50000-scale maps. No active grizzly bear dens were identified during baseline studies.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

New methods for detecting the presence grizzly bears within the RSA were developed for ongoing monitoring in 2001 and 2002. Ground surveys for bear sign were conducted within randomly selected plots located within preferred habitat. All observations of beds, digs, tracks, scat, hair, and prey remains were recorded. Data collected during 2001 and 2002 were not used to formally reexamine of the EA, however.

Wolverine baseline data were collected using track surveys of a predetermined 100 km route using snow machines. The number of tracks, direction of travel, and location were recorded for all wolverine sign encountered.

Surveys for upland breeding birds (passerines, shorebirds, ptarmigan) were conducted in sample plots stratified across three habitat types. The species of each bird observed was recorded, along with behaviour, location, and ELC unit. These data were used to estimate density, species richness, and species diversity.

Baseline data collection for raptors (Peregrine Falcon and Gyrfalcon) was conducted in conjunction with aerial surveys for carnivore dens. Raptor surveys focused on areas that were expected to provide the most suitable nesting sites. An additional survey of all suitable raptor nesting-habitat within 11 km of the mine site was done by helicopter. Potential nesting sites were initially recorded and then verified during the nesting season. Breeding success of suspected nesting attempts was assessed during late July.

Waterfowl surveys were completed for 10 lakes within 10 km of the mine site and 8 lakes greater than 11 km from the mine site. The 10 closest lakes were resurveyed later in the summer. For each surveyed lake, the number of individuals and species observed per linear distance of shoreline was recorded.

For each of the key questions, a linkage diagram was developed to determine which mine construction, operation, and closure activities may have an impact on wildlife. Mitigation options were then investigated to determine the most effective strategy for minimizing these effects. Potential impacts that were likely to persist after mitigation were identified as residual impacts.

Impact assessments for residual impacts and overall environmental consequence were conducted for each VEC and each of the three key questions. Residual impacts for each species were classified based on the direction, magnitude, geographic extent, duration, reversibility and frequency of the expected impact on habitat, movement and behaviour, and abundance. The environmental consequence for each assessment was determined by combining the predictions for each of the residual impact components into a single measure. Environmental consequence was presented categorically as being negligible, low, moderate, or high, based on a numerical calculation of the combined components.

The position presented by De Beers in its EAR and throughout the November-December 2002 Technical Sessions and Public Hearing was that impacts from the SLDP would be of low



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

environmental consequence for all wildlife. De Beers examined habitat loss as a portion of the home range size of each VEC and concluded that there will be limited loss of habitat as a result of the mine footprint. De Beers predicted the effects of the mine on wildlife behaviour and concluded that behavioural effects are unlikely to result in detectable impacts to populations. Direct mortality as a result of the mine was also expected to be low. De Beers stated that rigorous mitigation will be applied and that monitoring will allow them to detect if mitigation measures require adaptation to address issues such as wildlife habituation. De Beers' arguments were based on the premise that the mine would affect a limited area within a large landscape and that reclamation would reduce the duration of the impact. In response to Information Requests and technical documents prepared by the Review Board and the Parties, De Beers provided clarification and further information on some issues; however, De Beers did not revise the conclusions presented in its EAR. De Beers was confident in its predictions, indicating it had not underestimated impacts and the predictions were enhanced by monitoring results at other mines.

### **2.10.2 Summary of Responses from the Parties**

Uncertainty was the focus of much wildlife-related discussion and debate throughout the EA process. The uncertainty primarily resulted from what the Parties viewed as insufficient baseline data. Parties raised concerns about the study area boundaries, data collection methodologies, and sampling intensity. Baseline data concerns – for both scientific and TK sources – formed the root of issues relating to impact predictions and residual effect conclusions. The Parties also suggested that De Beers had not provided adequate details of their mitigation and monitoring plans, adding to uncertainty in impact predictions.

The Parties criticized assessment methods and conclusions during the EA process. It was suggested that impact predictions for habitat loss were unrealistic and based on poor habitat definitions. The Parties noted that impact predictions for changes in wildlife movement and behaviour were not quantitative and suggested that this may have led to an underestimation of the potential effects. It was also suggested that the sensitivity of key species was not adequately considered, resulting in uncertainty about potential direct mortality effects.

Although the IR process did serve to provide clarification on some topics, many of the issues raised by the Parties were not resolved by the responses. Wildlife-related IRs were made by the Review Board and the following Parties: LKDFN, Environment Canada, GNWT, YKDFN, Dogrib Treaty 11 Council, and NSMA. Information Requests dealt with the following general topics:

- Baseline study design;
- Adequacy of baseline information;
- Impact predictions and certainty;
- On-site wildlife management;
- Waste management;
- Employee training; and,
- Monitoring.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The IR responses that resulted in resolution were generally related to study design questions. For instance, IRs concerning designation of the RSA boundaries were prepared by the LKDFN, Dogrib, and the Review Board. De Beers' answers to these questions were found to be satisfactory, and the issue was not raised during the wildlife Technical Sessions. The IR responses that dealt with protocols for on-site wildlife management, waste management, employee training, and monitoring provided a general indication of the approach De Beers planned to adopt but were lacking in details. As a result, many of these issues were carried forward to the Technical Sessions. Issues related to adequacy of baseline information, impact predictions, and certainty were not generally resolved during the IR process.

Technical session discussion was predominantly related to the following topics:

- Adequacy of baseline information;
- Use of existing information sources, including scientific studies and TK;
- Valued Ecosystem Components and other species;
- Study design and assessment methodology; and,
- Mitigation, management, and monitoring.

Substantial information exchange occurred during the two technical session days assigned to wildlife and wildlife habitat issues. A portion of the final day was also used to discuss wildlife and wildlife habitat cumulative effects. Many issues were further clarified during these discussions, but few issues were considered to be fully resolved. Issues relating to raptor baseline data collection and impact analysis (raised by Environment Canada, INAC, GNWT, and the Review Board) were generally resolved during the Technical Sessions. Environment Canada was also satisfied with De Beers' commitment to include policy for dealing with migratory birds and their nests in the wildlife management plan, which was yet to be developed. The remainder of the issues were either unresolved or only partially resolved. A representative of the YKDFN expressed dissatisfaction with the technical session results when she stated:

*"I also want to say that some of the answers that were given to the wildlife issues today did not seem satisfactory to us. From hearing Alfred and from listening to the elders when I came in, they were not really happy with the kind of answers that they heard. They would like to get a better understanding of the answers that should have been given to Ann's questions regarding caribou"*

(Rachel Crapeau, YKDFN, Technical Session Transcript, Day 6, December 2, 2003, p. 77)

Many of the issues raised in the IRs and the Technical Sessions were repeated in the technical reports submitted by the YKDFN, the Dogrib Treaty 11 Council, NSMA, and the GNWT. Although they participated in the Technical Sessions and submitted technical reports on other topics, INAC and Environment Canada did not submit wildlife-related technical reports.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The outstanding issues discussed at the Public Hearing closely resembled the issues that were presented in the technical reports. The Parties remained concerned about the adequacy of baseline data and the resulting effect on the EA as a whole. Concern was expressed regarding the remaining uncertainty associated with impact predictions and suggested that this uncertainty necessitated strengthening the mitigation, monitoring, and adaptive management presented by De Beers. In general, the Parties disagreed with De Beers' conclusion that uncertainties could be overcome by means of the proposed Environmental Management System. The Parties were especially concerned that, although De Beers had committed to use mitigation, monitoring, and adaptive management to respond to unpredicted outcomes, there was a failure to provide details of its wildlife management plan.

### **2.10.3 Key Issues**

Many of the outstanding issues that remained at the closing of the Public Record were concerns that spanned a range of specific topics. For instance, concerns about baseline data adequacy were expressed for a number of the VECs and related to impact assessment analyses for habitat loss, influences on movement and behaviour, and mortality effects. In order to facilitate an organized discussion of the outstanding issues, the following sections will deal with these issues as they relate to the three key questions addressed in De Beers' EAR, involving:

- Impacts on wildlife habitat;
- Impacts on change in movement patterns and behaviour; and,
- Impacts on wildlife abundance.

#### **2.10.3.1 Impacts on Wildlife Habitat**

Parties to the EA raised concerns about how De Beers estimated the amount of habitat affected by the project and how the magnitude and environmental consequence of those impacts were calculated.

##### ***Description of Issue***

In its EAR, De Beers suggested that habitat change is associated with the following activities:

- Facility construction and operation;
- Surface storage areas construction and operation;
- Water management facilities construction and operation;
- Granular resource extraction from an esker; and,
- Road and airstrip construction and operation.

The impacts of these activities on habitat were assessed for both direct and indirect effects. In the scientific literature, direct habitat effects are often defined as those that occur when the physical characteristics of the land are altered in such a way as to substantially affect the ability of the habitat to provide the basic requirements for one or more species. Indirect effects on habitat occur when the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

physical characteristics of the land undergo little to no change, yet the value of the habitat changes for one or more species. De Beers suggested that direct habitat change would be expected to occur when the mine site is cleared for facility construction. De Beers focused its analysis of indirect habitat effects on the amount of area potentially impacted by fugitive dust deposition. Fugitive dust deposition was considered to have the potential for indirect effects on habitat as the collection of dust on vegetation may influence plant growth and, therefore, habitat quality for wildlife.

De Beers adopted a mine development strategy to minimize both the footprint (direct) and dust-related (indirect) impacts on wildlife habitat. Mitigation practices included measures such as utilizing underground mining and crushing, restricting the mine surface footprint to 560 ha, and using covered conveyors during mine operations. These practices were expected to result in lower habitat impacts than have been seen at larger above-ground mines in the Slave Geological Province.

In Section 10.4.2.2.3 of the EAR, De Beers assessed remaining direct impacts of the SLDP on wildlife habitat in general and on a species-specific basis. General habitat impacts were assessed by calculating the area of each habitat class expected to be directly impacted, and presenting that estimate as a proportion of like habitat available within the LSA and the RSA. Impacts on individual species, or species groups, were assessed by comparing the expected habitat loss within the mine footprint to the expected home range size of each VEC. At the local level, some habitat types were expected to have a high habitat loss as a percent of the original (example: 83% for birch seep). De Beers pointed out that the absolute loss would still be relatively low on an area basis. At the landscape level (within the RSA), all direct habitat losses were predicted to be less than 1%. Residual impact and environmental consequence conclusions for each species were influenced by the proportion of a species' home range potentially impacted. De Beers concluded that environmental consequence from direct habitat loss was low for all VECs.

The NSMA disagreed with De Beers' effect magnitude and environmental consequence conclusions for direct loss of upland breeding bird habitat at the local level (LSA). The NSMA suggested that the magnitude should have been reported as high, rather than low, and that the environmental consequence should have been reported as moderate to high for the LSA, rather than low as De Beers suggested. The argument put forth by the NSMA was that De Beers had used different criteria for determining upland bird consequence, and the methodological discrepancy led to confusion and unrealistic conclusions.

*“The measurements of migratory birds are the only exception in wildlife baseline to the otherwise unsatisfactory quantification of baseline conditions. Even so, the interpretation of the results is confusing and the weighting of the results may be questioned...It does not serve either the regulators or the stakeholders if they need to re-evaluate and interpret the results on their own to verify the conclusions.”*

(NSMA, De Beers Snap Lake Diamond Project EAR Review Technical Report, prepared by Stantec Consulting Ltd., February 2003, 4.5 and 4.6)





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

For all VECs except upland breeding birds, De Beers used the proportion of habitat lost within an average home range to guide conclusions on magnitude. Any loss less than 40% was considered to be low to moderate in magnitude. For upland birds, habitat loss due to the SLDP was over 100% of the expected seasonal bird home range. Extrapolation from the baseline data suggested that there may be 52 fewer birds that breed within the LSA as a result of the SLDP. The NSMA suggested that this indicated that the local effect would be moderate to high, rather than low. De Beers argued that impacts on upland breeding birds would be localized and that a loss of habitat for 52 birds within the RSA would have minimal impacts on the regional population.

De Beers assessed indirect habitat loss by estimating the area most likely be affected by fugitive dust from mine and road activities. Beyond the footprint of the mine, it was estimated that there would likely be another 55 ha (0.55 km<sup>2</sup>) affected with a 500 m buffer around the mine footprint and an additional 36.7 ha (0.37 km<sup>2</sup>) affected within 50 m of the roads. Fugitive dust was expected to be seasonal to infrequent throughout the life of the mine. De Beers concluded that the environmental consequence of dust deposition would be low for all species.

The GNWT argued that the assessment of indirect habitat impacts was incomplete, as it did not consider indirect habitat impacts that result from wildlife avoidance of human activity. The GNWT stated that:

*“De Beers does not adequately address how sensory disturbance might potentially affect grizzly bear or wolverine habitat use within the RSA...Female bears with cubs are more security conscious and, therefore, likely to be displaced by human activities. This may force bears to leave habitat they are familiar with...Both continuous noise from the mine (surface), and intermittent noise from road and aircraft, would probably be audible to wildlife for a number of kilometers from the source. Assuming an ambient noise level of 23 dBA (EAR Page 8-18), it seems likely that grizzly bears and wolverines would be able to detect the operational noise at a distance of approximately 10 km (Figure 8.3-2)...Since both grizzly bears and wolverines tend to avoid areas of human activity, it’s uncertain how residual impacts of sensory disturbance (e.g., noise) will potentially affect habitat use within the RSA.”*

(GNWT, Technical Report De Beers Snap Lake Diamond Project, February 2003, p. 60)

De Beers acknowledged this potential influence of the mine on grizzly bears in its EAR: the movement and behaviour of:

*“If barren-ground grizzly bears have a similar sensitivity to human activities as other grizzly bear populations, then disturbance from the mine may cause bears to avoid the area.”* (EAR, p. 10-169).



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

During the Public Hearing, the Dogrib provided evidence that caribou may also avoid areas surrounding industrial activity. De Beers did not, however, incorporate such behaviourally-induced impacts on habitat use into its assessment of indirect impacts on habitat.

The Board notes that the scientific literature supports the GNWT and Dogrib position that some species use habitat close to human activity less than expected if the development were not in place. This type of indirect effect on habitat has been demonstrated for both carnivores and ungulates and, as was noted by the GNWT at the November-December 2002 Technical Sessions (Day 5), this relationship was considered in the EA conducted for Diavik.

### ***Conclusions***

The Board concludes that the assessment of potential impacts on wildlife habitat failed to consider the full extent of indirect impacts on habitat for carnivores and caribou.

By utilizing methods to determine effect magnitude for upland breeding birds in a manner different from all other species, De Beers provided an inconsistent analysis of direct habitat loss at the local level. Although De Beers' use of varying criteria for determining effect magnitude resulted in its conclusion that impacts would be low for all species, the inconsistent application of assessment methods undermined the Board's confidence in these conclusions. Based on De Beers' calculation of the number of breeding birds potentially affected by the mine footprint, the Board concludes that the productive capacity of the local area will be affected and accepts the NSMA's argument that the local environmental consequence will be moderate to high for upland breeding birds.

The Board also concludes, that differences in opinion over assessment methods are overshadowed when considered in relation to the regional scale and ecology of the species being considered (upland breeding birds, grizzly bears, and caribou). Although impacts on upland breeding bird habitat may be moderate to high within the local area, at the regional scale the impact will be very small. De Beers reported that baseline data indicated that there was an average of 5.8 birds/ha found within sedge wetland habitat. Assuming that this bird density is representative of that found within sedge wetland habitat across the RSA, there would be approximately 42,000 birds found within that habitat class in the RSA. De Beers predicted a loss of 12.4 ha of sedge wetland habitat within the RSA, which translates into an expected loss of habitat for approximately 72 birds. This habitat loss could, therefore, impact approximately 0.17% of the regional upland breeding bird population but the actual impact on bird numbers may be even less. De Beers committed to avoid clearing activities during the breeding season whenever possible, and avoid nests during the breeding season. As such, the expected loss of habitat will not likely result in the direct mortality of birds previously associated with the cleared habitat. Although no data were presented on whether or not the surrounding landscape is at carrying capacity for breeding opportunities, it is possible that returning birds may simply move into adjacent unaffected habitat.

The Board also concludes that there is remaining uncertainty associated with the assessment of indirect effects on grizzly bear habitat, but the ecology of this species indicates that the issue of



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

indirect habitat loss is secondary to the issue of direct mortality. In its February 2003 Technical Report, the GNWT stated that:

*“Across North America, the decline in grizzly bear range can be attributed to three primary factors: 1) loss of bear habitat, 2) avoidance by bears of areas involving human activity and infrastructure, and 3) bears being killed by humans. This last factor is probably the most significant threat currently facing bears on the Central barrens.”*

(GNWT, Technical Report De Beers Snap Lake Diamond Project, February 2003, p. 57)

The Board also notes that if a zone of influence with a radius of 10 km (from the centre of the mine) had been used for assessing the indirect impacts on grizzly bear habitat, as suggested by the GNWT, the impacted area would have been equivalent to approximately 5% to 15% of an individual bear’s home range. Based on the 40% threshold used by De Beers for determining effect magnitude, the magnitude of effect from indirect impacts on habitat use would likely be in the range of low to moderate. The Board concludes that indirect habitat loss alone from SLDP is not likely to have a significant impact on grizzly bear populations.

Indirect habitat effects for caribou from the SLDP are also unlikely to be significant given the large size of the seasonal ranges.

Indirect impacts on habitat are more likely to become a significant issue for populations when considering cumulative effects. As a result, as development continues within the Mackenzie Valley and Slave Geological Province, indirect impacts from avoidance will become increasingly important. Although some behavioural monitoring and research is underway, at the current time, studies of avoidance of human development is not available for carnivores and caribou within the Slave Geological Province. Studies of this nature will be required as the monitoring and management of cumulative effects proceeds. There is a need for scientifically sound research projects to address this issue and to examine the relationship between a reduction in habitat effectiveness, caused by both direct and indirect impacts on habitat, as well as population response.

The Board concludes that the SLDP on its own is not likely to have a significant adverse impact on wildlife habitat (direct and indirect) within the region.

### *Suggestions*

**Based on the above conclusions, the following suggestions should be considered for implementation:**

**(S21) De Beers should design a project-specific monitoring protocol to test for behaviourally-induced habitat avoidance effects as a result of the project, and include this in an Adaptive Management Plan. There is a need to develop scientifically sound research projects to address this issue and to examine the relationship between project activities**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

and a reduction in habitat effectiveness. This protocol should apply to grizzly bear, wolverine and caribou and should be developed in consultation with the GNWT and TK holders.

(S22) The GNWT, using results gained from the monitoring undertaken in the above suggestion and information from the other mines, should evaluate whether there is a population level avoidance response to the SLDP.



Alice Abel making a presentation to the technical sessions held in Yellowknife in November of 2002.

### 2.10.3.2 Change in Movement Patterns and Behaviour

Issues of baseline data adequacy, impact assessment methodology, mitigation planning details, and monitoring details were raised by the Parties in relation to the potential impacts of the SLDP on wildlife movement and behaviour.

#### *Description of Issue*

De Beers collected data on wildlife behaviour incidentally during the baseline study. The majority of this information was collected for upland breeding birds and caribou during abundance surveys.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Little behaviour data was collected for the other VECs. No behaviour-specific surveys or response trials were conducted to quantify baseline behaviour and movement or responses to mine-related disturbance.

In its EAR, De Beers identified four major areas where the SLDP may influence wildlife movement and behaviour:

- Attraction of wildlife from adjacent areas;
- Impediment or disruption of movement through traditional travel routes;
- Alteration of behaviour that can influence energy balance, and survival and reproductive rates; and,
- Reduction of movement of individuals among local populations.

De Beers assessed environmental consequence of these impacts from the following mining activities:

- Blasting;
- Human, vehicle and aircraft traffic;
- Habitat fragmentation; and,
- Winter and esker access roads.

De Beers acknowledged that *“Despite mitigation, activities related to the Snap Lake Diamond Project will result in changes to wildlife movement and behaviour”* (EAR, p. 10-174).

However, De Beers asserted that the magnitude of residual impacts on wildlife movement and behaviour would be negligible to low for each activity and all species. The environmental consequence was also predicted to be low for each species/activity interaction. De Beers suggested that mitigation measures such as minimizing the mine footprint and noise through underground operations would reduce the smaller impact on wildlife behaviour and movement than might be observed at other existing mines within the region.

The Parties concerns about the effects of the SLDP on animal movement patterns and behaviour were primarily related to issues of baseline data collection, the use of existing scientific and TK, and the ability of De Beers to make credible predictions about impacts from the proposed mine. Potential project impacts on wildlife movement and behaviour were of great concern for Aboriginal groups. During the Public Hearing, the YKDFN summed up the concerns of several Parties:

*“We are very concerned about the changes in the animals’ behavior in those areas because ... there’s different things that are happening in those regions now, that never happened before.”*

(Rachel Crapeau, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, p. 139)

Caribou were the species of primary concern for most Parties. This concern reflected the integral role that caribou play in the lives of the Aboriginal people and communities of the Northwest Territories.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Effects on grizzly bear and wolverine behaviour and movement were also discussed by the GNWT, and Aboriginal groups.

The NSMA, GNWT, and YKDFN were unconvinced by the predictions presented in the EAR as they felt that there were insufficient baseline data on behavioural responses of the VECs to the SLDP to support the conclusions. The YKDFN and GNWT noted that De Beers did not actively collect behaviour data in its baseline studies. Instead, De Beers focused on conducting surveys that provided information on the presence or absence of a species within the study area, but provided little information on the behavioural response of a species to disturbance. De Beers noted that it did utilize GNWT satellite collar data for caribou, which suggested that there is considerable variation in the number of animals that may be exposed to mine disturbance from year to year. This information did not provide an indication of how those animals exposed to the mine would respond. De Beers acknowledged that movement and behaviour data was limited for grizzly bears and wolverine.

The NSMA, YKDFN, and GNWT suggested that existing scientific and TK information were not fully utilized and may have been valuable given baseline data limitations. The NSMA and YKDFN indicated that TK could have been utilized to augment the baseline information providing insight into how human disturbance might affect caribou movement. In referring to something she learned from an elder at a caribou workshop, a YKDFN representative demonstrated the type of information that could have been used to augment the baseline data:

*“J.B. Rabesca was there, too. He told us the story about how caribou didn't really go to this one lake because one person built his house right on a caribou's trail. I thought that was interesting. So if one little house did that to the caribou migration, what about a mine on the land?”*

(Rachel Crapeau, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, p. 122)

The GNWT indicated that De Beers could have augmented their baseline data with existing scientific data relating to caribou disturbance and the relationship between changes in behaviour and influences on animal energetics and population effects. In its Technical Report, the GNWT suggested that the use of surrogate information from caribou monitoring at EKATI would have been applicable and that:

*“A combination of data analyses and modeling would have given De Beers more quantitative predictions of impacts and a sampling design for monitoring to determine the credibility of their predicted impacts.”*

(GNWT, Technical Report De Beers Snap Lake Diamond Project, February 2003, p. 56).

In response to dissatisfaction with De Beers' baseline data, the YKDFN, NSMA, and GNWT expressed a lack of confidence in De Beers' predictions concerning impacts of the SLDP on wildlife movement and behaviour. The YKDFN pointed out that quantitative predictions were not provided by De Beers and suggested that the lack of data precluded De Beers from making valid conclusions.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The NSMA suggested that Key Question W-2<sup>10</sup> remained unanswered as behavioural responses of each species were not measured as part of the baseline data and behavioural responses to the mine were not predicted quantitatively. Although De Beers did not provide quantitative predictions in its EAR, De Beers did provide qualitative predictions concerning residual impacts and the associated environmental consequence.

De Beers acknowledged that there was a moderate degree of uncertainty associated with its predictions of low impacts on behaviour and movement for grizzly bears. De Beers had moderate to high confidence in its predictions for low impacts on caribou behaviour and movement. The LDFN, YKDFN, and GNWT did not share De Beers' confidence in predictions of low impacts on caribou behaviour and movement. The LDFN indicated at the Public Hearing that it felt that caribou movement patterns were already being influenced by the existing developments. The YKDFN agreed with the LDFN and went on to assert that movement patterns would be affected by the SLDP:

*"...if the mine is developed in that area it is going to affect the caribou migration. Where are they going to go then? ...I know that the...mine is going to affect caribou migration."*

(Rachel Crapeau, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, p. 137).

During its Public Hearing presentation, the Dogrib Treaty 11 Council also stated concerns about general changes to caribou movements and behaviour:

*"And I'm here to tell you that that's the primary message that the Grand Chief came with, which was to tell you that Dogrib observations are ... that the caribou are changing their behavior and their patterns. And we, the Dogribs, think it's because of the mines, but what they're really here to tell you is something's changing out there."*

(Jean Teillet, Legal Counsel to Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 4, May 1, 2003, p. 166.

Unlike the YKDFN, however, the Dogrib Treaty 11 Council representative indicated that their concerns were primarily of a cumulative effects nature, and not solely related to the SLDP:

*"I want to make it clear that the Dogribs do not believe that the De Beers Snap Lake Project, in and of itself, is going to have a significant impact on the caribou. The Dogribs are not of that opinion."*

(Jean Teillet, Legal Counsel to Dogrib Treaty 11 Council, Public Hearing Transcript Day 4, May 1, 2003, p. 173)

During the Hearing, De Beers maintained its assertion that the SLDP would not have a noticeable influence on caribou behaviour and migration. When this idea was challenged by the LDFN observations, De Beers replied by stating:

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<sup>10</sup> Environmental Assessment Report Key Question W-2: What impacts will the Snap Lake Diamond Project have on wildlife movement and behaviour?



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*“I think this is one area where there is disagreement. I think there is disagreement ... around the predictions of science and traditional knowledge.”*

(Dr. Robin Johnstone, De Beers, Public Hearing Transcript Day 4, May 1, 2003, p. 107)

Although Dr. Johnstone’s comment indicated that the disagreement on the issue of caribou behavioural effects was between the predictions of TK and science, the scientific opinions provided by De Beers and the GNWT were not in agreement either. The GNWT suggested that there may in fact be moderate impacts on caribou movement and behaviour:

*“We do agree with De Beers that there will be a measurable ... behavioural response of the caribou to the mine, but we perhaps agree considerably less about the consequences of those behavioural responses...we suggest that the uncertainty is sufficient that the environmental consequences for caribou should be rated as moderate, and not as low.”*

(Dr. Anne Gunn, GNWT, Public Hearing Transcripts, Day 4, May 1, 2003, p. 184)

The GNWT also expressed scientific concerns over De Beers’ impact predictions regarding the behaviour and movement of grizzly bears (Public Hearing Transcript, Day 4, p. 202). The GNWT suggested that further modelling and analysis could have been done.

### ***Conclusions***

The Board concludes that the baseline data provided by De Beers included little useful information for assessing the potential impacts of the SLDP on wildlife movement and behaviour. Although De Beers did make use of external information, its assessment would have benefited from better use of existing information from scientific studies and TK. De Beers did reference caribou behaviour monitoring at the EKATI mine, but appeared reluctant to make full use of these caribou behaviour monitoring results, suggesting that the SLDP differed from EKATI in terms of size and disturbance level. Although the footprint of the SLDP is considerably smaller than that of EKATI, GNWT pointed out at the Public Hearing that wildlife responses may not be strictly related to just the size of the disturbance.

The Board acknowledges that movement and behaviour data for some species is difficult and expensive to collect. This is particularly so for species such as grizzly bears and wolverine. In the absence of local baseline data, the Board feels that De Beers could have made better use of information from the West Kitikmeot Slave Study, monitoring activity at EKATI and Diavik, and published literature to provide a more quantitative analysis of potential impacts.

The Board is concerned that De Beers’ conclusions about the impacts on wildlife movement and behaviour had little quantitative information and may lack adequate foundation. Even in situations where changes in behaviour were predicted, there was little analysis provided to suggest the magnitude of such changes on individual reproductive success and population dynamics. De Beers’





## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

conclusion that the SLDP will have no effect on caribou migration were based on professional opinion but were not adequately supported by either western science or TK. Professional opinion provided by the GNWT and TK provided by the LDFN and YKDFN representatives suggested that there may be an impact on caribou movement and behaviour as a result of this project. As a result, the Board feels that there is considerable remaining uncertainty associated with the probable impacts of the SLDP on caribou behaviour and movement.

De Beers did not convince the Board that significant impacts on wildlife movement and behaviour were unlikely. The GNWT and the communities presented evidence that suggested that impacts could be moderate to high. In the Board's view, this information was as convincing as the case presented by De Beers. Consequently, the Board concludes that significant impacts on caribou movement and behaviour could result from the development of the SLDP. The Board notes however that the number of caribou affected could vary widely from year to year. If the number of animals negatively affected is minimized, population-level impacts from the Snap Lake Project will be minimized. During the November-December 2002 Technical Sessions held in late 2002, De Beers suggested that it would work with GNWT to develop thresholds for the implementation of specific mitigation measures. This approach would ensure that more stringent mitigation was enacted with increasing numbers of caribou, limiting the number of animals exposed to significant impacts on movement and behaviour. As of the closing of the Public Record, however, no such detailed mitigation plan had been submitted by De Beers.

In summary, the Board concludes that De Beers has not provided sufficient evidence to demonstrate that a significant adverse impact on caribou, grizzly bear, and wolverine movement and behaviour will not occur as a result of the SLDP. Without further evidence or monitoring and mitigation details, the Board concludes that precautionary measures must be implemented to prevent significant adverse impacts from occurring.

### ***Recommendations***

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R13) De Beers shall, in consultation with the GNWT, develop a Caribou Protection Plan that imposes increasingly stringent mitigation measures as the number of animals potentially exposed to disturbance from the site increases. This plan could be modeled on the caribou protection measures included as terms and conditions of land use permits by INAC in the past.**

**(R14) De Beers shall, in consultation with the GNWT, develop a monitoring program to test the predictions of the EAR for grizzly bears, wolverines, and caribou and to further the scientific understanding of behavioural responses of these species to mine-related disturbance.**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

**(R15) De Beers shall evaluate and incorporate the results of the project-specific monitoring into the Wildlife Management Plan (see recommendation 2.5.3.3.2) to minimize impacts on grizzly bear, wolverine, and caribou behaviour and movement.**

**(R16) These measures should be incorporated where possible in land use approvals and as part of the Environmental Agreement.**

### 2.10.3.3 Wildlife Abundance

#### *Description of Issue*

Parties to the EA raised concerns about how De Beers assessed the potential impacts of the SLDP on wildlife abundance using inadequate baseline data and mitigation plans that provided insufficient detail.

De Beers' EAR prepared by De Beers assessed the potential influence of the following activities and facilities on wildlife abundance for the following linkages:

- Direct and indirect mortality from attraction to the project footprint;
- Direct mortality from wildlife-human interactions;
- Direct mortality from vehicle/aircraft collisions;
- Potential toxicity from North Pile seepage;
- Direct and indirect mortality from fugitive dust;
- Direct and indirect mortality from inhalation of toxic air emissions;
- Direct and indirect mortality from toxic spills; and,
- Increase in legal and illegal hunting and trapping activities from increased access due to the winter and esker access roads.

Direct mortality resulting from the attraction of animals to the mine footprint and wildlife-human interactions was found to be of greatest concern for carnivores and upland breeding birds. Substantial project-related mortality for other VECs was considered to be unlikely. De Beers concluded that mitigation could be used to minimize impacts on all VECs. It was also suggested that any losses were reversible given the reproductive potential of the various populations. De Beers focused on the prevention of direct mortality from attraction to the mine site. A key aspect of its planned mitigation was a waste management program, education, and enforcement policies for handling and disposing of food waste. De Beers concluded that if these measures were successful, there would be a low impact on the abundance of grizzly bears, wolverine, wolves, foxes, and upland breeding birds. The environmental consequence of impacts on abundance was predicted to be low for all VECs.

The NSMA and GNWT questioned the conclusions presented by De Beers, suggesting that a lack of baseline data limited confidence in the predictions. The main species of concern for direct mortality effects were grizzly bears and wolverines, both of which are listed as Species of Special Concern by Committee on the Status of Endangered Wildlife in Canada. Environmental consequence predictions



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

in De Beers' EAR were based in part on whether the expected influence on mortality would fall within the range of natural variation and whether the impact was reversible based on natural reproduction. The NSMA argued that De Beers had not collected the information necessary to draw conclusions based on natural range of variability and reversibility. NSMA suggested that baseline data collection methods provided a poor indication of population numbers within the RSA and that no data on reproductive potential had been acquired. NSMA argued that De Beers did not, therefore, have the information necessary to determine the natural range of variation, and thus impact predictions based on natural range of variation were invalid.

The Review Board was also concerned that there was not sufficient information upon which to base a reasonable prediction concerning the environmental consequence of the project on grizzly bear and wolverine populations. To reduce uncertainty in the prediction of impacts on grizzly bears, the Board requested that De Beers submit an analysis of the potential impacts of the project on population viability, using demographic data from the West Kitikmeot Slave Study and a population viability analysis conducted by McLoughlin *et al.* (2003)<sup>11</sup>. The GNWT was asked to conduct and submit a similar population viability analysis for the wolverine population in the Slave Geological Province.

Using demographic data from the West Kitikmeot Slave Study, De Beers estimated the natural range of variability for grizzly bear mortality within the RSA. De Beers also assessed the potential impact on population viability using a best-case and worst-case scenario for mine-related mortality based on results from other mines in the Slave Geological Province. De Beers reported that under its best case scenario (no mine-related bear mortalities) there would be no impact on population viability. The analysis for the worst case scenario (mortality rate of 0.5 bears per year) suggested that the natural range of variability would be surpassed, but that regional population viability would not be jeopardized, provided that existing mortality rates from other sources remained constant.

The GNWT responded to an April 4, 2003 request by the Review Board by stating that the information necessary to conduct a population viability analysis was not available for wolverine populations in the Slave Geological Province. This called into question De Beers' ability to make predictions based on natural range of variation and reversibility for wolverine as the data necessary to determine these parameters did not appear to exist.

The GNWT's main concern with regards to the issue of direct mortality on grizzly bears and wolverines was that De Beers had not provided details of on-site wildlife management and waste management programs and that this left unacceptable uncertainty, particularly for Species of Special Concern.

*“Although the Developer recognizes the importance of a waste management program, no comprehensive waste management plan was included with the Environmental Assessment Report, or has been submitted for review. In the absence of a comprehensive plan, the level*

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<sup>11</sup> McLoughlin, P.D., M.K. Taylor, H.D. Cluff, R.J. Gau, R. Mulders, R.L. Case and F. Messier. 2003. Population viability of barren-ground grizzly bears in Nunavut and the Northwest Territories. Arctic. In press.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*of bear mortality could be significant over the life of the mine. Without specific mitigation measures, there is a high level of uncertainty as to whether the environmental consequence of this mine is 'low'.*"

(GNWT, Technical Report De Beers Snap Lake Diamond Project, February 2003, p. 58)

The GNWT noted that grizzly bear populations are susceptible to additive mortality and that reversibility of effects is therefore uncertain:

*"The ability of bear populations to adjust or to recover from excessive mortality rates is poor. They live a long time but they produce relatively few young and it may take -- an adult female may have to live to sixteen years old, in this area, in order to replace herself in the population. She would have to live for another four years or more to actually add to the population. This illustrates the low biological resilience of these populations to over harvest. And as a result, over harvest made over a year or two, can result in a population level effect that lasts for ten or more years."*

(Dr. Ray Case, GNWT, Public Hearing Transcripts, Day 4, May 1, 2003, p. 200)

The GNWT also suggested that conflicts with wolverines were likely at Snap Lake:

*"despite your best efforts to limit your odours and waste, (there is) evidence which suggests that wolverine can be fairly motivated and can in fact compromise chain link fences, barb wire fences, and so I think, based on the evidence to date, (from) some of the mines to the North, some mortality is inevitable."*

(Robert Mulders, GNWT, Technical Session Transcripts, Day 6, December 2, 2002, p. 25)

As wolverine are similar to grizzly bears in terms of low densities and reproductive rates, population impacts from mine-related mortality may be slow to reverse. The Board was concerned with this potential given the limited understanding of wolverine demographics and population viability within the region. Avoiding wolverine conflicts in association with the SLDP is therefore of great importance.

During the November-December 2002 Technical Sessions, De Beers outlined a number of mitigation measures that would ultimately be incorporated into its Environmental Management System. Among the measures discussed were waste management procedures that would ensure that food waste would be transported from the cooking facilities to the incinerator without going outside. Other measures discussed by De Beers included the need to have employee training and deterrent mechanisms. Comprehensive on-site wildlife management or waste management proposals were not submitted by De Beers for review. The GNWT did not consider the issue resolved and carried its concerns about grizzly bear and wolverine mortality forward to the Public Hearing.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Small changes in mortality rates could have long-ranging impacts on grizzly bear and wolverine populations within the region. It is important, that De Beers' confidence in its ability to minimize mortality be well founded. If De Beers' on-site wildlife management and waste management programs are not successful, the result could be a negative impact on grizzly bear or wolverine populations. Furthermore recovery may be a slower process.

### *Conclusions*

The Board concludes that De Beers did not provide a convincing case for the residual impact and environmental consequence predictions for carnivores. De Beers' assessment of grizzly bear population viability using recently published demographic data did, however, provide evidence that the SLDP could be developed without resulting in a significant impact on population viability within the Slave Geological Province. This assessment was done at the request of the Review Board (April 4, 2003). It highlighted the importance of achieving a near-zero mine-related mortality rate for bears. If De Beers is able to achieve a near-zero mortality rate for grizzly bears and wolverines as claimed, then significant impacts on abundance are not likely. If, however, De Beers' mitigation is inadequate to prevent grizzly bear and wolverine mortality, there may be long-lasting impacts on both species. Given this background, the Board is concerned with De Beers' statement in its EAR that "*The success of the waste management program is currently uncertain*" (EAR, p10-224). To add to this statement, the Board notes that comprehensive details of this plan have not been presented to the GNWT and other Parties to review and critique.

The Board has concluded that De Beers has not provided sufficient evidence to adequately demonstrate that a significant adverse impact on grizzly bear and wolverine abundance will not occur as a result of the SLDP. The commitments made by De Beers in its EAR and throughout the EA process do outline the basic components of the necessary on-site wildlife management and waste management plans. However, without additional details about the waste management procedures and wildlife deterrent measures, the Board concludes that precautionary measures must be implemented to prevent significant adverse impacts on grizzly bear and wolverine populations.

### *Recommendations*

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R17) De Beers shall, in consultation with the GNWT, develop a comprehensive waste and odour management strategy to minimize the attraction of carnivores to the site. The strategy must identify and describe details of design features, operational measures, employee/contractor staff awareness and training, for handling of food, food waste and other wastes throughout the mine site and specifically for the incinerator, landfill site, kitchens, camps and personnel quarters.**



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

**(R18) De Beers shall, in consultation with the GNWT, develop a comprehensive on-site Wildlife Management Plan that limits the attractiveness of the mine site to carnivores and includes protocols for dealing with on-site wildlife encounters. The requirement for the on-site wildlife management plan shall be incorporated into the proposed Environmental Agreement.**

### **2.11 Resource Uses**

#### **2.11.1 Summary of Developer's Submissions**

##### **Heritage Resources**

The heritage resource analysis conducted by De Beers examined effects on prehistoric and historic period archaeological resources, and historic period structural features (*e.g.* standing and collapsed cabins, campsites). The assessment was conducted using a variety of secondary sources, terrain analysis, on-ground inspections and other inventory studies that involved, at various stages, the direct participation of Aboriginal groups from the YKDFN and the LKDFN.

Based on these extensive inventories and the examination of linkages between the project and the locations of various resources, De Beers concluded that all but one of the heritage resources identified, lie outside the proposed development area. The site within the development area was considered to be an isolated find and artifacts were collected and sent to the Prince of Wales Northern Heritage Centre. Because the vast majority of the Snap Lake winter access road is situated on ice formed in open water, De Beers concluded that direct impacts on heritage resource would be low, and limited to the on-land portions of the access road and indirect effects would be moderate and likely only in the case of accidents.

Nevertheless, De Beers indicated that many landforms near the proposed development zones have heritage site potential, and therefore committed to additional investigation of these areas by professional archaeologists, and consultation with the Prince of Wales Northern Heritage Centre, should development plans change.

##### **Traditional Land Use**

In terms of traditional land use, a review of existing secondary source information and De Beers' community consultations with TK holders, indicated that there had been extensive traditional use of the RSA by the NSMA, the Yellowknives Dene, Dogribs and Chipewyan of the North Slave. No burial sites were identified. More recently, studies and consultations indicated that little fishing occurs in the RSA, but trapping is extensive (although no traplines were identified in the vicinity of Snap Lake). Aboriginal peoples continue to travel through the RSA to reach caribou hunting areas to the north of the mine, near MacKay Lake. Dogrib Elders indicated that caribou harvesting has occurred in the vicinity of the SLDP over the last 20 years. Although no traditionally significant



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

areas were identified in the RSA by the Yellowknives Dene, NSMA or the Dogribs, or the LKDFN. Significant features such as the Old Lady of the Falls, the Mowhi Trail, and burial sites that were identified by community elders were located outside the RSA.

De Beers' EAR indicates that it will continue to enforce its no fishing and hunting policy for employees and contractors at Snap Lake, and have indicated that, to date, employees and contractors have cooperated with this policy. Moreover, no fishing equipment is available on-site for employee use, including rods and tackle, areas of cleaning, cooking or storage of fish, disposal options for remains or the ability to transport fish from the site.

De Beers' EAR indicates that historical land use documented by TK and in other studies were considered, including a study prepared by the NSMA as a companion to the Comprehensive Review Study on the DIAVIK Diamonds Project entitled "Can't Live Without Work" and data collected in support of the Dene-Metis Land Claim negotiations.

De Beers concluded that the SLDP will likely result in a loss of <1% of the RSA and that impacts on traditional land use would be relatively short term. No effects on traditionally significant areas were identified.

### Non-traditional Resource Use

De Beers' analysis of non-traditional resource use considered effects on ecologically representative areas, subsurface resources (*e.g.* eskers, mineral claims, exploration and extraction areas), domestic and sport hunting, domestic trapping, sport and commercial fishing, recreation and tourism, permanent and seasonal camp areas, and access.

With respect to these areas of concern, De Beers concluded that because the mine footprint comprised only 0.01% of the Coppermine River Uplands Ecoregion the adverse effect of the SLDP on the availability of land for ecologically representative areas was low, and that De Beers can be a positive factor in the establishment of protected areas within the ecoregion, through its representation on the *NWT and Nunavut Chamber of Commerce Protected Areas Strategy Advisory Committee*. Adverse impacts on most other non-traditional natural resource uses were also considered to be low or negligible due to the relatively low intensity of uses in the RSA and few measurable direct or indirect effects on areas used for such purposes. In consultation with INAC, De Beers confirmed that there are no cabin leases within the RSA but that there may be one squatter on MacKay Lake within the RSA. Access to the RSA for domestic hunters and fishers would be improved by the presence of the Snap Lake winter access road, but fly-in access would not be affected. Improved access via the Snap Lake winter access road was also thought to increase opportunities for exploration.

### Aesthetic Quality

De Beers' analysis of changes in visual quality of the Snap Lake area concluded that the project's infrastructure would be visible but that the overall consequence of such changes would be low. On-



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

site buildings, the steam plume (which may reach 270 m in the winter), the North Pile and outside lighting were considered.

The effects of the SLDP on the Tibbitt-Contwoyto winter road were considered to be low because during years of peak traffic volume along the road, the project would contribute 28% of the traffic load and 13% of the daily load to the Lockhart Lake camp. De Beers indicated that SLDP traffic would not result in an exceedance of the road's peak capacity.



Dogrib interpreter, Margaret Mackenzie, with Dogrib elders during the evening session of the public hearing.

### 2.11.2 Summary of Responses from the Parties

The NSMA indicated that impacts on its traditional land use (fisheries) practices had not been assessed by De Beers and furthermore, that De Beers did not make an effort to provide, analyze, or monitor traditional land use, and subsistence economy in the NSMA community:

- The NSMA stated that it has a strong subsistence economy and traditional land use that it would like to see protected. Data presented by the NSMA indicated that 88% of NSMA members sampled reported participation in traditional land use activities throughout a single





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

year, and 42% of the sample reported spending over two months on the land during a year, and 62% of the sample reported over one month of land use during a year.

- The NSMA indicated that De Beers provided no rationale for its selection of a 31 km radius for its RSA regarding resource uses. The NSMA believed the RSA should be larger and should have overlapped with the RSA studied by Diavik to avoid large gaps in the study of impacts on resource uses. De Beers noted that it selected the RSA on experience with the EKATI and Diavik mines which indicated a maximum zone of influence to be 10 to 15 km. De Beers' EAR doubled the size of this area to ensure a conservative analysis.
- The NSMA indicated that traditional fishing places proximal to Yellowknife were not considered. The NSMA's TK holders have observed adverse changes on NSMA traditional fisheries from recreational non-aboriginal fishing, and expressed a concern that increased recreational fishing pressures for off-work De Beers employees would further degrade the resource. The NSMA expressed its position that the lakes at which its members carry out traditional fishing activities cannot sustain any increased angling pressures and that any further negative impacts to the fisheries will result in corresponding effects on Metis culture, land use, economy, health, Aboriginal rights, and spiritual and cultural practices.

The Northwest Territories Metis Nation also indicated that the traditional South Slave Metis use of the Snap Lake area has not been acknowledged by De Beers. Representatives of the LKDFN indicated that the mine may impact berries and plants that are valued for food and medicine.

De Beers acknowledged that the NSMA, the Yellowknives, Dogribs and Chipewyan of the North Slave have all used the study area for traditional purposes and stated that some information collected cannot distinguish traditional use between communities and may include information from people who are now members of the NSMA. De Beers' EAR identified the MacKay Lake area as an important fishing area to the NSMA, but that no fishing areas within the RSA were identified.

### 2.11.3 Conclusions

The Board is satisfied that effects on resource use by others have been adequately considered by De Beers and that the effects of the SLDP on heritage resources, traditional land use, non-traditional resource use, aesthetic quality, and the use of the Tibbitt-Contwoyto winter road are not likely to be significant. The 31 km RSA is considered to be a conservative estimate of the zone of influence of the mine.

The Board is of the opinion that De Beers' fishing and hunting policy is likely to be effective at protecting renewable resources in the LSA around SLDP. The Parties did not present any evidence that such policies have not been an effective mechanism for protecting such resources in the vicinity of mine sites.

In summary, the Board concludes that the SLDP is not likely to have a significant adverse impact on resource use by others. However, the Board is of the opinion that additional measures should be



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

considered to ensure that impacts on resources and resource users remain within acceptable levels and/or can be managed effectively in the future.

### 2.11.4 Suggestions

**Based on the above conclusions, the following suggestions should be considered for implementation:**

**(S23) Given De Beers' acknowledgement that Aboriginal groups have used the study area for traditional purposes, these groups should be involved in project related monitoring activities to ensure that mitigation measures are successful, particularly with respect to impacts on renewable resources. Appropriate training should be provided by De Beers to individuals involved in these monitoring activities**

**(S24) The Board suggests that De Beers ensure that employee and contractor awareness programs highlight the importance of the fishing and hunting policy for Snap Lake.**

## 2.12 Air Quality

### 2.12.1 Summary of Developer's Submissions

De Beers examined the potential effects of emissions from the SLDP on the air quality within the RSA. The analysis considered a wide range of potential sources of emissions, ranging from air and water heaters to power and process plant emissions. The EAR considered impacts from SO<sub>2</sub>, NO<sub>2</sub>, Total Suspended Particulate (TSP), PM<sub>10</sub> and PM<sub>2.5</sub>, and Polycyclic Aromatic Hydrocarbons (PAHs). The approach to impact assessment was quantitative and based on dispersion modeling.

The maximum annual TSP, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations were predicted to be above the applicable CCME Canada-Wide Standard within the active mine area. Maximum 24-hour TSP and PM<sub>10</sub> predictions were also above the criteria in small areas near the quarry. These exceedences were considered by De Beers to be low in magnitude, infrequent and highly localized within the mine site or adjacent to the quarry. The surface operations will incorporate a number of mitigation steps that will minimize dust emissions from the SLDP. Covered conveyor belts will be used to transport ore from the primary underground crushers to the processing plant during full operations. Plans to minimize the exposed areas on the North Pile, actions to suppress dust from surface roadways and the airstrip (*e.g.* watering) and the installation of dust collectors at crushing operations will also reduce ambient dust.

Elsewhere in the RSA, all maximum concentrations were below applicable criteria. Similarly, annual concentrations of TSP, PM<sub>10</sub> and PM<sub>2.5</sub> were also below applicable criteria across the RSA. For



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

example, annual TSP concentrations outside the active mine area are less than 25% of the applicable criteria.

Dispersion modeling predicted that NO<sub>x</sub> and SO<sub>2</sub> emissions from the SLDP would be lower than applicable criteria and that potential acid input due to NO<sub>x</sub> and SO<sub>2</sub> was also calculated to be below levels considered to be protective of sensitive ecosystems.

De Beers predicted the maximum ground level concentrations of PAHs and trace metals within the RSA under wet and dry conditions for the purposes of wildlife and human health risk assessment. On the basis of this analysis, Naphthalene was determined to be the only chemical of concern for the purposes of wildlife and human health risk assessment. It was the only chemical predicted to exceed baseline concentrations and there is no guideline established to protect human health.

The EAR indicated that a vapour plume reaching up to 269 m might be visible on cold and calm days, but that combined emissions that might produce a haze will not substantially degrade regional visibility.

De Beers concluded that diesel fuel was the most appropriate energy form for use at the Snap Lake mine.

De Beers indicated that the SLDP will result in 102 kilotonnes of greenhouse gas (GHG) emissions per year such as carbon dioxide that have been linked to climate change. Of this amount, 70% was attributed to the emissions from the power generators. This represents a 5% and 4.7% increase in GHG emissions for the NWT in 2000 and 2005, respectively. An increase of 0.01% from 2000 GHG emissions across Canada was also expected.

### **2.12.2 Summary of Responses from the Parties**

The GNWT, Environment Canada and CARC raised issues regarding air quality during the EA process. Environment Canada and the GNWT held the position that polluting up to a limit is not acceptable for the management of air quality. During the November-December 2002 Technical Sessions, GNWT questioned the underlying assumptions used in the dispersion modeling and maintained that De Beers should develop and implement an air quality management plan that includes a comprehensive emission and air quality monitoring strategy to ensure that emissions are tracked and contaminants of potential concern are monitored.

Environment Canada indicated that PM<sub>10</sub> and PM<sub>2.5</sub> should be monitored and that De Beers establish partnerships with other mine operators for the implementation of a regional air quality monitoring program.

The GNWT expressed concern regarding the disparity among GHG emission predictions reported by De Beers and more recent information from a federal inventory. The GNWT noted that although there has been more development in the NWT over the past several years, NWT emissions appear to



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

be roughly stabilized. GNWT attributed this to the Giant Mine shutdown, the NWT Power Corporation's hydro-electric power additions, increased natural gas use in Inuvik and more efficient operations overall.

CARC indicated that what De Beers had estimated as its GHG emissions will result in a 10% increase in the emissions of GHGs, from the baseline year of 1990 for NWT emissions. CARC expressed a concern that little effort was being made by the federal and territorial governments to evaluate the SLDP, in light of Canada's Kyoto commitments. CARC requested that the SLDP be assessed in light of Canada's ratification of the Kyoto protocol, and that procedures be developed to ensure that all future developments in the Mackenzie Valley receive similar consideration.

### **2.12.3 Key Issues**

The Board is of the opinion that the key issues regarding air quality effects are related to De Beers' predictions of air quality within the LSA and RSA and GHG emissions.

#### **2.12.3.1 Local and Regional Air Quality**

##### ***Description of Issue***

Environment Canada and GNWT indicated that polluting up to a limit is not acceptable and that some of De Beers' emissions off the mine site are predicted to approach some of the CCME guideline values, most notably for particulate matter. Environment Canada sought clarification that De Beers would monitor both PM<sub>10</sub> and PM<sub>2.5</sub> to ensure that its emissions are indeed below relevant standards, particularly the CCME's Canada-Wide Standards. Environment Canada also recommended that De Beers minimize environmental impact through monitoring combined with adaptive management and through use of the best available technology economically achievable.

During the Public Hearing, De Beers restated its commitment to operate within existing standards and laws, and committed to conduct monitoring as requested by Environment Canada and the GNWT. De Beers provided no position regarding a regional air quality monitoring initiative. Environment Canada indicated that expert staff are available to assist in designing the monitoring program.

##### ***Conclusions***

The Board concludes that significant adverse impacts on local air quality are not likely. Although De Beers predicted that dust levels would exceed recognized criteria, the Board concludes that these events are not likely to have a significant adverse impact on air quality or human health. The Board reached these conclusions because the impacts are anticipated to be low in magnitude, infrequent, highly localized within the mine site or adjacent to the quarry, and away from areas where workers may reside during work rotations. The mitigation measures proposed by De Beers such as the application of water or the installation of dust collectors at crushing operations are known to be effective and can be optimized during the construction and operations to improve their effectiveness



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

if required. However, the Board is of the opinion that additional measures should be considered to ensure that impacts on air quality remain within acceptable levels and/or can be managed effectively in the future.

### *Suggestions*

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S25) The Government of Canada and the GNWT should ensure that any Environmental Agreement include commitments by De Beers to:**

- a) **Meet all applicable air quality criteria and standards both within the active mine area where workers may reside during work rotations and within the LSA and RSA; and,**
- b) **Design and implement a comprehensive emission and air quality monitoring strategy to ensure that emissions are tracked and contaminants of potential concern are monitored. This monitoring program should include monitoring of both PM<sub>10</sub> and PM<sub>2.5</sub> within the active mine site and within the LSA and RSA. De Beers should design the program in consultation with Environment Canada and the GNWT.**

### **2.12.3.2 Greenhouse Gases**

The need to evaluate the SLDP in light of Canada's Kyoto commitments was not an explicit requirement of the Terms of Reference for the EA issued to De Beers. This issue, however, was raised by CARC and the Dogrib Treaty 11 Council during Public Hearing and is discussed in the following sections.

#### *Description of Issue*

With respect to GHGs and Canada's Kyoto commitments, INAC and Environment Canada indicated that the implications of the Kyoto protocol as it applies to the SLDP were not examined by the federal government. Some interest had been expressed by the GNWT, and other Parties about using hydro-electric power to substitute for some diesel. The GNWT indicated that it specifies low sulphur diesel in all of its own fuel purchasing contracts.

The GNWT indicated that the Government of Canada and the GNWT are committed to working with industry to address climate change and air pollution. The GNWT informed the Board that it is investigating all options to reduce fossil fuel use in the NWT through energy efficiency, and the use of renewable energy. De Beers is proposing to use fossil fuels imported from southern refiners at the proposed Snap Lake mine. The GNWT quote volumes of fuel for each use category at Snap Lake to be: 28 million litres per year for generating electricity, 8 million litres per year for heating, and 4



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

million litres for transportation. The GNWT indicate that volumes for generation will increase over time.

The GNWT noted that it has several developed rivers in the Great Slave Lake basin, with the capacity to supply cost effective electricity to new demand clients, such as De Beers' SLDP. The GNWT encouraged De Beers to purchase low sulphur diesel for all non-hydro energy requirements at the mine site.

The GNWT suggested that the expansion of the NWT's hydro-electric generation and transmission system would result in legacy infrastructure to serve future energy demand for NWT communities and the non-renewable resource sector.

The GNWT noted that more recent information was available from the department of Resources, Wildlife and Economic Development regarding GHG emissions than was used in the EAR. The more recent information split out NWT and Nunavut emissions. The GNWT requested De Beers to re-examine their assessment of GHG emissions. In response, De Beers indicated that the assessment and impact predictions would not change and would remain at approximately the levels predicted in the EAR. De Beers expressed an opinion that the release of GHG and issues of climate change are a national and global concern, and pointed out that there is a high level of uncertainty regarding the effects of increasing GHG emissions on the local scale.

CARC asked De Beers whether it was going to use low sulphur fuel at the site. De Beers clarified that the fuel to be used on site is a P-50, which is a low gel 18 point low sulphur fuel.

Subsequent to the Public Hearing, the Review Board received a letter from the GNWT (May 23, 2003) confirming De Beers' interest to purchase reliable hydroelectric power for the SLDP site, prior to facility start up in mid-2007. The confirmation was made in a March 5, 2003 letter of interest addressed to the Northwest Territories Power Corporation, from AMEC on behalf of De Beers. The use of hydroelectric power would substitute for burning some fossil fuels at the mine site.

### ***Conclusions***

The Board is concerned over the contribution of this project to GHG emissions such as carbon dioxide, that have been linked to global warming. The Board recognizes that climate change is an important environmental issue to the NWT and Canada as a whole. The SLDP alone represents approximately a 10% increase in the emissions of GHG, from the baseline year of 1990 for NWT emissions and therefore, in the opinion of the Board, may constrain the NWT's ability to contribute positively to Canada's Kyoto commitments.

The Board concludes that the maximum use of either low sulphur fuel or hydro-electricity at the mine site is desirable to reduce air quality effects and GHG contributions.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The Board concludes that the provision of hydro-electric energy to the SLDP and other developments along the winter road needs to be investigated further as a means to reduce both GHG emissions and environment effects from transportation of fuel.

### *Suggestions*

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S26) The Government of Canada and GNWT should ensure that any Environmental Agreement include the following commitments by De Beers:**

- a) **Maximum use of low sulphur diesel by De Beers; and,**
- b) **Reporting by De Beers to Governments on GHG emissions on an annual basis.**

## 2.13 Noise

Noise from the SLDP has the potential to affect both humans and wildlife, both on and off-site. The effects of noise on wildlife are discussed in Section 2.10. This section addresses the effects of noise on people (*i.e.* human receptors).

### 2.13.1 Summary of Developer's Submissions

De Beers reported that the main source of ambient noise at the SLDP site was wind. The minimum hourly sound levels measured during a two day noise survey undertaken in July, 2001 was 23 dBA  $L_{eq}$ .

De Beers EAR examined a wide range of activities that might generate noise during both construction and operations phases of the project. Construction noise predictions were calculated for the noisiest conditions during the construction period, while operation phase noise predictions were calculated by modeling.

De Beers' choice to use underground mining methods, has allowed De Beers to reduce the potential for environmental effects related to such things as traffic, noise and wildlife disturbance. Since mining and crushing will occur underground in a wet environment, and ore will be transported to the surface by conveyor, rather than trucks, the noise will be reduced, compared to typical above ground mining operations.

De Beers predicted that construction site noise will be less than 40 dBA  $L_{eq}$  at 1.5 km from the site decreasing to ambient background levels at 6 km from the site. As such, average construction noise would not be heard at the nearest tourist sites located well beyond 9 km from the site. Traffic noise



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

from trucks on the winter road during construction would be audible for 6 km along the road and not likely to be audible at the nearest tourist site to the winter road. Similarly, traffic noise would not be audible at the nearest tourist site to the esker access road during construction. Overall, the residual impacts of noise during construction were considered to be negligible to low.

De Beers predicted that operations site noise will be less than 40 dBA  $L_{eq}$  at 1.5 km from the site, decreasing to ambient background levels at 6 km from the site. As such average operations noise would not be heard at the nearest tourist sites. Traffic noise from trucks on the winter road during operations would be audible for 10 km along the road and would likely be audible at two of the nearest tourist sites to the winter road. Air traffic noise was predicted to be near or below ambient noise at the nearest tourist sites, however individual fly-overs will be audible. Overall, the residual impacts of noise during operations were considered to be low. Mitigation measures to manage noise emissions from the site will also include the installation of high performance engine exhaust silencers on the power plant diesel generator units.

### **2.13.2 Summary of Responses from the Parties**

None of the Parties to the EA commented on the noise assessment conducted by De Beers as it related to off-site human receptors at either the November-December 2002 Technical Sessions or the Public Hearing.

### **2.13.3 Conclusions**

The Board concludes that the adverse impacts of noise to off-site human receptors are not likely to be significant. The Board is confident that on-site noise can be effectively managed and that significant adverse impacts on mine workers are unlikely. However, the Board is of the opinion that additional measures should be considered to ensure that impacts of noise remain within acceptable levels and/or can be managed effectively in the future.

### **2.13.4 Suggestions**

**Based on the above conclusions, the following suggestion should be considered for implementation :**

**(S27) The Government of Canada and the GNWT should ensure that any Environmental Agreement includes the commitments made by De Beers to design and implement a noise monitoring and abatement strategy to ensure that noise emissions are as low as reasonably achievable with best available technology. This monitoring program should include periodic monitoring of noise both within the active mine area, and within the LSA and RSA. De Beers should design the program in consultation with the GNWT.**





## 2.14 Environmental Health

### 2.14.1 Summary of Developer's Submissions

De Beers examined the effects of emissions from the SLDP on the health of humans and wildlife. Because TK studies link people's health with the health of the land, and because of the importance of plants and animals to people's way of life, De Beers' EAR considered plant and animal health to be a human health issue as well. The environmental health analysis focused on the potential for long term (or chronic) effects of chemical exposures on health. Short term (or acute) effects on health were not examined in detail, because the maximum predicted concentrations of chemicals from routine emissions were not high enough to cause concern over acute health effects.

The assessment considered effects from the exposure to chemicals from existing conditions, existing conditions plus emissions from SLDP operations, and post-closure. Effects from the construction phase were not considered because of the short duration of the construction phase and because concentrations of chemicals would not be high enough to cause acute health effects. The post-closure analysis focused on the exposure of humans and wildlife to water in lakes north of Snap Lake that might be affected by groundwater seepage from the SLDP.

Environmental risk assessment was the primary tool used in the analysis, which was conducted according to established human and wildlife health risk assessment protocols endorsed by Health Canada, the CCME and the USEPA. Baseline data used in the analysis included data from monitoring and sampling studies, including TSP, fish tissues, surface water in Snap Lake and MacKay Lake, snow, lichens and soil. De Beers' analysis concluded that direct exposure (*i.e.* inhalation of dust, drinking water, eating soil and vegetation) and indirect exposure (*i.e.* ingesting prey) to chemicals emitted from the SLDP will not result in adverse health impacts to wildlife.

### 2.14.2 Summary of Responses from the Parties

The general sentiment of most Parties to the EA toward environmental health issues was best expressed by the YKDFN.

*“People the world over want nutritious food, of course, but also want to minimize the contaminants that are in that very same food. Just as an example of food that is nutritious in building a strong musculature and circulatory system, giving us strong hearts, et cetera, it might also contain contaminants that could cause birth defects in the very same food. So we want to make sure that the food is nutritious, from the land, but also has minimal to none contaminants in it”*

(Tim Byers, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, page 132)



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

During the Hearing, Mr. Michel Paper of the Dogrib Treaty 11 Council reinforced the need for careful management of mining developments based on previous experience with past mining operations that caused environmental contamination.

*"I love my land. I love living here...and you also have...ruined the land -- disappointed the land, and take example, Giant Mine, and Colomac Mines. A lot of things have been contaminated, as well as there's -- at Giant Mine, there's a problem with the arsenic, and it's been underground for many years"*

(Michel Paper, Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 4, May 1, 2003, page 264)

Because environmental risk assessment relies heavily on modeling, the focus of most Parties to the EA was on the assumptions regarding the selection of VECs, the scope of the analysis and assumptions regarding exposure of wildlife and humans to chemicals. During the November-December 2002 Technical Sessions and Public Hearings, much of the focus was related to the effects of dust fall on the land, water and wildlife.

LKDFN noted that animals considered in the EAR are caribou, grizzly bears, wolves, foxes, wolverines, upland breeding birds, raptors and waterfowl. This seemed to suggest that these were the only wildlife species that may be impacted by the SLDP. However, LKDFN Elders have mentioned that moose and black bears, as well as other treeline species, have been seen as far north as MacKay Lake

Several other Parties also expressed a concern in regard to the health of the caribou, especially as it relates to the health of the food of the caribou. The LKDFN saw dust emissions as having an effect on the lichen and questioned whether any studies had been done on lichens in the SLDP area.

Dogrib Treaty 11 Council questioned whether there were any studies conducted regarding the effects of dust from mining activities in similar (e.g., arctic and subarctic) environments, and if so, whether these studies were integrated into the environmental health analysis.

Although not specifically related to De Beers' environmental health analysis, the YKDFN also expressed concern about the effects of mine-generated dust on waterbodies and on the land (particularly, the plants that people and animals eat). The YKDFN requested that De Beers characterize the dust to determine its chemical properties. The YKDFN pointed out that De Beers' EAR does not mention whether there is a possibility that the dust deposited onto Snap Lake will be moved, by wave action and water density differentials, into larger concentrated masses that would result in thicker depositions on the bottom.

The Dogrib Treaty 11 Council asked about the potential attraction of caribou to salts in the North Pile. De Beers noted at the Hearing that it would implement mitigation to prevent the access of caribou from the North Pile if this became a concern.



### 2.14.3 Key Issues

The Board is of the opinion that the key issue regarding environmental health is related to De Beers' predictions of effects on wildlife and human health.

#### 2.14.3.1 Effects on Wildlife and Human Health

##### *Description of Issue*

The key exposure pathways to wildlife that were examined by De Beers included exposures from changes in air quality, soil quality, surface water and snow quality, fish quality and changes in plant and prey tissue quality. Chemicals of concern in the analysis included, aluminum, barium, chromium, manganese, strontium, thallium and naphthalene. The wildlife health assessment used a 25 year timeline and assumed that wildlife with small home ranges spend 100% of their time within the LSA, while animals with large home ranges spend less time within the LSA, but at least all of their time within the RSA. De Beers' wildlife specialists estimated the time that migratory animals may be within the LSA and RSA.

De Beers concluded that direct exposure (i.e., inhalation of dust, drinking water, eating soil and vegetation) and indirect exposure (i.e., ingesting prey) to chemicals from the SLDP will not result in adverse impacts to the health of wildlife. Aluminum exposure to caribou, grizzly bear, wolverine, Arctic ground squirrel and ptarmigan were identified to be of concern in the baseline case and during operations, largely because it is naturally present in the local soils. It was assumed that 100% of the aluminum in soils would be available for uptake by wildlife. In the EAR, De Beers proposed to conduct further soil characterization and analysis to better understand the baseline exposure. Subsequently, De Beers prepared a "2002 Soil Sampling Program Report for Environmental Health" in January 2003. This report estimated aluminum availability to be <1% in the soil samples collected in 2002 and re-assessed the environment risks to caribou, grizzly bear, wolverine, Arctic ground squirrel, and ptarmigan. This re-assessment concluded that wildlife health risks are not expected to occur for all of the species studied under baseline or during operations.

De Beers indicated that any potential impacts from the SLDP on black bears, moose, and other treeline species are predicted to be negligible and would not be greater than those species (i.e., Valued Ecosystem Components) assessed in the environmental health analysis (i.e., Caribou, Grizzly bear, Wolf, Wolverine, Peregrine falcon, Fox, Arctic ground squirrel, Ptarmigan, Mallard duck and Common loon). According to De Beers, this is because the species examined in the environmental health assessment represent a wide range of sensitivity to chemicals from different mammalian and avian families.

The key exposure pathways to humans that were examined included exposures from changes in air quality, surface water and snow quality, fish quality and changes in plant and prey tissue quality. The analysis focused on the exposure of people who may travel through the study area to harvest traditional foods and the exposure of people who may consume traditional foods. For example, the



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

exposure of people to inhaled chemicals, drinking water, snow, consumed fish tissue and game meat were examined. Effects on humans were evaluated according the three life phases (i.e., toddler, child and adult). Exposures of humans to a variety of metals, PAHs, airborne chemicals such as NO<sub>2</sub> and SO<sub>2</sub> were initially considered, but the only chemical of concern that was quantitatively evaluated was naphthalene.

De Beers indicated that the assessment was limited to naphthalene because it is the only chemical of concern whose emissions exceeded predicted baseline concentrates and there are no guidelines to protect human health. Direct exposure to chemicals for a hunter or fisherman was evaluated for a 25 year timeline, assuming a 30 days per year hunting and fishing effort within the LSA.

De Beers concluded that people will not be exposed to chemicals emitted from the SLDP that would result in adverse health effects. De Beers indicated that no additional air and water quality monitoring is warranted beyond those programs that are already planned.

De Beers noted that integrating data on dustfall from other sites into the risk calculations would not be valid because only site-specific data are relevant to the assessment of risks to wildlife in the study area. The baseline studies conducted in 2001 focussed on the RSA and provided data used in the risk calculations. Because there are no mining activities in the RSA (i.e., 31 km radius around the SLDP), the baseline data collected provided an idea of naturally occurring chemical concentrations, plus any effects from the Advanced Exploration phase. Any metals and PAHs that could be transported long-range from other sources would have been measured in the baseline study.

In response to the Parties concern regarding dust fall, the environmental health analysis specifically included dust-based exposure pathways. Predicted wildlife exposure to metals and PAHs via dust and other sources (e.g., food uptake, water) while the SLDP is in operation was assessed. Additional mitigation measures for the effects of dustfall with elevated chemicals on wildlife health were not described in the report because no deleterious effects from fugitive dust are predicted to occur for wildlife in the LSA or RSA. De Beers indicated that conservative assumptions were made using maximum predicted chemical concentrations in dust and extremely conservative assumptions about how much time an animal would spend in the vicinity of the mine where dustfall would be greatest.

De Beers indicated that a variety of dust suppression techniques will be used during construction and operation of the SLDP. Also additional mitigation the already-planned dust suppression measures were not considered necessary because impacts to wildlife health are not predicted.

De Beers indicated that air quality baseline conditions encountered in the Snap Lake area, total suspended particulate and dust fall conditions, and the chemical compositions of dust associated with the SLDP were characterized in the EAR. The air quality assessment of the SLDP simulated the transport and deposition of airborne dust covering the dynamic meteorological conditions observed at the site during the monitoring period. The modelling considered range of particle dynamics that could affect the transport and deposition of dust in the atmosphere. However, settling rates of the influence of wave dynamics on the redistribution of dust particles were calculated.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers indicated that the total annual depositions are very small and wind and wave action will redistribute dust particles. In sensitive areas such as lake trout spawning beds, the greatest total accumulations of dust will occur over the bed closest to the SLDP site. The EAR predicted dust accumulation over the most exposed aquatic habitat in Snap Lake as a result of project activities to be 0.231 mm after 26 years; this is below the 1 mm effects threshold. This location was immediately adjacent to the mine and dust accumulation decreases with increasing distance from the mine. This prediction did not account for wind and wave action, which will be continually redistributing any dust that does enter the lake. Therefore, De Beers concluded that it is unlikely that after 26 years the total dust accumulation would result in adverse effects.

### *Conclusions*

Although not all wildlife species were considered in the analysis, De Beers evaluated those species of greatest concern to the Parties to the EA. These species also represented a wide range of sensitivity to chemicals. De Beers also evaluated the direct exposure to chemicals for a hunter or fisherman for a 25 year timeline, assuming a 30 days per year hunting and fishing effort, entirely within the LSA (i.e., in close proximity to the SLDP). Evidence presented by the NSMA indicated that throughout a single year, the majority (i.e., 62%) of the sample reported over one month of land use during a year. As such De Beers' assumption regarding the length of time a hunter or fisher would be on the land appears to be appropriate and conservative.

Similarly, based on conservative assumptions regarding dust fall onto Snap Lake, De Beers concluded that it is unlikely that over the mine life the total dust accumulation would result in adverse effects of fish habitat. Finally, previous sections of this Report of EA have concluded that no significant adverse impacts on fish or fish habitat are likely as a result of the enrichment of Snap Lake or multiple stressors causes by the SLDP itself. In the opinion of the Board, the environmental health analysis is likely to have overestimated environmental risks.

The Board appreciates the additional studies undertaken to better understand the effects of aluminum in soils on wildlife health, but does not agree with De Beers that further monitoring or risk assessment is not warranted, beyond the air and water quality monitoring programs that are already planned. Firstly, there is insufficient detail regarding the scope of the air and water quality programs in the EAR. Secondly, it is the opinion of the Board that De Beers must continue to demonstrate to the public that no significant effects on the health of wildlife and humans are occurring throughout the life of the project and in the post-closure phase.

The Board concludes that the effects of emissions from the SLDP on the health of humans and wildlife are not likely to be significant. The environmental health analysis conducted by De Beers addressed the concerns of the Parties to the EA and those of the Board. The analysis used reasonable assumptions and well accepted methodologies, where available. However, the Board is of the opinion that additional measures should be considered to ensure that impacts remain within acceptable levels and/or can be managed effectively in the future.



## *Suggestions*

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S28) The follow up and monitoring programs that will be carried out by De Beers should be utilized by the GNWT where appropriate to monitor adverse impacts on wildlife and human health.**

## **2.15 Biophysical Cumulative Effects**

This section relates solely to the assessment of cumulative effects on the biophysical environment, which includes the following components:

- Heritage resources;
- Traditional land use;
- Non-traditional land use;
- Aesthetic quality;
- Air quality;
- Noise;
- Hydrogeology;
- Hydrology;
- Water quality;
- Aquatic organisms and habitat;
- Geology and Terrain;
- ELC (vegetation) and biodiversity;
- Wildlife; and,
- Environmental health.

The assessment of cumulative effects related to socio-economic resources is discussed under the Economic and Socio-cultural headings of this report, in Sections 2.16 and 2.17 of this report.

### **2.15.1 Summary of Developer's Submissions**

#### **Cumulative Effects Assessment Approach**

The overall approach to cumulative effects assessment was described in the EAR and involved the following steps:

1. Identification of issues from a variety of sources and the development of questions based on these issues for consideration in the cumulative effects assessment;



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

2. Identification of linkages between residual impact on components due to the SLDP and one or more of the other projects identified in the EA Terms of Reference;
3. Undertaking analysis of cumulative effects based on the residual effects of other projects where linkages were found;
4. Describing cumulative effects using criteria such as magnitude, duration, geographic extent and reversibility; and,
5. Estimating the overall environmental consequence (i.e., residual impact classification) by combining magnitude, duration, geographic extent and reversibility.

The EAR examined cumulative effects on several aspects or questions relating to the cumulative effects on the environment, including: air quality, noise, hydrogeology, hydrology, water quality, aquatic organisms and habitat, terrestrial resources, geology and terrain, vegetation, wildlife and wildlife habitat, heritage resources, traditional land use, non-traditional land use, aesthetic quality and environmental health.

De Beers concluded that no linkages exist between the SLDP and cumulative effects on the following components. No adverse cumulative effects on these components are predicted as a result of the SLDP:

- Hydrogeology;
- Hydrology;
- Water quality;
- Aquatic organisms and habitat;
- Geology and terrain;
- ECL and biodiversity;
- Traditional land use;
- Non-traditional land use; and,
- Aesthetic quality;

De Beers identified linkages between the SLDP and the following components, and further assessment was carried out for these components:

- Air quality;
- Noise;
- Heritage resources;
- Environmental health; and,
- Wildlife.

De Beers' cumulative effects assessment for the five above listed components are briefly described below.



# **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

## **Air Quality**

De Beers demonstrated that the SLDP emissions after mitigation would result in changes to the ambient air quality. The results of the air quality model indicate that the cumulative impact from the SLDP will be confined to the LSA with negligible to low environmental consequence on air quality. De Beers' predictions suggest that the SLDP will contribute less than 20% to the cumulative air emissions from other projects in the Slave Geological Province. Predictions also suggest that the incremental increase in ground level concentrations of particulate matter and potential acid input due to SLDP is less than 3%.

Greenhouse gases are discussed under the Section 2.12.3.2.

## **Noise**

De Beers considered cumulative noise impacts from the SLDP and other mines and traffic noise on the Tibbitt-Contwoyto winter road.

De Beers concluded that there is no valid link between the change in environmental noise within the RSA and the SLDP and other existing and proposed projects (except part of the Tibbitt-Contwoyto winter road). Similarly, De Beers concluded that there was no valid link between cumulative noise impacts from the SLDP or the Tibbitt-Contwoyto winter road and primary communities, due to the large distances (50 to 100 km) between the primary communities and the SLDP and Tibbitt-Contwoyto winter road.

A valid linkage was established between cumulative noise impact and the Warburton Bay Lodge; however, De Beers concluded that the magnitude and overall environmental consequence of the impact would be low.

## **Heritage Resources**

With respect to cumulative impacts on heritage resources, De Beers considered site clearing, construction and infrastructure development associated with the SLDP and other mines, and annual construction activities associated with the Tibbitt-Contwoyto winter road.

In its EAR, De Beers states that Snap Lake is located in an area that has low archaeological potential. It states that results to date indicate that, provided the development proceeds as planned, no heritage sites are expected to be encountered during the construction and operations stages of the project. De Beers acknowledges that heritage resources are non-renewable and that development impacts to these resources are irreversible as a result. De Beers concluded that the cumulative impacts to heritage resources would be moderate, but that there will be an increase in the amount of heritage information available, as a result of the SLDP.





## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

### **Environmental Health**

De Beers examined the potential for cumulative wildlife and human health effects from the SLDP in combination with other projects and activities in the Slave Geologic Province, including the influence of transboundary pollution. Through a qualitative risk assessment approach, De Beers considered cumulative effects on environmental health related to changes to air quality, soil quality, water and snow quality, and plant/prey tissue quality. It concluded that it is highly unlikely that the SLDP would lead to an incremental increase in adverse wildlife and human health effects.

### **Wildlife**

De Beers concluded that cumulative impacts are likely to occur for caribou, grizzly bear, wolves and wolverines.

The assessment of cumulative impacts for caribou, grizzly bear, wolves and wolverines used a combination of qualitative and quantitative analysis to reach an overall conclusion regarding the likelihood of an adverse cumulative environmental effect on specific species. To a large extent, De Beers examined cumulative effects of the SLDP with only selected other projects and activities (e.g., other mines, portions of the winter road). De Beers did not consider all lodges, exploration, scientific and maintenance camps or other major projects within the Slave Geological Province in early stages of planning as these were deemed to be beyond the scope of the assessment and because in many cases, EAs had not been done or no project specific data was available.

Although De Beers concluded that cumulative impacts would occur for caribou, grizzly bear, wolves and wolverines, De Beers determined that the cumulative effects were of low overall consequence in each case. De Beers acknowledged that there exists a large degree of uncertainty in predicting many cumulative effects, but were of the opinion that the analysis did not underestimate these effects.

### **2.15.2 Summary of Responses from the Parties**

The Parties to the EA focused on cumulative effects from the perspective of wildlife, which is reflected in the following summary of responses from the Parties.

CARC questioned whether effects of extra traffic on the winter road due to the SLDP on caribou, wolverine, grizzly bears and other forms of wildlife were considered and inquired about the monitoring that is being done by the joint venture that operates the winter road and how De Beers proposed to be involved that monitoring. Although De Beers responded during the Hearing that the direct effects of increased traffic on wildlife were not addressed in the EAR, it is noted that the winter road and increased traffic were consideration in the assessment of direct and cumulative habitat loss, wildlife abundance and environmental health components of the EAR, and also considered in the assessment of accidents and malfunctions. With respect to effects on wildlife, DeBeers indicated that



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

the key issue is the timing of operations on the winter road, in relation to when the various wildlife species are in that area.

EBA Engineering Consultants, the company that provides consulting services to the winter road joint venture indicated that the joint venture, has recently received a renewal of their licence of occupation for the winter road and are putting into place an environmental management system, including a detailed description of environmental conditions at every portage along the road, an ice management system and a wildlife habitat assessment program, which is well underway. As part of planning for the future of the winter road, an assessment of the traffic has been completed. Without the SLDP, traffic along the winter road is predicted to increase to a maximum of twelve thousand (12,000) loads per year. The incremental increase in traffic associated with the SLDP is predicted to be in the order of four thousand (4,000) loads per year.

There was a broad consensus among the Parties to the EA, including GNWT that developer's baseline data were not sufficient to support the cumulative effects assessment or to provide a valid baseline for comparison against future monitoring programs. The key deficiencies identified related to the thoroughness and adequacy of caribou baseline studies. Most Parties, including GNWT, expressed concern that little quantitative analysis or use of available models was undertaken to support cumulative effect predictions or increase confidence in De Beers' conclusions.

The focus of most Parties to the EA were on cumulative impacts to caribou, grizzly bear, wolves and wolverines. Most of the Parties maintained that the overall cumulative effects ratings (i.e., low and medium) were underestimated. As noted previously, Parties to the EA were not unanimous in their recommendations for how the Review Board should respond to uncertainty. The majority of the Parties expressed a desire to see a strengthening of the mitigation, monitoring, and Adaptive Management Plans in order to reduce uncertainty and ensure that unpredicted environmental effects be avoided. The NSMA also suggested that remaining uncertainties prevented the Review Board from making a determination on significance of potential impacts from the project and identification of necessary steps to mitigate those impacts.

Key pieces of evidence presented by Parties to the EA at the Public Hearing included:

- Results of GLOBIO Cumulative Effects Modeling, presented by CARC in the form of mapping. CARC's modeling considered a much broader range of past, existing, reasonably foreseeable, and hypothetical projects than assessed by De Beers over a larger geographic area;
- A recent multi-year study entitled *Report on the Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)* (National Research Council, 2003);
- TK evidence that indicated that cumulative effects on caribou might occur within three to five years; and,
- Predictions by GNWT that cumulative effects on caribou may become measurable in 15 years.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

Most Parties to the EA expressed concerns regarding the status of region-wide cumulative effects monitoring and assessment initiatives stemming from the DIAVIK diamond mine project approval. CARC was particularly concerned about the lack of any announcement for funding in the 2003/2004 fiscal year. To this end, the Dogrib Treaty 11 Council suggested that the Board and government consider a development hiatus.

Concerns were expressed by several Parties that the commitments to monitoring and adaptive management made by De Beers are lacking in detail. Parties to the EA were in agreement that such details should have been presented in the EAR, but in their absence, could be incorporated into an Environmental Agreement. Most Parties to the EA were of the opinion that such an Environmental Agreement must be in place at least prior to the start of construction. There was also widespread consensus that any cumulative effects monitoring or management programs must involve Aboriginal groups in both program design and implementation, particularly with respect to the collection, use and interpretation of TK.

### **2.15.3 Key Issues**

The Board is of the opinion that that the key issues regarding biophysical cumulative effects are related to environmental health and wildlife. Several key issues related to wildlife were identified: direct and indirect wildlife habitat loss, effects on caribou movement, effects on carnivores (i.e., grizzly bear, wolves and wolverines mortality), and issues related to monitoring and integrated resource management. In the opinion of the Board, the resolution of issues relating to monitoring and integrated resource management is essential to the management of cumulative environmental or wildlife effects.

#### **2.15.3.1 Environmental Health Cumulative Effects**

##### ***Description of Issue***

De Beers examined the potential for cumulative wildlife and human health effects from the SLDP in combination with other projects and activities in the Slave Geologic Province.

De Beers noted that there is a lack of data from other projects in the vicinity that contribute to cumulative health effects and a lack of a generalized model of multiple stressor effects. Therefore, the analysis (risk assessment approach) was qualitative, integrating professional judgement and the available data from the EKATI and Diavik mines and from recent programs such as the Northern Contaminants Program.

De Beers assessed the cumulative effects of changes to air quality, soil quality, water and snow quality, and plant/prey tissue quality on wildlife health. De Beers concluded that it is highly unlikely that the project would lead to an incremental increase in wildlife disease, growth impairment or reduction in reproduction of wildlife as a result.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers concluded that there was no direct linkage between cumulative human health effects and air quality, water quality and plant tissue quality, therefore these parameters were not assessed in the cumulative effects assessment. De Beers examined the cumulative effects to human health related to eating meat from animals that may have been exposed to chemicals throughout the cumulative effects assessment study area. It concluded that it is highly unlikely that the project would lead to any incremental increase in adverse human health effects from people eating this animal tissue.

The Parties to the EA did not explicitly express concern over the cumulative environmental health effects assessment by De Beers. However, the GNWT did note that it is aware of concerns repeatedly being raised about dust having cumulative effects:

*“We’ve heard this over a number of years, and the Department is now working with stakeholders to try and come up with some more definitive information on the effects of -- of dust, and the relationship is that the dust lands on the caribou forage, and particularly lichens, are very efficient at scavenging metals, so we’ll be investigating this further. We simply recognize the concern, and the need for extremely stringent measures in mitigation the effects of dust.”*

(Anne Gunn, GNWT, Public Hearing Transcripts, Day 4, May 1, 2003, p. 193)

### **Conclusions**

The Board notes the lack of data from other projects in the vicinity that contribute to cumulative health effects on humans and wildlife, and the lack of a generalized model of multiple stressor effects from other developments in combination with the SLDP. Therefore, the Board is of the opinion that an exact quantitative measure of the residual adverse cumulative effects from the combined exposure to chemicals is not possible at this time.

The Board agrees with the qualitative assessment conducted by De Beers and concludes that the SLDP is not likely to be a significant contributor to regional cumulative effects on human and wildlife health.

### **2.15.3.2 Wildlife Cumulative Effects**

#### **2.15.3.2.1 Cumulative Effects - Direct and Indirect Wildlife Habitat Loss**

##### ***Description of Issue***

De Beers’ EA predicted the direct habitat loss on caribou based on the relationship between the home range size of the Bathurst Herd (estimated at 250,000 km<sup>2</sup>) and expected habitat loss due to the SLDP and other project footprints located within the home range. Cumulative direct habitat losses were estimated at 0.1% for caribou.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers' EA predicted the direct habitat loss to carnivores such as grizzly bear, wolves and wolverines based on the relationship between the home range size of individuals and expected habitat loss due to the SLDP and other project within the home range. Cumulative direct habitat losses were estimated at up to 2.5% for grizzly bear, 3.5% for wolves, and between 9.7% and 31.0% for wolverines.

De Beers reviewed other studies that examined the relationship between the loss of suitable habitat and landscape type to population trends. De Beers determined that a decrease in species abundance and diversity may be observed when the amount of suitable habitat lost exceeds a threshold value of 40% to 90%.

Evidence provided by CARC in the form of GLOBIO Cumulative Effects Modeling considered a much broader range of projects than assessed by De Beers. The projects included by CARC in analysis were distributed over a larger geographic area and over a longer period of time (both past and future). For example, De Beers considered the cumulative direct habitat loss for caribou for the EKATI™ Diamond Mine and expansion, Diavik Diamond Mine, Tahera Jericho Diamond Mine, Lupin Gold Mine and the Tibbitt-Contwoyto winter road. The CARC analysis also considered past and existing projects such as the Snare Rapids Reservoir, hydro-electric rights-of-way, past producing mines, advanced exploration sites, settlements, etc.

The evidence provided by CARC in the form of GLOBIO Cumulative Effects Modeling indicated that the SLDP footprint would represent approximately 2.2% of all existing project footprints in the Slave Geologic Province (i.e., direct cumulative habitat loss). When zone of influence buffers are attributed to these footprints (i.e., direct and indirect habitat impacts), the cumulative area influenced within the Slave Geological Province ranged from 1.1% for areas where there is a high risk of reduced abundance of most biodiversity, to 14% for areas where there is a high risk of impacts on species and food chains. When these same buffers were applied to a high induced development scenario, the area predicted to be influenced by cumulative effects ranged from 1.9% for high risk of reduced abundance of most biodiversity, to 18% for areas where there is a high risk of impacts on species and food chains. The GLOBIO Cumulative Effects Modeling results presented by CARC did not relate the cumulative affected area to the home range sizes of caribou, grizzly bear, wolf or wolverine to expected habitat loss.

### ***Conclusions***

The Board acknowledges that De Beers has minimized the SLDP's footprint and the resultant direct loss of habitat, by using underground mining, and minimizing the size of the North Pile.

The Terms of Reference for the EA requested that De Beers consider existing forecasting models of cumulative infrastructure development where such models were available.

In response to a question from the Board, De Beers confirmed that it did not conduct any analysis of cumulative effects of the SLDP using a model other than the Hegmann *et. al.*, process provided by



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

the Canadian Environmental Assessment Agency. De Beers also advised the Board that the GLOBIO model merely predicts the growth of projects but does not provide a mechanism for assessing actual effects.

The Board does not agree with the rationale provided by De Beers in the EAR regarding the applicability or usefulness of the GLOBIO Cumulative Effects Model. In the opinion of the Board, the application of some form of quantitative modelling in combination with data on home ranges of individual species would have allowed De Beers to consider a broader range of projects in its cumulative effects assessment. This would have provided the Board with additional quantitative information regarding cumulative direct and indirect habitat losses. In the opinion of the Board, De Beers was remiss in dismissing available quantitative models as analytical tools in its assessment of cumulative effects. The application of some form of quantitative model, even to make predictions of the growth of projects in the future, would have been more consistent with De Beers' claims that it has not underestimated cumulative effects.

De Beers' assessment was limited to the cumulative impact from direct habitat loss. From an ecological perspective, it would have been more appropriate to also include the influence of indirect impacts on habitat, which would account for changes in habitat use resulting from disturbance, not just direct footprints. The GLOBIO model used by CARC considers both the direct and indirect influence of various types of development. The Board recognizes that the GLOBIO model does not necessarily reflect effects that would be observed in the field, but considered the GLOBIO analysis helpful in addressing both direct and indirect effects of a wide range of developments.

Taking into account a broad range of projects both within and outside of the home ranges of species affected by the SLDP, and the GLOBIO analysis that addressed indirect habitat effects, the evidence presented indicates that the cumulative direct and indirect impacts on wildlife habitat as a result of the SLDP are likely to be greater than predicted by De Beers. For example, the evidence presented by De Beers indicates that the cumulative direct habitat loss for wolverines as a result of the SLDP is likely to be greater than 9.7% but less than 31.0%, depending upon the home range size for an individual. Taking into account direct and indirect habitat impacts from a broader range of projects both within and outside of the home ranges of individuals, the Board concludes the cumulative effect on habitat is likely closer to 31%.

Nevertheless, the Board concludes that the direct and indirect habitat effects associated with the SLDP are not likely to be significant because the area likely to be lost to wildlife (i.e., direct habitat loss) is considered to be negligible relative to the wildlife habitat available at the level of the Slave Geological Province. The area of direct and indirect wildlife habitat disturbance has been limited by development of an underground mining program and can be further limited through effective mitigation measures and continual improvement in environmental performance at the mine site. Loss and disturbance of habitat is also expected to be reversible over the long term. The CARC presentation of a GLOBIO analysis for the Slave Geological Province indicated that there may be up to 18% of the region impacted under a high development scenario. Notwithstanding the criticism of the GLOBIO, the Board is of the view that this information shows that the Slave Geological Province



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

can no longer be considered a completely pristine environment. The GLOBIO results suggests that long-term planning should begin now to ensure that significant adverse impacts on wildlife habitat and populations do not occur in the future.

The Board notes that De Beers attempted to set thresholds in its analysis in order to decide whether a significant adverse cumulative environmental effect is likely to result from its proposed project. In the opinion of the Board, the development of such thresholds for a variety of species would serve to provide an objective measure for future cumulative effects assessments and could provide a degree of certainty for developers, conservation organizations and local communities.

The Board concludes that the SLDP in combination with other developments is not likely to have a significant adverse cumulative effect on wildlife habitat. However, the Board is of the opinion that additional measures should be considered to ensure that impacts on the environment remain within acceptable levels and can be managed effectively in the future.

### *Suggestions*

**Based on the above conclusions, the following suggestions should be considered for implementation:**

**(S29) The GNWT should develop cumulative effects thresholds relating to direct and indirect habitat loss for various wildlife species of management concern (e.g., caribou, grizzly bear, wolf, wolverine) as a wildlife management tool for use in responding to development in the Slave Geological Province.**

**(S30) The GNWT should within 24 to 36 months develop a standard methodology or model for quantifying direct and indirect wildlife habitat loss. The GNWT should encourage developers of future developments to utilize these models for purposes of impact assessment.**

### **2.15.3.2.2 Cumulative Effects - Caribou Population and Movement**

#### *Description of Issue*

De Beers concluded that the migratory movement of caribou is unpredictable. The number of caribou traveling through the potential zone of influence is highly variable from year to year. Natural variation in caribou movement is closely related to the extent of insect harassment, predation and forage quality.

Data presented by De Beers indicated that between 1,200 and 30,000 caribou have traveled through the RSA of the SLDP each year between 1999 and 2002. Estimates in the EAR were that less than 1% of the Bathurst Herd pass through the RSA; 30,000 animals would be closer to 10% of the herd. The large variability in survey numbers over a relatively short period of time indicates that it is



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

possible that more than 30,000 animals could migrate through the study area in some years. As mentioned previously, De Beers acknowledged that localized avoidance of the SLDP site is likely, but also indicated that caribou in general tend to avoid the types of terrain and habitat in the vicinity of the SLDP site. De Beers predicted that a 10% decrease in foraging time for those individuals that travel through the zone of influence of all four mines would result in a 0.24% to 0.64% reduction in feeding opportunities within the Bathurst Herd. Together, the mines would effect 2% to 6% of the Bathurst Herd each year, but that this effect would not likely be detectable from cumulative influences of winter and summer forage quality, weather conditions, insect abundance and predation.

Evidence provided by GNWT confirmed that avoidance of the SLDP site can be expected. Migratory movement of caribou is predictable, but not with the specificity needed, such that the number of caribou potentially exposed to the SLDP and other developments within their home range is highly variable from year to year. For example, GNWT cited experiences at other mines, where avoidance of project sites has been observed. GNWT also commented that in 1997 at the EKATI site, a peak of 300,000 caribou was observed, which far exceeded EKATI's baseline information, confirming the wide range of natural variation. Furthermore, Jean Teillet, Legal Counsel to the Dogrib Treaty 11 Council indicated that in Grand Chief Joe Rabesca's lifetime, he has seen thousands of caribou move through the Snap Lake area.

*"...the Grand Chief said...was telling me the other day, and was going to tell you, so I'm going to tell you what he said, that in his lifetime, he's seen thousands of caribou through this area. So -- and also, that the caribou move, so just the fact that they haven't been there for the last few years to the Grand Chief means nothing. They could all be there tomorrow...next year."*

(Jean Teillet, Legal Counsel to Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 4, May 1, 2003, p. 170)

Most Parties to the EA, including GNWT, concluded that baseline data were not sufficient to support the cumulative effects assessment or to provide a valid baseline for comparison in future monitoring programs. The key deficiencies identified related to the thoroughness and adequacy of caribou baseline studies. For example, several Parties noted that:

- The coverage of study area and timing of aerial surveys was inadequate;
- Only two years of baseline data were used by De Beers to determine natural variability of caribou abundance near the SLDP site;
- Changes in activity patterns and movement paths in the vicinity of the SLDP site and access roads were not analyzed; and,
- Quantitative analyses of impacts on caribou energetics and demographics were not undertaken despite the availability of tested quantitative models that would likely yield reliable results.

Many Parties, including GNWT expressed concern that little quantitative analysis or use of available models was undertaken to support cumulative effect predictions or increase confidence in





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

conclusions. This concern was elevated because examples of such quantitative work existed with Diavik, the WKSS and EKATI. Several Parties to the EA noted that De Beers conducted little analysis on historic caribou trail data, and that the ENERGETICS modelling approaches developed for the Porcupine Caribou Herd and applied during the Diavik assessment were not used. De Beers did not consider these models to be validated and indicated that their use might cast suspicion about the credibility of scientific methods:

*“...using models with little or no validation has a high risk of undermining the credibility of scientific analysis with First Nation communities and holders of Traditional Knowledge.”*

(De Beers response to Review Board request of April 4, 2003)

Upon questioning from the Board, GNWT indicated that the ENERGETICS and POPULATION models developed using empirical data from migratory caribou and applied during the Diavik assessment could have been applied to the SLDP using recent Bathurst Herd data. GNWT was confident that because these models have undergone validation, looking at different scenarios and putting in different data, their results would be reflective of field observations. GNWT indicated that the use of these models would have indicated of the possible implications of cumulative effects on long-term caribou population trends.

Most Parties to the EA agreed that the methodological concerns identified above created a high level of uncertainty. De Beers' EAR acknowledges that considerable uncertainty exists, but in its presentation at the Public Hearing re-affirmed its position that impacts were not underestimated.

The YKDFN, LKDFN, and Dogrib Treaty 11 Council presented evidence with respect to caribou movement that suggested that movement and behaviour has been unpredictable lately and that some Elders have observed subtle changes in caribou behaviour. Others noted that caribou have not been migrating close to their communities as they have in the past. For example, a Denesoline Elder indicated:

*“On the south side of our area, there has been... no caribou in two years, even ‘til today...I don't know why we haven't got caribou on that side. There we used to get Bathurst herd and Beverly herd and now there's nothing out there in our area for two years...it is the first time it ever happened”.*

(August Enzoe, LKDFN, Public Hearings Transcripts, Day 4, May 1, 2003, page 235)

The Dogrib Treaty 11 Council referred the Board to a recent multi-year study entitled *“Report on the Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)”* (National Research Council, 2003). The study contains evidence that the extensive network of roads, pipelines and oil/gas facilities has interfered with caribou movement to the extent that adverse cumulative effects were detected, including a shift in calving areas and movement patterns when compared with caribou herds in areas where there was no development.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*“With the gradual loss of access to preferred foraging habitats, increasingly more females seek “next best” available areas. As those areas become insufficient to accommodate the population, use declines at a rate proportional to the increase in density of structures” (National Research Council, 2003)*

*“Avoidance of expanding infrastructure triggered changes in distribution that progressed from localized adjustments, to major shift in the use of habitats.” (National Research Council, 2003)*

The Dogrib Treaty 11 Council best articulated the implication of this type of cumulative effect.

*“... the Dogribs are not so worried about the initial localized adjustment, what they're worried about is the major shift that might come down the road and what will that cost be to the Dogribs and to all the other Aboriginal people who rely on the caribou. And we say that that would be an almost inestimable damage to them.”*

(Jean Teillet, Legal Counsel to Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 4, May 1, 2003, page 172)

Several Parties to the EA indicated that the GLOBIO cumulative effects modeling conducted by CARC of a high induced development scenario within the Slave Geologic Province demonstrated that a “wall” of development is forming, implying that cumulative effects similar to those noted in Alaska are likely to occur here. De Beers indicated that the experience from Alaska is noteworthy, but that the type and intensity of development there is markedly different from that in the Slave Geologic Province.

Overall, GNWT noted that cumulative effects on caribou may become measurable in 15 years, while others indicated that changes are already occurring and may become noticeable within three to five years.

*“In a few years, the caribou will change their route again. They will go a different way. They will be disturbed by the winter road, planes and blasting. You will see [these changes] in 3-5 years from now.”*

(Florence Catholique, LKDFN, quoting an Elder Louis Abel (2001), Public Hearing Transcripts, Day 4, May 1, 2003, page 231)

*“Now, we've already told you that... the Dogribs... are confirming, or perhaps adding their analysis to -- or stories to what Lutsel K'e and the Yellowknives have already told you, which is that they see changes...in the Caribou Herd.”*

(Jean Teillet, Legal Counsel to Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 4, May 1, 2003, p. 170)

### Conclusions



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

In the opinion of the Board, the weight of evidence suggests subtle changes may already be occurring in the environment and on caribou movement. Impacts on foraging behaviour may influence the energetic balance of individual caribou, and consequently overall population dynamics, if the duration and number of affected individuals is great. Impacts on movement patterns have the potential to influence both caribou energetics and community hunting opportunities if large changes in movement pattern occur. As such, the Board must ensure that each additional impact is justifiable and does not cause a significant cumulative impact. In this context, government and industry must begin to fulfill their adaptive management responsibilities and undertake the work necessary to satisfy the public that the well-being of the caribou herds is being given due attention.

The Board recognizes that the best way for any developer to avoid cumulative effects is to avoid or minimize direct effects of the project. To this end, the Board acknowledges that in comparison to existing diamond mines in the NWT, De Beers has taken extensive measures to minimize the SLDP footprint and related disturbances to wildlife through site design. The Board expects that continued improvement and adaptive management through the implementation of De Beers' Environmental Management System will serve to further improve the site's overall environmental performance and reduce disturbance to wildlife. The Board is convinced that little more can be done by De Beers alone to minimize the disturbance of the SLDP to wildlife and avoid the potential for major shifts in migration patterns from multiple disturbances in the region.

Notwithstanding this conclusion, the Board is of the view that more could have and needs to be done by De Beers in cooperation with others to understand the behavioural response of individual caribou to development, and how the herd as a whole might respond to multiple disturbances in the region (i.e., major shifts in migration patterns).

It is also the Board's opinion that the De Beers should have considered individual and population-level effects of a broader range of developments in the Slave Geological Province during its cumulative effects analysis. De Beers should have provided quality baseline information supported by TK, to increase the precision of impact predictions and improve adaptive management efforts during project development. A more robust analysis of various development and environmental scenarios using several lines of inquiry to make a more conservative estimate of indirect habitat impacts (i.e., use of EKATI data to make predictions using the ENERGETICS and POPULATION models, use of the GLOBIO or other zone of influence methods), as well as more extensive use of TK and academic research and literature would have increased the Board's confidence in De Beers' conclusions.

Therefore, in considering the evidence presented, the Board agrees that the deficiencies identified by the Parties are important. It is the opinion of the Board that De Beers was remiss in choosing not to conduct more appropriate baseline studies, apply existing quantitative models in its cumulative effects assessment and adequately integrate Traditional Knowledge into its assessment. However, it is also the opinion of the Board that the rectification of all deficiencies in the baseline database is not possible by De Beers alone.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

During the Public Hearing, the GNWT alluded to limitations of the existing scientific data for examining the potential impact of individual projects on caribou movement.

*“We did undertake an analysis to see if we could...look at the effect of any particular site on movements, and we came up with no statistical relationship, but just a couple of hints. Since then we changed the satellite collars so they're now reporting every day, during the period of July and early August. Once we have another year's information, we will be analyzing it, to look at the probability of the caribou, and their dispersion around any particular sites.”*

(Dr. Anne Gunn, GNWT, Public Hearing Transcript Day 4 (May 1, 2003), p. 189)

The Board is of the opinion that more comprehensive baseline information and additional analysis could have verified what we can derive from available scientific and Traditional Knowledge, and experience from existing diamond mines, namely:

- Migratory movement of caribou is variable and difficult to predict;
- Number of caribou traveling through the potential zone of influence is highly variable from year to year; and,
- Movement patterns and energetic limitations are closely related to the extent of insect harassment and range condition.

The weight of evidence suggests subtle changes are already occurring in the environment and caribou movement patterns, and that continued disturbance of caribou migratory habitat may likely result in a significant cumulative effect in the future. However, the evidence from this proceeding does not convince the Board that the SLDP in itself will cause a significant adverse cumulative impact on caribou movement at this point. The Board agrees with De Beers and GNWT that the incremental change in movement caused by the SLDP in combination with other projects listed in the Terms of Reference, is anticipated to be within the range of natural variation exhibited by caribou.

The Board is also confident at this point that the intensity of past and existing development in the Slave Geological Province is not comparable to that on the North Slope of Alaska. Evidence presented at the Hearing indicated that the Alaska study focused on total development footprint of 70 to 80 km<sup>2</sup> in an intensively used area of 2,600 km<sup>2</sup> (i.e., approximately 3% of the Alaskan study area). Also, the cumulative effects modeling conducted by CARC indicates that total past and existing development footprints (including the SLDP) within the Slave Geological Province is approximately 300 km<sup>2</sup> of a 211,000 km<sup>2</sup> study area (i.e., approximately 0.14%). Moreover, the Board agrees that the types of infrastructure and development found on the Alaskan North Slope is currently different than that in the Slave Geological Province.

These conclusions notwithstanding, the Board is of the view that the potential for significant adverse cumulative effects exists. Although the intensity of future development in the Slave Geological Province may not approach levels on the Alaskan North Slope for some time, the high-induced development scenario presented by CARC strongly suggests that there is potential for the intensity of



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

development in the Slave Geological Province to increase substantially within the anticipated life of the SLDP. If all development predicted in the “high-induced” GLOBIO results occurs, then significant adverse cumulative effects are possible. The Board notes, however, that rigorous testing of the GLOBIO results is required.

In summary, the Board concluded that De Beers has not provided sufficient evidence to adequately demonstrate that a significant adverse impact of the SLDP in combination with other developments on caribou population and movement will not occur. The Board also concludes that significant adverse cumulative effects on caribou population and movement are possible in the future. Given the available evidence, the Board concludes that precautionary measures must be implemented to prevent such an significant adverse impacts from occurring.

### ***Recommendations***

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R19) De Beers shall design and implement a pre-construction baseline data collection program for caribou within the RSA, in cooperation with the GNWT, Aboriginal groups, and renewable resource users. This program shall be designed such that it can contribute to regional monitoring initiatives.**

**(R20) De Beers shall design and implement a specific monitoring program to detect effects of the SLDP and the Snap Lake winter access road on caribou behaviour. The requirement for this program shall be included in the Environmental Agreement.**

**(R21) The GNWT shall, within 24 to 36 months, develop a model that detects and evaluates the effects of development on caribou movements and populations in the Slave Geological Province. This model shall enable the setting of thresholds of allowable caribou disturbance for use in future EAs in the Slave Geological Province**

### **2.15.3.2.3 Cumulative Effects - Direct Carnivore Mortality**

#### ***Description of Issue***

In its February 2003 Technical Report, the GWNT indicated that the greatest potential impact on carnivore populations was from direct mortality. In this Technical Report, the GNWT recommended that De Beers use recently published information on grizzly bear population demographics and population viability to reassess the impacts of its project on the grizzly population. The GNWT was of the opinion that the grizzly bear population in the Central Arctic was susceptible to decline if increases in annual mortality were incurred. The Board agreed that such information was important to address the potential cumulative effects on grizzly bears, so it requested this information. An analysis was submitted by De Beers to the Public Record in April 2003. A similar analysis for



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

wolverines was requested from the GNWT by the Board. The GNWT replied by indicating that there was not currently sufficient information on wolverine population demographics to conduct a population viability analysis.

De Beers' analysis for grizzly bears indicated that in a worst case scenario, where the SLDP failed to improve the record of industry-related grizzly bear mortalities, the SLDP would contribute 0.5 mortalities/year to the cumulative (i.e., industry and non-industry) grizzly bear mortalities in the Slave Geological Province. This would amount to 13 bears over the 26 year mine life. Such an increase in the annual removal rate would still be below the maximum cumulative removal rate of 15 bear/year recommended by McLoughlin *et al.*, (2003b)<sup>12</sup>. De Beers has indicated that such a worst case is “...an unacceptably high impact on the environment and an overestimate that is unwarranted given the efficacy of current mitigation methods” (De Beers Canada Mining Inc., response to Review Board request from April 4, 2003).

De Beers indicated that during the past 14 years of De Beers' presence in the NWT, there have been two instances of bear mortality attributable to De Beers - one black, and one grizzly bear. Also, De Beers stated that “*While we cannot absolutely guarantee to meet that objective [i.e., near zero mortality] over the 25 year life of the mine, our considered expectation is that we will be very close.*” (John McConnell, De Beers, Public Hearing Transcript, Day 5, May 2, 2003, page 306)

To this end, De Beers concluded that taking into account the effectiveness of current mitigation and management practices, cumulative adverse impacts on grizzly bears would not be significant, and would likely be within range of natural variation. The GNWT indicated that reports of losses from other mines may be inaccurate and do not necessarily account for all forms of losses (e.g., problem, accidental and illegal kills).

During the November-December 2002 Technical Sessions, GNWT agreed with De Beers regarding the number of grizzly bears with home ranges that overlap the RSA. GNWT disagreed that impact on grizzly bear was low. GNWT indicated that hunting quotas in Nunavut and problem kills associated with mining and outfitters already contribute to at least 14 bear mortalities per year across the Slave Geological Province.

GNWT agreed that because bear kills by humans is the most significant threat facing bears in the central barrens, there is a need to minimize the potential for bear kills at the mine site through effective waste and odour management measures. The main concern of GNWT was that no specific details for a waste management plan were submitted by De Beers. GNWT suggested that it was not reasonable to assume that carnivore mortality would be near zero without a fully developed waste management plan in place. GNWT suggested that mortality rates could, therefore, be much higher than predicted by De Beers. This issue also raised concerns about potential impacts on wolverine populations.

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<sup>12</sup> McLoughlin, P.D., M.K. Taylor, H.D. Cluff, R.J. Gau, R. Mulders, R.L. Case, S. Boutin, and F. Messier. 2003. Demography of barren-ground grizzly bears. *Canadian Journal of Zoology*. 81:294-301



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### *Conclusions*

The Board reiterates its observation that De Beers has taken extensive measures to minimize the SLDP footprint and related disturbances to wildlife from the project site. The Board recognizes that continued improvement and adaptive management through the implementation of De Beers' Environmental Management System may further improve the site's overall environmental performance and reduce disturbance to wildlife. The Board however had no evidence that demonstrates that De Beers' Environmental Management System has in the past or will in the future serve this function.

Notwithstanding these conclusions, available evidence indicates grizzly bears and wolverines are found in low densities in the area. Their home ranges cover a large geographic area and these animals are susceptible to impacts by a wide range of developments. They are also indicators of overall environmental health. Grizzly bears and wolverines are both species listed by Committee on the Status of Endangered Wildlife in Canada and must therefore be managed with care.

In the opinion of the Board, mortality is of greater concern for bears and wolverines than are habitat effects. The Board concludes that in relation to the mining operations within the Slave Geological Province, mortality is most likely to be associated with improper waste management procedures, poor environmental awareness, and training of employees and contractors. Without having been provided with explicit details of De Beers' waste management and employee environmental awareness and training programs, the Board is not convinced that De Beers' will be successful in achieving a near-zero grizzly bear and wolverine mortality rate. The Board also lacks evidence that waste management practices at other mine sites are effectively achieving a near-zero bear mortality rate elsewhere. Moreover, the Board is concerned about the lack of good data regarding the grizzly bear losses in the Slave Geological Province. Finally, the Board is of the opinion that the scale and intensity of De Beers' pre-development activities have been relatively small when compared to those anticipated for SLDP. Consequently, the risk of grizzly bear mortality is higher at the development stage.

The Board is concerned that with increasing development and human activity in the Slave Geological Province that the future grizzly bear loss in the area may exceed that maximum cumulative removal rate of 15 bears per year as recommended by McLoughlin *et al.*, (2003b). The Board also notes that the threshold of 15 bears per year is merely an estimate that requires additional scientific study. Further, the McLoughlin *et al.*, (2003b) estimate does not account for illegal, unreported kills. Therefore, the actual threshold may in fact be less than 15 bears per year. The Board agrees with GNWT's comments during the November-December 2002 Technical Sessions that an increased level of mortality may not be sustainable over the long term.

The Board is also concerned about the lack of information regarding the population size and natural variation in wolverine populations in the Slave Geological Province. At present, the Board is not aware of any credible threshold that could be applied to determine the significance of the effects of



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

the SLDP and other projects on wolverine populations. De Beers has not provided sufficient evidence to convince the Board that the mitigation measures and adaptive management approach proposed for the SLDP, and in place at other mines, are effective to minimize mortality rates of wolverine. The Board is convinced that, with increasing development and human activity in the Slave Geological Province, the removal rate of wolverine will increase. Given that wolverine are a listed species, and the absence of information necessary to complete a population viability analysis, the Board is of the opinion that it is prudent to act with caution.

The Board concludes that De Beers has not provided sufficient evidence to adequately demonstrate that a significant adverse impact of the SLDP in combination with other developments on grizzly bear and wolverine populations will not occur. Without additional data or analysis, the Board concludes that precautionary measures must be implemented to prevent significant adverse impacts from occurring.

### ***Recommendations***

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

**(R22) De Beers include, as part of its on-site Wildlife Management Plan, an awareness and training program designed to reduce carnivore mortality at the site.**

**(R23) De Beers shall design and implement a pre-construction grizzly bear and wolverine baseline monitoring program, in cooperation with the GNWT and in consultation with renewable resource users within the RSA.**

**(R24) The GNWT shall develop a standardized set of procedures for monitoring grizzly bear, and wolverine populations, behaviour and movement, for use at the SLDP and other developments in the Slave Geological Province. These procedures shall be developed in consultation with TK holders and made available to De Beers and others within 24 months.**

**(R25) GNWT shall evaluate the likelihood of adverse cumulative effects on grizzly bear and wolverine populations in the Slave Geological Province. Based on this information, the GNWT shall develop a quantitative threshold of allowable bear and wolverine mortality for use as an indicator of likely significance for future EAs. This work shall be completed within 24 months.**







Review Board environmental assessment officers, (from left to right) Alan Ehrlich, Sherry Sian, Martin Haefele, and Snap Lake environmental assessment coordinator, Glenda Fratton of Gartner-Lee Ltd., during a site visit to the De Beers Canada Mining Inc Snap Lake Diamond Mine.

#### 2.15.3.2.4 Cumulative Effects - Monitoring and Integrated Resource Management

##### *Description of Issue*

De Beers acknowledges that considerable uncertainty exists regarding cumulative effects assessment and management. De Beers has committed to participation in regional initiatives to develop cumulative effects monitoring and have indicated that data will continue to be collected in a form and manner compatible with present monitoring activities in the Slave Geological Province. Moreover, De Beers has indicated that all environmental monitoring programs will be incorporated into an Environmental Agreement to support an adaptive management strategy.

With respect to adaptive management, the NSMA noted that

*“...there is a complete absence of concrete monitoring plans and insufficient evidence in the EAR] to demonstrate that De Beers can develop adaptive management plans. Without complete baseline data, the NSMA cannot accurately assess the effectiveness of adaptive*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*management plans to mitigate impacts on wildlife*". Kris Johnston, NSMA, Public Hearing Transcript Day 4 (May 1, 2003), p. 152.

Other Parties, particularly the Dogrib Treaty 11 Council and CARC expressed concerns that monitoring was the only commitment made by De Beers and the only measure discussed by other government Parties to deal with cumulative effects. The following quote from the Dogrib Treaty 11 Council illustrates the importance of going beyond monitoring as a response to potentially significant cumulative effects:

*"If indeed, the caribou are already being effected in a minor way, and the slippery slope we're sliding down here is leading to major effects on the caribou, then monitoring is simply going to provide us with ring side seats, and high powered magnifying glasses with which we can more closely observe the long, slow destruction of these magnificent caribou herds. Monitoring will do nothing to mitigate development effects, nothing to save the herd, and nothing to save the lifestyle of the Aboriginal people who rely on those herds."* Jean Teillet, Dogrib Treaty 11 Council, Public Hearing Transcripts, Day 5 (May 2, 2003), p. 266.

Overall, a variety of Parties to the EA also expressed concerns that:

- Decisions about industrial activities in the Mackenzie Valley are made by territorial, federal, and now, by Aboriginal bodies, while communication and coordination among these bodies is often sporadic;
- EA, licensing, and permitting decisions have been happening on a case-by-case basis without the benefit of a comprehensive Mackenzie Valley-wide land use plan to guide the scope, intensity, direction, or consequences of development;
- Project specific rehabilitation of disturbed habitat is also planned without an overall plan to identify valley wide land use goals, objectives, performance criteria, or monitoring requirements; and,
- Little consideration has been given to understanding how different future trajectories would be viewed by different groups, especially by Aboriginal people and building agreement on the preferred development scenario(s).

The Dogrib Treaty 11 Council suggested that the Board and government consider the SLDP as the last project that could be supported in the area, and that a development hiatus should be taken until there is sufficient information to determine the effect of the existing development on the environment. This development hiatus would also allow time for comprehensive planning in the Mackenzie Valley.

CARC also identified the need for effective monitoring and integrated resource management to address the possible cumulative effects of multiple developments in the Slave Geological Province and beyond. Both the Dogrib Treaty 11 Council and CARC called for public reporting by INAC of inspection reports relating to permits and licences in the NWT. INAC's policy regarding release of inspection reports to the Mackenzie Valley Land and Water Board's Public Registry is that where



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

there are no unresolved issues, inspection reports are routinely provided to the Mackenzie Valley Land And Water Board, which places them on the Public Registry. Where there are issues as yet unresolved, copies are not provided to the Mackenzie Valley Land And Water Board, until acceptable corrective action is at least agreed to, and a credible commitment made.

There was widespread consensus that any cumulative effects monitoring or management programs must involve Aboriginal groups in the design and implementation, particularly with respect to the collection, use and interpretation of TK.

To this end, the Dogrib Treaty 11 Council recommended that a valley-wide land use plan be developed to guide industrial development and provide a shared vision for the Mackenzie Valley. The Board heard that a comprehensive inventory of past and existing industrial facilities is required, including an assessment of the nature and extent of existing contamination. It was further suggested that the land use plan must identify development goals and thresholds based on a thorough assessment of a wide range of development scenarios on the environment, giving substantial weight to the needs of Aboriginal groups regarding their subsistence harvesting activities.

INAC stated at the Public Hearing that a Cumulative Effects Assessment and Management Framework has been completed, along with a blueprint for implementing the framework. Documentation is publicly available on various websites. The framework and blueprint provide a detailed, step-by-step approach for the ongoing monitoring and management of cumulative effects in the NWT. One of the recommendations is the creation of a regional monitoring agency to move away from project specific agencies or ad hoc monitoring programs. INAC informed the Board of the discussion taking place regarding the potential for a NWT-wide monitoring agency that would include in its mandate the NWT portion of the Slave Geological Province.

Parties to the EA expressed concern throughout the Hearing about the lack of understanding in regards to the cumulative environmental effects in the Slave Geological Province, particularly from a wildlife perspective. During the Public Hearing, the question was raised about the possibility of establishing an NWT-wide monitoring agency as an *“arms-length Crown Corporation...that would incorporate the environmental sciences, and the traditional knowledge network required to support sound decision making in the NWT”* (David Livingstone, INAC, Public Hearing Transcript, Day 4, (May 1, 2003), p. 214). The developer has a responsibility to gather sufficient information to support a cumulative effects assessment but Parties to the EA for the SLDP also expressed the concern about the status of coordinated cumulative effects monitoring and assessment within the **Slave Geological Province**. The suggestion of a NWT-wide research based institute was raised as a possible solution in providing coordinated baseline information to more effectively deal with cumulative effects assessment within the Slave Geological Province.

Concerns were expressed by CARC that the development and implementation of the Cumulative Effects Assessment and Management Framework and other critical components of this work have not proceeded in an expeditious manner over the past several years. INAC was unaware of the funding allocated to this initiative for the present year and could not confirm funding would be available for



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

the balance of the year or beyond. De Beers confirmed at the Public Hearing that it is prepared to commit time and effort towards the implementation of this initiative, but did not indicate to the Board that funding was a possibility.

### ***Conclusions***

The Board agrees with the concerns expressed by several of the Parties to the EA that the commitments to monitoring and adaptive management made by De Beers lack detail. Although the Board would have preferred that detailed monitoring and adaptive management programs be presented as evidence during the EA process, the Board is confident that such details can be worked out and should be incorporated into an Environmental Agreement.

The Board supports the development of an Environmental Agreement between De Beers and the Governments of Canada and the Northwest Territories and others. The Board is of the opinion that such an Agreement can play an important role in developing new environmental management initiatives as part of a co-operative approach to achieve sustainable development.

The Board is also of the opinion that effective environmental management in the NWT requires a comprehensive and mature environmental regulatory regime. Environmental agreements provide a useful mechanism to ensure that commitments to environmental monitoring and adaptive management made by De Beers, that cannot be included in regulatory instruments, are implemented and effective over the life of the project. However, in the opinion of the Board, reliance by government and industry on Environmental Agreements negotiated with individual developers does not provide for comprehensive environmental management, particularly for cumulative effects management in the Slave Geological Province.

The Board notes that under Part 6 of the MVRMA, INAC has an obligation to analyze scientific data and TK data for the purposes of monitoring the cumulative impact of concurrent and sequential uses of land and water, and deposits of waste in the Mackenzie Valley. To this end, the Board stresses that any cumulative effects monitoring or adaptive management programs, whether conducted by De Beers or under the CEAM Strategy and Framework or NWT Cumulative Impact Monitoring Program, must involve Aboriginal groups in the design and implementation of the program, particularly with respect to the collection, use and interpretation of TK.

During the Hearing, suggestions for a moratorium on development were made. There was some discussion that the SLDP be the last project to be supported in the Slave Geological Province. The Board does not subscribe to this view. In the opinion of the Board, the measures recommended and suggested in this Report of EA, in addition De Beers' commitments, will likely be sufficient to avoid significant cumulative effects of increased human development in the near term.

The Board is nonetheless of the opinion that monitoring and integrated resource management will be essential to avoid significant adverse cumulative effects associated with ongoing development in the Slave Geological Province. The timely implementation of the CEAM Strategy and Framework and



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

the NWT Cumulative Impact Monitoring Program are perhaps the most important steps that need to be taken in order to ensure that the environment will be protected and the quality of environment-related decision-making in the NWT continues to improve.

The Board recognizes that much work has been done under the leadership of INAC and Environment Canada, with the involvement of GNWT and other stakeholders in the development of a framework for cumulative effects monitoring and management in the NWT. The Board concludes, however, that more work and funding is required to deliver the much needed comprehensive cumulative effects management system in a timely fashion.

The Board agrees with the concerns expressed by several Parties to the EA, regarding the status of decision-making, communication, and coordination among stakeholders in the Mackenzie Valley regarding cumulative effects monitoring and management. The development of the *Blueprint for the Cumulative Effects Assessment and Management Strategy and Framework in the NWT and its Regions* approved after the Diavik comprehensive study in 2000 has not been timely given the pace of development in the NWT. Moreover, the lack of long term, stable funding for the implementation of the blueprint is disturbing. The Board is confident that the CEAM Strategy and Framework for the NWT and related monitoring programs are sufficiently broad in scope, to deal with the full range of cumulative effects issues. Given the evidence presented during this EA, the Board is of the opinion that the immediate implementation of the Framework and completion of an audit under Part 6 of the MVRMA is essential.

De Beers has not been engaged in the development of the CEAM Strategy and Framework and has not made any specific commitments other than future participation in such regional initiatives. Clearly, if De Beers' commitment to adaptive management is to be realized then it must be an active participant in these initiatives, and share the financial, management and administrative burden for the implementation of these initiatives.

The Board has already concluded that taking into consideration mitigation measures proposed by De Beers that the SLDP, in combination with other future developments, has the potential to cause significant adverse cumulative effects on 1) caribou populations and movement, and 2) grizzly bear and wolverine populations due to direct mortality (see Sections 2.15.3.2.2 and 2.15.3.2.3). The measures proposed by De Beers are those over which it has control. The Board is concerned that to avoid such adverse impacts from occurring a more comprehensive response is required. While the Board recognizes De Beers commitments to monitoring and adaptive management, the Board is mindful of the fact that "monitoring" is not mitigation as so aptly put by Jean Teillet, Counsel to the Dogrib Treaty 11 Council in the Hearing.

The Board has been critical of the level of environmental baseline data collected by De Beers for their assessment of the SLDP. However in the area of cumulative effects assessment, it is the Board's view that the information required is not the sole responsibility of the developer and that a joint industry-government partnership should be established for the collection of cumulative effects data



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

for the whole of the Slave Geological Province. There are models available to government for addressing these challenges.

There is an overall lack of coordinated environmental baseline information for developments in the Slave Geological Province and access to information is also currently a challenge in NWT. The current levels of baseline information collection by government agencies does not appear to the Review Board, to be sufficient to support environmental impact assessment decisions of resource development projects within the Slave Geological Province. The Board concludes that alternative delivery mechanisms need to be considered for the collection and management of environmental baseline information.

### ***Recommendations***

**Based on the above conclusions, the Board recommends that the following measures be implemented:**

- (R26) The Board recommends that the Government of Canada take the lead in implementing a regionalized, multi-party response to the monitoring for and management of cumulative effects in the Slave Geological Province preferably under the umbrella of the CEAM Strategy and Framework.**
- (R27) The GNWT shall undertake a review of grizzly bear and wolverine populations in the Slave Geological Province to determine if current management measures relating to direct kills are adequate to deal with potential cumulative effects and to develop a response where significant adverse impacts are identified. This review should be used to contribute to any cumulative effects monitoring and management program for the Slave Geological Province.**
- (R28) De Beers, and the Government of Canada and the GNWT shall negotiate and sign an Environmental Agreement prior to the issuance of a Production Water Licence.**
- (R29) The Government of Canada and the GNWT shall ensure that the De Beers Environmental Agreement is consistent with those negotiated for similar mines within the Slave Geological Province.**
- (R30) The Government of Canada and the GNWT shall ensure that any future Environmental Agreements be negotiated during the EA process so that a draft Agreement can be entered into evidence for consideration by the Board so that it can be satisfied that cumulative effects are being addressed and mitigated.**
- (R31) The Government of Canada and the GNWT, De Beers, Diavik, and BHP Billiton shall work towards consolidating the Environmental Agreements for these developments**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

within 24 months. The consolidation should result in a standard agreement which can be used for future mines in the Slave Geological Province.

**(R32) The Government of Canada, along with all other interested Parties, shall take immediate action to implement the *Blueprint for the Cumulative Effects Assessment and Management Strategy and Framework in the NWT and its Regions*. The Board further recommends that the Government of Canada allocate long-term, stable funding to this initiative for a term of no less than ten years.**

**(R33) The Government of Canada shall take immediate action to complete an environmental audit as required by Part 6 of the MVRMA including the establishment of a baseline of environmental conditions and trends that may be used in future application of Part 5 of the MVRMA.**

**(R34) The Government of Canada and the GNWT in consultation with the REVIEW BOARD, shall within 12 months undertake an analysis of the role of Environmental Agreements in the evolution and operation of the environmental regulatory regime in the NWT.**

**(R35) The Government of Canada and GNWT should consider the feasibility of establishing a research-based institute devoted to improving the scientific understanding of baseline conditions and environmental responses to renewable and non-renewable developments within the Slave Geological Province.**

## 2.16 Economic

### 2.16.1 Approach on Project-specific & Cumulative Effects

With the exception of the information presented in Section 12.2 in the EAR, throughout the EA process there was little discussion either by De Beers or the Parties as to the cumulative economic impacts of the SLDP. In addition, the mitigation measures proposed by De Beers to address economic issues were substantially the same for cumulative impacts as they were for project-specific impacts. Therefore this section focuses on project-specific effects and makes only generally references to cumulative impacts.

### 2.16.2 Summary of Developer's Submissions

During, the Public Hearing, De Beers provided an overview of the expected contributions of the SLDP to the economies of the local communities, the NWT and Canada. A series of key economic indicators were given that demonstrated that the NWT economy is robust and growing while inflation is low and stable. For example, Gross Domestic Product in the NWT grew from \$1.9 billion in 1998 to \$3.1 billion in 2002. There were also increases in private capital expenditures, retail trade,



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

manufacturing shipments, employment, and personal incomes in the primary communities (both including and excluding Yellowknife). As well, there have been declines in income support payments, income support cases, income support beneficiaries in primary communities (both including and excluding Yellowknife). De Beers stated that the SLDP would help to maintain the momentum of the NWT economy.

De Beers provided estimates of the number of direct and spin-off (indirect and induced) jobs that would be generated by the SLDP. It was estimated that for Canada there would be 3,140 jobs during construction, 1,656 jobs per year during operations and 360 during mine closure. In the NWT, it is anticipated that there would be 1,118 jobs during construction, 950 per year during operations and 175 during mine closure. The operations phase is the largest and longest phase of the project (estimated to be 22 years) with the greatest economic effect on the NWT.

De Beers stated in the EAR (Section 12.2.4.1, p. 12-27) that to meet the cumulative employment targets of the existing mines and the demands of the SLDP there would be an increased need to provide immediate and substantial training of the local and regional labour pool. De Beers added that other economic developments in the area, such as oil and gas, if they occur, would compete for some skilled labour from the same labour pool. To the extent that these developments take place, the need for further skills training and in particular in-migration (mostly to Yellowknife and other main centres) would be further accelerated.

De Beers presented a regional labour market analysis that concluded that the labour supply in the NWT is sufficient to meet the cumulative demand for the estimated number of direct, indirect and induced mine jobs from 2004-2011, even when labour supply is limited to the Snap Lake primary and catchment communities along with projected in-migration.

While De Beers did not provide cumulative quantitative estimates, it did state that existing mining projects will produce, with the addition of the SLDP, a considerable increase in fiscal revenues generated within the territory, and in the overall level of economic activity and resources available for investment by the GNWT.

De Beers did provide estimates of the tax and fiscal impacts for all three phases of the SLDP For Canada, cumulative revenues for all three phases of the proposed project are estimated to be \$737 million. For the GNWT, total cumulative revenues are estimated to be \$173 million. After the impact on the Formula Financing Grant is taken into account the total cumulative net tax and fiscal impacts on Canada is anticipated to be \$788 million and \$119 million for the NWT.

De Beers made a number of commitments during the EA process, which included:

- To support business development and provide training and skills development to help overcome some of the barriers to employment faced by NWT residents;
- A commitment to specific targets for the proportion of total employment and spending that would take place in the NWT;





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- The establishment of a De Beers Canada Fund, which will be used to support educational and community improvement initiatives in the NWT;
- To promote northern hiring by providing incentives to live or more move to the NWT; and,
- To make the NWT the point of hire for all employees and not pay for transportation costs for employees living in southern Canada to the NWT.

De Beers concluded that individuals, families, communities, and governments would be better off as a result of the contributions of the SLDP to the economy of the NWT. The key benefits would be employment, job training, skills and capacity development, community development, opportunities for local businesses, and tax revenues and royalties. De Beers suggested that these benefits would be shared by a number of groups in the NWT. The primary communities and catchment communities would benefit from training, employment and business opportunities. The GNWT would benefit from new tax revenues and increased transfers from the federal government as a result of increased population. Finally, the federal government would benefit as a result of new taxes and royalties and lower overall transfers to the GNWT.



Review Board panel members during a break in the proceedings at the public hearings held in Yellowknife.



### **2.16.3 Summary of Responses from the Parties**

There were eight presentations made by interested Parties at the Public Hearing that related to the economy. They included the YKDFN, NMSA, Dogrib Treaty 11 Council, LKDFN, the GNWT, the NWT and Nunavut Chamber of Mines, the Northwest Territories Construction Association and the Yellowknife Catholic Schools.

All of the Parties to the EA recognized that positive benefits would accrue to the NWT as a result of the SLDP and no one suggested to the Board that it reject the proposed project.

The need for the economic development that would be fostered by the SLDP was most clearly stated by Bill Enge, President of the Yellowknife Métis Nation Local 66 of the NSMA, who stated that: *“The Northwest Territories needs economic development and we need jobs and we need to bring ourselves into a level of prosperity that the rest of this country enjoys”* (Bill Enge, Yellowknife Métis Nation Local 66, Public Hearing Transcript Day 5, May 2, 2003, p. 219)

The NWT and Nunavut Chamber of Mines presentation focused primarily on the cumulative benefits of the mining industry to the economy. According to the Chamber, the key benefits in the NWT included the building of business capacity, increased labour force training and the development of infrastructure. The Chamber noted that many of these benefits were flowing to northern Aboriginal residents and businesses and that mining projects were promoting sustainable development in the NWT.

It was the view of the NWT Construction Association that economic and social benefits accruing from the development of the Snap Lake mine would far outweigh the environmental and social costs. The Association did warn against setting unrealistic employment targets that might lead employers to compete for the limited number of workers in the NWT labour pool, leading to a rise in labour costs. The Association also outlined the need for a realistic definition of what constitutes a northern business to ensure that actual northern businesses benefit from the northern preference policies.

Mr. Kurt Von Hagen, who represented the Yellowknife Catholic School Board, stated that to date: *“De Beers has made a strong (start) in honouring its commitments to the north”*. (Public Hearing Transcripts Day 5, May 2, 2003, page 213). Mr. Von Hagen referred to two examples of this, the De Beers development of NWT apprenticeship support materials and the investment by De Beers in the career and technical centre being built by the Yellowknife Catholic School District.

While there was general support for the project many Parties made a number of suggestions and recommendations to improve benefits to the north. Some of the major suggestions and recommendations included:

- The GNWT and CARC stated that De Beers should quantify its commitments in areas such as hiring and purchasing and formalize these commitments in a Socio-economic Agreement. As



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- a result De Beers did commit to specific employment and spending predictions (targets) and agreed to formalize these commitments in a Socio-economic Agreement with the GNWT.
- The GNWT suggested that, because of the labour shortage in the NWT that has resulted from the impact of other mining projects, De Beers should provide direct transportation to the mine site from more communities than the primary communities. De Beers presented a regional labour market analysis that concluded that the labour supply in the primary communities and catchment area would be sufficient (with anticipated in-migration) to meet the cumulative demand for the estimated number of direct, indirect and induced mine jobs for 2004-2011.
  - The GNWT suggested that there should be incentives for employees to remain in, or relocate to the NWT. De Beers stated that it will have a four days in and three days off (4-3) rotation for its management employees and expect that the majority will relocate to the NWT. In addition the company has developed a northern allowance program to encourage all employees to move north. This program includes relocation assistance, a salary subsidy (to offset higher living costs in the north), an accommodation and utility subsidy and an annual vacation travel subsidy. (Responses to the Review Board April 4, 2003 Questions - Q2.1 and Q2.2).
  - In response to a question from the Board during the Hearing, De Beers stated that the point of hire for all southern employees would be in the NWT and that De Beers would not pay the transportation costs for employees living in the south to travel to the NWT.
  - The GNWT made a request that De Beers enter into a formal agreement with them to supply rough diamonds to support a secondary diamond industry. In response, De Beers agreed to work with the GNWT and Aboriginal groups to facilitate a supply of rough diamonds and to formalize this commitment in a socio-economic agreement. (Technical Sessions December 6, 2002)
  - The GNWT wanted De Beers to commit to hydro-electric expansion to help provide sustainable business opportunities and reduce GHG emissions and other air pollutants. In response, De Beers expressed interest in purchasing reliable hydroelectric power for the SLDP site and agreed to explore this opportunity with the Northwest Territories Power Corporation.
  - The NSMA stated that there was a need for specific baseline data for its organization and identified examples that included: existing employment, skills, education levels, barriers to employment, existing housing and infrastructure, and traditional land use. The NSMA also suggested that the mine production rate must be set so that all predicted impacts and proposed mitigate measures remained valid.

### 2.16.4 Key Issues

Key economic issues considered by the Board include:

- Predicted employment and business opportunities;
- Rate of production;
- Hydroelectric energy option;



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Resource depletion, economic sustainability and diversification; and,
- Government finances.

### 2.16.4.1 Predicted Employment and Business Opportunities

#### *Description of Issue*

De Beers, in its EAR, and during the November-December 2002 Technical Sessions, did not commit to specific targets for the proportion of total mine purchases that would be made in the NWT, or the percentage of total employment would be comprised of NWT residents. Instead, the developer committed to maximizing northern benefits by giving priority to potential northern employees and businesses. Parties expressed concern that De Beers commit to targets for the level of northern benefits and that these targets must be included in written agreements.

De Beers' EAR, however, offered a prediction that the SLDP would have positive employment effects on the NWT and southern Canada. De Beers estimated that 40% of the construction workforce and 60% of the operations and closure workforces would be made up of residents of the NWT. De Beers predicted that during operations the SLDP would employ 500 persons and that 150 would be hired from northern communities and an additional 150 persons hired in the south would migrate to the NWT. The remaining 200 would be residents of southern Canada who would fly-in and fly-out to the mine site.

The issue of targets for employment and business spending was raised by the Review Board, GNWT and CARC throughout the EA. In response to a written question from the Review Board to a question from CARC during the Public Hearings, De Beers agreed to commit to the northern employment targets contained in the EAR and include them in a Socio-Economic Agreement with the GNWT. To help meet these targets, De Beers indicated that it would provide a wide range of programs that would be aimed at overcoming the barriers to employment faced by many residents of the NWT. These measures would include the establishment of hiring priorities that favoured northerners, a number of recruitment, training and employment programs aimed at northerners, literacy training and a series of impact management measures aimed at increasing employment opportunities for northerners.

The YKDFN and NSMA expressed concern as to whether there would be an opportunity to be involved in not only training but in the design and appropriateness of the training programs. The NSMA argued that the lack of baseline data regarding its organization made it impossible for the Board to understand the impacts on its community and its specific need for training.

De Beers predicted that the SLDP would provide positive opportunities for participation by northern businesses in the supplying of goods and services to the SLDP. De Beers committed to make efforts to increase these opportunities through a number of mechanisms, including having a resident business development manager to assist Aboriginal and other northern companies in bidding on contracts.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

In a response to a question from the Board, De Beers stated that it is prepared to commit to a target for purchases from NWT businesses of 35% to 45% for construction procurement and 50% to 60% for operations and closure.

De Beers in its Conformity Response committed to the construction of a local facility that would do sorting and valuation of rough diamonds to allow presentation for federal mining royalty valuation. In addition De Beers committed to training more sorters than required for the first five years of operation.

During the November-December 2002 Technical Sessions and at the Public Hearing, De Beers committed to work with the GNWT to come up with a facility for the provision of Snap Lake rough diamonds to one or more NWT cutters and polishers. The GNWT also asked De Beers to agree to provide rough diamonds that could be certified as coming from the SLDP to the local cutting and polishing industry and provide it under the same terms and conditions as currently done at EKATI. De Beers agreed to work with the GNWT to sign an agreement to that effect.

During the EA process the Parties agreed that many of De Beer's commitments to northern economic benefits should be formalized in a Socio-economic Agreement that would be negotiated between De Beers, the GNWT and other directly affected parties. CARC, LKDFN and NSMA suggested that it was essential for the Board to know the provisions of this Socio-economic Agreement and that therefore it should be concluded prior to the closure of the public record. They recommended extending the closing of the public record if necessary to accommodate this. The Dogrib Treaty 11 Council and the GNWT suggested that it was not essential for the Socio-economic Agreement to be finalized prior to the EA decision but that it should be concluded prior to the regulatory process. The GNWT also stated at another point in the Public Hearing that it would like to see the Socio-economic Agreement completed by June 30, 2003. The YKDFN stated in its opinion that the Socio-economic Agreement should be completed before construction.

### ***Conclusions***

The Board accepts that the SLDP with De Beers' employment and business commitments, including the accompanying mitigation measures, will likely have a significant positive benefit on the economy of the NWT.

The Board agrees with the GNWT that, because of concerns over potential labour shortages and the desire to maximize northern benefits, De Beers should expand the catchment area for potential labour by increasing the number of communities that will be considered as a point of hire.

It is also the Board's view that the successful completion of a Socio-Economic Agreement with the GNWT and other directly impacted parties will be an essential step in implementing De Beer's commitments. This is necessary to prevent significant adverse socio-economic impacts from occurring with respect to employment and business opportunities.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### *Recommendations*

Based on the above conclusion, the Board recommends that the following measures be implemented:

**(R36) The GNWT Socio-Economic Agreement shall include the commitments given by De Beers to employment (including training targets) and procurement targets, and the provision of rough diamonds from the proposed Snap Lake mine to the local NWT secondary diamond industry.**

**(R37) De Beers and the GNWT shall negotiate and sign the Socio-economic Agreement prior to the issuance of a Production Water Licence.**

### **2.16.4.2 Rate of Production**

#### *Description of Issue*

Both the GNWT and the NSMA raised the issue of the mine production rate and whether it might be increased. The NSMA was concerned that if De Beers changed mine production rates it would jeopardize all predictions and mitigation measures in the EAR. As a result, the NSMA wanted De Beers to be ordered by the Board not to vary from the proposed production rate.

De Beers stated that the production rate of 3,000 tonnes per day is an engineered design that is appropriate to the type and dimension of deposit at Snap Lake. In the EAR, and later during the November-December 2002 Technical Sessions, De Beers said that if it found that it was beneficial to significantly increase production De Beers would make the necessary applications to the Mackenzie Valley Land and Water Board.

#### *Conclusions*

The Board recognizes that, if the production rate were to be substantially increased that the EA predictions could change with accompanying effects on the environment. The impacts of a change in production rates would be examined at the time that De Beers proposed such an expansion. Such a change would most likely trigger the regulatory process by requiring amendment to the Production Water Licence.



### **2.16.4.3 Hydroelectric Energy Option**

#### ***Description of Issue***

In its Technical Report, the GNWT referred to MVRMA s.115(b) and went on to state:

*“... the failure to utilize industrial expansion (e.g. mining) to support development of hydroelectric energy and transmission capacity in the NWT may have significant socio-economic impacts on the future energy supplies of NWT communities. Secondly, future development of mineral resources in the NWT may be significantly hindered by the failure to invest in sustainable energy infrastructures. This may impact on the long term position of mining development in community economics. In addition, the impact of this proposed large addition of fossil fuel generation in the NWT economy on the obligations that will accord to the GNWT, under the ratified Kyoto Accord, may be significant.”*

(GNWT, Technical Report, De Beers Snap Lake Diamond Project February 2003, p. 27)

The GNWT recommended in its Technical Report that De Beers, through a Socio-economic Agreement with the GNWT, work to set mutually agreeable conditions for the future development of hydroelectric supplies for the mine site.

At the Public Hearing, the GNWT expressed that the expansion of NWT’s hydro-electric generation and transmission system provides:

*“sustainable business opportunities for Aboriginal businesses and other NWT business interest. The positioning of cost effective hydro-electricity transmission infrastructure in the Slave Province, can improve prospects for a sustainable mining industry in the NWT.”*

(Pietro Debastiani, GNWT, Public Hearing Transcripts, Day 5, May 2, 2003, p. 156)

Subsequent to the Public Hearing, the Review Board received a letter from the GNWT (May 23, 2003) confirming De Beers’ interest to purchase reliable hydroelectric power for the SLDP site, prior to facility start up in mid-2007. The confirmation was made in a March 5, 2003 letter of interest addressed to the Northwest Territories Power Corporation, from AMEC on behalf of De Beers. The use of hydroelectric power would substitute for burning some fossil fuels at the mine site.

#### ***Conclusions***

If the negotiations between De Beers and GNWT result in a proposal for hydroelectric power, it will be subject to part 5 of the MVRMA. The Board notes that the suggestion made under Section 2.12.3.2 (Greenhouse Gases) addresses this issue from an air quality perspective.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

### 2.16.4.4 Resource Depletion, Economic Sustainability and Diversification

#### *Description of Issue*

Parties to the EA expressed concern that resource extraction projects have led to economic booms and busts rather than contributing to economic diversification and sustainable development in the NWT.

De Beers stated that the SLDP would contribute to economic sustainability and diversification in at least three ways:

1. Develop people by providing support for education, training and skills assistance so northern residents could develop careers and abilities at various job levels while at the same time developing transferable skills. *“So, for example, if someone gets trained as a bookkeeper or heavy equipment operator, they clearly have some job mobility. (They) can move from one employer to another (and) can move from one geographic location to another.”* (Peter Homenuck, IER for De Beers, November-December 2002 Technical Sessions, Day 5, December 5, 2002, p 46).
2. De Beers’ commitment to buy northern services and goods to help build business capacity. De Beers stated that this would create a wide range of employment opportunities in businesses that would supply goods and services to the SLDP and to household that would derive income from the project. This would create an opportunity for the creation of new businesses leading to greater economic diversification. *“I think it’s important to recognize that there’s a 20, 25 year period here in which communities and individuals through joint ventures can develop other kinds of economic activity using the Snap Lake project as a catalyst to try and develop other industry that will help diversify what may exist in some communities.”* (Peter Homenuck, November-December 2002 Technical Sessions, Day 5, December 5, 2002, p 46).
3. The commitment to the establishment of a De Beers Canada Fund. This fund would be financed by De Beers from profits earned by the SLDP and would be used to support educational and community improvement initiatives in the NWT. De Beers’ indicates that these improvements would have a lasting effect by helping to promote healthy communities.

The GNWT presented evidence that supported the notion that the diamond industry has been leading to growth in other sectors of the economy and lessening the NWT economy’s dependency on government employment and spending.

*“It was during this period (1999 to 2001) that the Diavik property was developed and BHP completed construction. We can also see some significant growth in other sectors of the economy, including trade, finance, professional services and accommodation. By contrast, government growth ... increased very little.”*

(Dan Westman, Public Hearing Transcripts, Day 5, May 2, 2003, p. 158).





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The NWT and Nunavut Chamber of Mines also supported the notion that the diamond industry has been a contributor to economic diversification and sustainability. The Chamber cited the example of how the training and skills learned by employees in the diamond industry were transferable to other sectors of the economy. The Chamber also stated that the diamond industry had led to the building of business capacity that has contributed to both diversification and sustainability.

CARC raised the concern of whether this project would simply be another boom and bust development that would not contribute to economic sustainability and diversification in the NWT. Their concern was that depletion of the resource would generate a short term boost to the economy without leaving lasting benefits in the north. CARC asked both the federal and territorial governments what their positions were on the feasibility and desirability of the target use of territorial revenues from Snap Lake towards economic diversification and sustainability for the NWT. CARC also recommended that the Board suggest that a portion of government revenues from non-renewable resource development, including the SLDP be set aside for economic diversification and to promote more sustainable development.

### *Conclusions*

The Board agrees that non-renewable resource projects should be designed so that they promote the goals of economic diversification and sustainable development.

The Board is of the opinion that additional measures should be considered to ensure that the SLDP and other non-renewable resources projects promote the objectives of economic sustainability and diversification in the NWT.

### *Suggestions*

**Based on the above conclusion, the following suggestions should be considered for implementation:**

**(S31) The Board suggests that the Government of Canada and the GNWT examine the feasibility of establishing a fund financed through a portion of non-renewable resource revenue to be used for the promotion of economic diversification and sustainable economic development in the NWT.**

## 2.16.4.5 Government Finances

### *Description of Issue*

Governments in the NWT have expressed concern that it will not receive sufficient tax revenues from new large resource development projects to offset the costs that these projects will generate. The



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

resolution of this issue will have a bearing on the North's capacity to accept future development projects.

De Beers predicted that the total cumulative tax and fiscal impacts on the Government of Canada would be revenues of \$737 million while revenues to the GNWT would be \$173 million. After the impact on the Formula Financing Grant is taken into account, the total cumulative net tax and fiscal impacts on Canada is anticipated to be \$788 million and \$119 million for the NWT. No estimates were provided of the cost (*i.e.* impacts of increased demands on government services and infrastructure) that the GNWT would incur as a result of the SLDP. As a result, it was not possible to estimate the bottom line impact on the GNWT.

The GNWT made the observation "*That there is no question that the distribution of benefits (tax and royalty revenues) from development is not in a particularly balanced fashion right now*". Although no evidence was presented, the GNWT also stated that "*It would be our considered view that that number (new revenues) would not come close to covering the increased costs. The GNWT concluded that "the federal government (must) invest further resources with the GNWT so program delivery can keep up to the needs that are brought about by development."* (Doug Doan, GNWT, Public Hearing Transcripts Day 5, May 2, 2003, p. 184, 187).

The Dogrib Treaty 11 Council, YKDFN and LKDFN made the argument that they lack the resources and the capacity to deal with change that is occurring and with the additional change that would likely result from the SLDP.

CARC stated that:

*"It's clear to us that GNWT needs more money to cope with development, but it is not willing to raise the funds through new taxation where we can keep all of the revenues, there's no claw backs, at least within the time frame of the current formula funding arrangement."*

(Kevin O'Reilly, Public Hearing Transcript Day 5, May 2, 2003, p. 282).

CARC recommended that the Board suggest a public review of the mineral royalty and taxation regime for its equity and fairness.

The YKDFN asked the GNWT if savings in lower social assistance payments and other government programs as a result of diamond mining would be directed back to the communities to increase their capacity to deal with socio-economic issues. The GNWT responded that any specific reduction in program spending could not be specifically targeted and would flow back to general government revenues.

### **Conclusions**

The Board agrees that the SLDP will generate significant new benefits to Canadian economy in the form of new tax and royalty revenues.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The Board, however, is concerned over the impact of the SLDP on community infrastructure and the relatively low level of financial benefits that directly benefit the GNWT. The Board is of the view that governments in the NWT must receive sufficient financial resources to deal with increased social and infrastructure requirements that invariably follow with increased natural resource developments. Without sufficient revenues northern governments will be unable to respond to the impacts of development and to effectively pursue the goals of economic sustainability and diversification.

The Board accepts the comments from the GNWT that northern government needs to receive more revenue to offset the increased costs that result from the development and operation of major resource projects. One of the primary mechanisms for securing these revenues can be achieved through a more equitable distribution of resources revenue through royalty payments.

The Board is of the opinion that additional measures should be considered to ensure that the distribution of government revenues from non-renewable resources projects is equitable and fair and also promote the objectives of long term economic sustainability and diversification in the NWT.

### ***Suggestions***

**Based on the above conclusions, the following suggestions should be considered for implementation:**

**(S32) The Board suggests that the Government of Canada conclude negotiations on a royalty revenue sharing agreement with the GNWT within 24 months in order to ensure that all royalty revenues generated by the SLDP, and other non-renewable resource developments, accrue to the GNWT and residents of NWT in a manner similar to that enjoyed by Southern Canadians.**

**(S33) The Board suggests that GNWT examine its current tax structure including the payroll tax to determine if more revenues can be raised from non-renewable resource development activities to help offset increased costs and promote the objectives of economic sustainability and diversification.**

## **2.17 Socio-Cultural**

### **2.17.1 Approach on Project-specific & Cumulative Effects**

Throughout the EA process, little distinction was made, either by De Beers or the Parties, between the socio-cultural effects that would result from the SLDP alone and those that would result cumulatively – that is, from the SLDP in combination with other existing or likely developments in the area. Although some Parties referred to cumulative socio-cultural impacts in their submissions or presentations, the impacts they described generally differed from project-specific effects in terms of the intensity of the impacts, rather than their nature. De Beers concurred with this view noting that



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

*“...the Snap Lake Diamond Project, in combination with the other identified mining development projects, will magnify the rate at which impacts will occur and the impacts will be greater than if each of the mining projects were to operate in isolation” (EAR, p. 12-22).*

The mitigation measures proposed by De Beers to address socio-cultural issues were also substantially the same for cumulative impacts as they were for project-specific impacts. The differences between the direct and cumulative measures described by De Beers lay primarily in the extent of the programs required - and the increased requirement for involvement of agencies in addition to De Beers - rather than in the nature of the programs.

As a result of the significant overlap between the project-specific and the cumulative effects on socio-cultural conditions, the following discussion focuses on socio-cultural effects in general, whether project-specific or cumulative. Where a distinction is made between the two, this is indicated in the text.

### **2.17.2 Summary of Developer’s Submissions**

#### **Scope and Sources of Information**

The socio-cultural assessment conducted by De Beers addressed expected impacts on individuals, families and communities in terms of their social, economic, and cultural well-being. The assessment was based on information collected through over 140 in-person interviews and approximately 50 meetings (letter to Gordon Wray, May 23, 2003, Request for Information - Updated List of Community Meetings). De Beers also undertook case studies, interviewing officials from Cogema and Cameco in Saskatchewan and a cross-section of residents of three Cree communities (Fond du Lac, Black Lake and Stony Rapids) in order to learn about their mine-related experiences (Response by De Beers to Q.3 of Review Board Information Request dated April 4, 2003). A number of secondary sources were also used to verify and/or expand on the impacts identified by De Beers.

#### **Evolution of Mitigation Measures to Address Key Concerns**

Community interviews and meetings revealed that key socio-cultural issues and concerns related to training, life skills, education, family support, Aboriginal cultures, and traditional resource use. Over the course of the EA process, De Beers developed a number of measures to address these concerns, to maximize positive effects and prevent or reduce any negative effects.

Thirteen core impact management measures were identified by De Beers in the EAR (p. 5-143); a fourteenth measure was added later. Of the 14 measures, five were directed at furthering “Recruitment, Training and Employment”, two were intended to promote “Economic Development”, and seven addressed “Health and Wellness” issues. Although there was inevitably some overlap in the measures to address economic versus social issues, socio-cultural concerns were primarily covered by the seven “Health and Wellness” measures. These measures included:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Substance abuse prevention and treatment;
- Family support services;
- Money management training;
- Cultural awareness programs;
- Programs to support Aboriginal traditional practices;
- The appointment of community liaison personnel; and,
- Arrangements for transportation to the site.

Elsewhere in the EAR, De Beers committed to the formation of a Mine Management Advisory Committee (EAR, p.14-2). The Mine Management Advisory Committee would comprise representatives from the primary communities as well as the First Nations Chiefs and Councils and the NSMA Executive and “...will provide a way for people in the primary communities to bring their concerns to a senior De Beers management level and to influence how the mine’s operations might change to help address these concerns” (De Beers’ response to IR 2.5.9a, August 2002). Although the Mine Management Advisory Committee was not described in the EAR or in later submissions as a socio-cultural measure *per se*, it will provide an avenue for consultation with affected communities in addition to that provided for by the appointment of the community liaison personnel. (The relationship between the Mine Management Advisory Committee and the two community liaison personnel referred to in the list above was not made clear by De Beers.)

A further set of socio-cultural mitigation measures was proposed by De Beers as part of their Human Resource Development Plan. This plan was initially described as a way of addressing measures “...for which De Beers has sole responsibility” (De Beers response to IR 1.20, June 2002) but was later described as a five-year plan which will include “...a number of wellness initiatives in partnership with government” (De Beers response to IR 3.5.14, September 2002). Initiatives will include human resource development programs; community capital infrastructure development; traditional skills workshops; healthy living workshops; on-site Alcohol Anonymous meetings; retirement planning workshops; sponsorship of Special Days activities; and fetal alcohol syndrome prevention promotion. (De Beers response to IR 3.5.14, September 2002, and Public Hearing Transcripts, Day 1, April 28, 2003, p. 51-52).

A further instrument for mitigation of socio-economic impacts was the proposed De Beers Canada Fund. De Beers committed to allocating a minimum of 1% of net annual after-tax cash flow to this fund for use by its Canadian operations. The fund would be similar to the De Beers Fund in South Africa which supports more than 500 ventures each year “including practical skills training, small business incentives, job creation, youth development, environmental conservation and community welfare projects” (Technical Session Transcripts, Day 9, December 5, 2002, p. 74).

### Description of Core Socio-Cultural Mitigation Measures

As noted above, the core of De Beers’ mitigation for socio-cultural impacts included seven “Health and Wellness” measures:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Substance abuse prevention and treatment;
- Family support services;
- Money management training;
- Cultural awareness programs;
- Programs to support Aboriginal traditional practices;
- The appointment of community liaison personnel; and,
- Arrangements for transportation to the site.

The latter two impact management measures listed above are actions for which De Beers committed to take full responsibility. With respect to community liaison personnel, De Beers stated that it would employ at least two full-time people to act as communications links between De Beers, employees, and the primary communities. Although “...based in Yellowknife, these people will visit each of the primary communities and the mine project site regularly” (EAR, p. 5-155).

Regarding transportation to the site, De Beers committed to providing direct flights to the mine site (not via Yellowknife) from all primary communities except Rae-Edzo, Dettah, and N’dilo.

Of the list of seven measures noted above, the first five measures (that is, all excepting community liaison personnel and site transportation arrangements) will be shared measures – that is, they will be accomplished in partnership with government agencies, public institutions, the private sector and the communities that will be involved in, affected by, or benefit from the SLDP (Response by De Beers to Review Board Information Request dated April 4, 2003, p. 42). These shared measures are at various stages of development. Thus, details regarding the nature of the programs included in the measures, and the contributions required or expected from the different partners, are not available. As De Beers notes, “...the process towards implementing the impact management measures is still in its earliest stages” (Response by De Beers to Review Board Information Request dated April 4, 2003, p. 42). Information provided by De Beers regarding the proposed shared measures is as follows:

- Substance abuse programs will consist of two components – prevention/awareness and addiction treatment. These programs will be negotiated with the GNWT, the federal government, and communities. The program “...could be comprised of on-site and community-based substance abuse prevention programs, substance awareness and prevention in schools and on-site. De Beers will support addictions treatment programs, and successful completion, combined with upgrading and skill training, will be linked to the recruitment and employment strategy” (De Beers response to IR 3.5.14, September, 2002).
- Family support services will encompass family counseling services in the primary communities for mine employees, their spouses, and their families. “This support service could include counseling related to family and relationship counseling, stress management, anger management, support services for women and single mothers, child care services and parenting training” (De Beers response to IR 3.5.14, September 2002). Implementation of these services will be done in partnership with community social service agencies, the GNWT, and the federal government.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Money management training, which will be mandatory for all new hires, will be provided in each of the primary communities for employees and their spouses. De Beers will also seek collaboration with recognized financial institutions to establish Internet and telephone-based banking services in the primary communities.
- Cultural awareness programs, which will be provided to all on-site staff, will include cross cultural training for all on-site staff, Community Appreciation days, a cultural exchange program for non-Aboriginal employees, paid mine visits for spouses and families, and the provision of traditional food on-site where commercially feasible.
- Support of traditional practices could include funding support for primary community programs or agencies whose mandate is to strengthen Aboriginal culture. Details regarding this measure are to be arranged with the primary communities.

(De Beers response to IR 3.5.14, September 2002, and response by De Beers to Review Board Information Request dated April 4, 2003, Table 5.1)

### Measure Implementation and Monitoring

Measures for which De Beers has committed to take full responsibility will be implemented by the developer independently. Implementation of the five shared measures described above may be accomplished through a number of agreements, such as the Socio-economic Agreement, Impact Benefit Agreements, and the Human Resources Development Plan. De Beers advised that all of these agreements and plans are currently being developed.

The Socio-economic Agreement is currently being discussed by the GNWT, the communities, and De Beers. The categories being discussed are training/education, employment, business, health and wellness, and monitoring protocols.

Impact Benefit Agreements are also being negotiated “...with four groups: the Dogrib Treaty 11 Council, the Lutsel K’e Dene, the NSMA, and the Yellowknives Dene...Components of the discussion include: financial, including cash payment for project equity or net profits; employment; training and education; monitoring and monitoring committee; community liaison; business opportunities; and health and wellness” (Public Hearing Transcripts, Day 1, April 28, 2003, p. 70).

De Beers introduced its proposed Human Resources Development Plan in response to the first round of Information Requests (De Beers response to IR 1.20(c), June 2002) and developed it further refined it between that time and the Public Hearing, particularly during the November-December 2002 Technical Sessions held in December 2002. As noted earlier, it will include a number of initiatives, many of which will be shared. Some of the components of the Human Resources Development Plan are already underway. These components, all in partnership, include a Trades Entrance Study Tutorial Program; a Community Literacy Program that allows “each grade school child in the Dogrib community, Lutsel K’e, Dettah, and N’dilo [to] order three free books for their own personal use” (Public Hearing Transcripts, Day 1, April 28 2003, p. 52); and a Career and Technical Centre, which will be used by a number of organizations to introduce trades training to



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

middle and high school students. De Beers has committed to contributing \$100,000 per year to the latter project for the next 5 years.

De Beers has committed to socio-cultural monitoring in order to confirm predictions of impact and evaluate the effectiveness of impact management measures. Monitoring will also provide a basis for ensuring that impact management measures are appropriate and/or to provide the basis for modification as necessary. Monitoring will be done largely under the terms of the Socio-economic Agreement. Details regarding plans for socio-economic monitoring were not provided.

### Residual Impacts

De Beers acknowledged that the socio-cultural impacts of the SLDP would vary among individuals, families, and communities, depending on their reactions to the changes associated with the project. However, De Beers was of the view that its proposed impact management measures and adaptive management approach would not only minimize negative social impacts from the SLDP but would also help to address some pre-existing social conditions.

Positive socio-cultural impacts were expected to be generated both directly and indirectly. Direct impacts anticipated by De Beers included provision of employment-related training programs and changes in family lifestyles related to wage employment. Indirect socio-cultural impacts included long-term community economic sustainability, provision of social support services *“leading to healthier individuals, families and communities”* (De Beers’ presentation at Public Hearing, Slide entitled “Analysis – Indirect Impacts”), and support and opportunities for cultural and traditional activities. The result would be an *“...improved quality of life for families and communities”* (De Beers’ PowerPoint presentation at Public Hearing, Slide entitled “How Will People and Communities Be Affected?”).

De Beers noted that the effects of mine closure were difficult to predict because these effects will depend on so many factors. However, the company anticipated that *“...with the full and effective implementation of the impact management measures, and through partnership agreements between De Beers, governments, and communities, Snap Lake will contribute to long-term economic sustainability in the primary communities upon closure of the project”* (De Beers Conformity Response, August 22 2002, Sec. 2.6, p. 17).

In the cumulative context, De Beers suggested that, after effective implementation of mitigation measures, *“the overall cumulative impacts will contribute to improved quality of life for employees and their families and will contribute to social and economic sustainability”* (letter from De Beers, dated February 13, 2003, entitled *Follow-up Information Regarding Socio-Economic Cumulative Effects Assessment*).





### 2.17.3 Summary of Responses from the Parties

Parties who made submissions regarding socio-cultural issues during the EA process included the YKDFN, the NSMA, Dogrib Treaty 11 Council, the LKDFN, GNWT, and the NWT and Nunavut Chamber of Mines, and the Northwest Territory Metis Nation. Three groups - Yellowknife Catholic Schools, the Yellowknife Métis Nation Local 66, and the NWT Construction Association - made presentations to the Public Hearing as members of the public.

Key issues identified by participants to the EA process included:

- Impacts on families and communities;
- Lack of community capacity and resources to deal with the effects of development;
- Effects on traditional practices, culture and language;
- Insufficient understanding, collection and use of TK in analyzing impacts and in developing mitigation and monitoring plans; and,
- Lack of detail regarding mitigative measures.

The lack of detail for mitigation was a particular concern with respect to shared measures because partnerships had not yet been developed. Furthermore, the contributions and responsibilities of the respective partners had not been defined.

The YKDFN noted that their present quality of life is important and that “...*our relatively peaceful existence and community values could come under indirect pressure from the same development that contributes to our local economy*” (YKDFN, April 17 Submission to Review Board: Snap Lake Public Hearing, p. 9). Specifically, the YKDFN indicated that:

- An influx of new workers and their families could add to pressures on land and wildlife from snowmobiling and hunting;
- A lack of accommodation in N’dilo and Dettah could lead to the need to house visitors in private homes, leading to family and social problems;
- High mine wages could lead to increased costs of living and a greater gap between rich and poor; and,
- Mining opportunities could lure young people away from education, leaving them without careers after the mine shuts down.

An additional concern was the potential effect on wildlife from excavation of the esker. The YKDFN noted that there had been little TK used in the development of excavation methods for the esker and expressed a desire to visit the esker and to have one of their people included in the inspection team for the excavations. (In a letter dated April 24 2003, De Beers invited the YKDFN to visit the esker quarry during the week of June 16 2003 to “...*discuss reclamation and review its location relative to historical resources and wildlife habitat*” (letter to Rachel Crapeau from Robin Johnstone, April 24 2003).



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Finally, the YKDFN noted their view that the Socio-economic Agreement should be finalized before construction on the project begins.

Among the concerns noted by the NSMA were:

- Inadequate collection and incorporation of TK in baseline data and plans for monitoring traditional land use, economy, subsistence economy, infrastructure, housing, and language use;
- The absence of monitoring plans and “... *insufficient evidence to demonstrate that De Beers can develop Adaptive Management Plans*” (“De Beers Snap Lake Diamond Project Public Hearing Presentation Summaries Submitted by: North Slave Métis Alliance, not dated, p. 6);
- Impacts on Métis fisheries outside De Beers’ RSA;
- The fact that Impact Benefit Agreements and the Socio-economic Agreement would not be in place until after the Board makes a recommendation. The NSMA recommended that the Socio-economic Agreement should be finalized prior to closing the public record;
- Inadequate analysis of community data to determine impacts of the wage economy on “...*the NSMA’s traditional economy, social cohesion, and individual health and wellness*” (Kris Johnson, NSMA, Public Hearing Transcripts, Day 5, May 2, 2003, p. 130);
- Inadequate baseline data on housing and overcrowding, and an associated inability to monitor or mitigate impacts;
- Lack of appreciation by De Beers that, although the NSMA community has the same governmental responsibilities as other Aboriginal communities in the NWT, it does not get core funding from the government and therefore may not have the same ability to adapt to change as other communities;
- Concerns regarding impacts on use of the Michief language; and,
- Loss of human capital and community capacity.

The NSMA concluded that there was insufficient information for the Board to assess the impacts of the project, the significance of those impacts, or the adequacy of mitigation measures. The NSMA further concluded that, without this information, the Board “...*cannot approve the project*” (Kris Johnson, NSMA, Public Hearing Transcripts, Day 5, May 2 2003, noted several times from p. 120-133).

The Dogrib Treaty 11 Council, stressed concerns about drug and alcohol abuse and the negative impacts on child care and family stability from the two-weeks in/two-weeks out work rotation. The Dogrib also noted that social support services, as they stand, are not helpful and, in fact, seem to encourage relocation of people, and their problems, to the larger centres.

LKDFN stressed the importance of the land to its community: It “...*is part of our past, our present day culture, economy, health and identity. This land is also the basis for our future*” (Denesoline Perspectives and Issues about the Proposed De Beers Canada Diamond Mine at Na Yaghe Kue, not dated, Part 1 – “Background”). LKDFN were concerned that the project could impact the migration



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

and health of caribou with negative impacts on the community. (Impacts on wildlife are discussed in Section 2.10)

*“We have always depended on the caribou for almost every aspect of our daily life. Caribou meat has always been and remains today, the main source of protein in the diet. The caribou is also the basis for the community’s social and cultural well-being, tying families and extended families together in traditional activities that date back thousands of years”* (Denesoline Perspectives and Issues about the Proposed De Beers Canada Diamond Mine at Na Yaghe Kue, not dated, Part 4.1).

The LKDFN suggested that a comprehensive plan be developed, based on TK, to monitor and manage impacts on wildlife.

At the Hearing, the LKDFN presented the results of a 2001 survey of mine employees and their families. The results showed that there has been a number of negative effects on families from mine employment, including breakdown of relationships, not enough time with children, pressures on the spouse from increased responsibilities, and, in some cases, marriage break-downs. The survey also showed that mine employees spend less time on the land than other community members do, with related concerns being health and economic stresses associated with replacing traditional food with store-bought food. The LKDFN noted many other concerns related to mine employment, including lack of money management skills, increasing income gaps in the community, increased costs of living, the potential for increased alcohol and drug abuse, and the loss of traditional values.

Among the recommendations made by LKDFN were that the community should be given “...*the employee assistance contract to provide culturally appropriate support programs for the mine employees and community members*” (Abbie Jonasson, LKDFN, Public Hearing Transcripts, Day 5, May 2 2003, p. 204) and that substantial investment be made in community infrastructure, such as housing, health care, schools, and other infrastructure, so that community members do not need to go elsewhere to have their needs met. The LKDFN recommended that the Socio-economic Agreement be concluded prior to the closure of the Public Record.

The main socio-cultural concerns noted by the GNWT were the lack of housing in Yellowknife and a lack of information from De Beers about its proposed measures to mitigate negative social impacts. The GNWT indicated a need for information regarding the contributions De Beers will make to proposed partnerships, the contributions it expects from government and community partners, and how these programs will mesh with existing community programming. It was the view of the GNWT that the Socio-economic Agreement should be finalized before the regulatory process proceeds.

The NWT and Nunavut Chamber of Mines cited the economic importance of mining and the opportunities for communities to participate in the benefits. As an example, the Chamber noted a substantial increase in post-secondary enrolment of people from Rae-Edzo over the past four years.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

Yellowknife Catholic Schools spoke in favour of the opportunities presented by the SLDP and mentioned the investment De Beers has made in the career and technical centre to be located in Yellowknife.

The Yellowknife Métis Nation Local 66, also spoke in favour of the project. They stated that, although “...development that goes on in this region affects our membership positively and negatively, ...development...has been overwhelmingly positive as opposed to negative with respect to socio-economic impacts on the members.” (Public Hearing Transcripts, Day 5, May 2 2003, p. 218)

The NWT Construction Association also stated the view that the benefits from developing the SLDP will outweigh the environmental and social costs and that provision of employment opportunities for northerners strengthens social well-being. However, the Association pointed out the need for governments to address issues like education, affordable housing, and the cost of living in the north to increase the size of the local labour pool available to developers.

### 2.17.4 Key Issues

Parties to the EA noted a variety of specific socio-cultural concerns. These and the measures proposed by De Beers to address them, can be grouped into three main categories:

- Impacts on social stability and community wellness;
- Effects on community services and infrastructure; and,
- Impacts on cultural well-being.

A description of these three issues and the Board’s conclusions for these issues are provided in Sections 2.17.4.1 to 2.17.4.3. The Board provides a collective set of suggestions for these issues in Section 2.17.4.4.

#### 2.17.4.1 Social Stability and Community Wellness

##### *Description of Issue*

In its EAR, De Beers noted that “expansion of the wage economy into communities...may exacerbate certain pre-existing dysfunctional conditions in the communities” (EAR, p. 5-123) and that there could be “effects on community social structures and/or relations due to rotational shift work” (EAR, Table 5.3-7). In the cumulative context, De Beers noted that impacts could include:

- Increased spending on addictive substances and the associated need for increased/improved substance abuse treatment and prevention services;
- Increased need for financial management skills training and services;
- Reduced out-migration from small primary communities due to increased employment opportunities; and,



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- In-migration primarily to Yellowknife and other larger centres due to the increase in employment opportunities in the NWT.

(Letter from De Beers, dated February 13 2003, entitled Follow-up Information Regarding Socio-Economic Cumulative Effects Assessment).

De Beers suggested that impacts on individuals and communities would depend on their response to these impacts and therefore could vary substantially.

De Beers proposed seven mitigative measures to reduce negative socio-cultural impacts. These measures are listed and described in Section 2.17.2. Of these seven measures, five are directed at reducing potential negative impacts on social stability and community wellness. These measures include:

- Substance abuse prevention and treatment;
- Family support services;
- Money management training;
- The appointment of two community liaison personnel; and,
- Direct transportation to the site from most primary communities.

De Beers also proposed a number of wellness initiatives under its Human Resources Development Plan. De Beers was able to provide few details regarding its proposed mitigative measures because many will be shared and most are in the early stages of development.

De Beers also committed to development of a De Beers Canada Fund that would allocate a minimum of 1% of net annual after-tax cash flow for use by its Canadian operations for funding “*non-profit community development projects working in the educational, community support, primary health care, skills development, environmental conservation and cultural sector aiming to benefit the broader community*” (Technical Memorandum, De Beers Canada Fund, February 28 2003).

Assuming effective implementation of mitigation and monitoring measures, De Beers was of the opinion that the project would contribute to “*efforts to address outstanding pre-existing social conditions, support for traditional values, increased individual capacities and increased community capacities*” (Public Hearing Transcripts, Day 5, May 2 2003, p. 50).

The GNWT and the NSMA were both concerned about the lack of information provided by De Beers regarding its proposed measures to mitigate negative social impacts. Both Parties suggested that it was difficult to assess the adequacy of these measures without more information.

The LKDFN suggested that “*mining employment causes dysfunctional families*” (Public Hearing Transcripts, Day 5, May 2 2003, p. 201). It was suggested that higher incomes could trigger more use of alcohol, drugs, and gambling; children being spoiled by money; and financial issues, all of which could have negative impacts on the family. Employment at the mine, by taking family members



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

away from home for periods of time, could cause or exacerbate negative impacts on family stability and therefore on community stability. As the LKDFN noted, *“these impacts may not be visible today or tomorrow but maybe next year or in five years. Children growing up with self-childcare facilities and absence of one or more parents will surely have devastating impact on our community in the future”* (Gloria Enzoe, LKDFN, Public Hearing Transcripts, Day 5, May 2 2003, p. 196). It was suggested that *“the mines have not been forthcoming with programs and resources to assist the community deal with the social impact of mine development”* (Abbie Jonasson, LKDFN, Public Hearing Transcripts, Day 5, May 2, 2003, p. 202).

In the cumulative context, the LKDFN noted that:

*“The mines will influence how our culture will evolve in the future. Long after the mines have finished their production, our community will still exist as it has since time immemorial. These changes may not be what the community wants for its future.”*

(Abbie Jonasson, LKDFN, Public Hearing Transcripts, Day 5, May 2 2003, p. 205)

The NSMA cited concerns regarding the impacts of the project on social cohesion. *“De Beers has not analyzed, or tried to understand, the NSMA traditional economy and its link to community health and wellness”* (Public Hearing Transcripts, Day 5, May 2 2003, p. 122).

Both the LKDFN and the YKDFN stressed the importance of culturally appropriate support programs for their community members.

The impacts that the two existing diamond mines have had on social stability and community wellness are assessed in monitoring reports prepared by the GNWT under the terms of the Socio-economic Agreements with BHP Billiton and Diavik. These reports are on the public record for the proceeding. Although De Beers made use of the first of these reports in collecting baseline data for the EAR (EAR, Section 5.2), the Board is disappointed that De Beers did not take full advantage of the reports to evaluate the impacts that the SLDP would be likely to have on social stability. Such an assessment would have been very helpful to the Board. The Board has therefore undertaken its own analysis of the information contained in these reports. Specifically, the analysis is based on information contained in the GNWT’s two latest monitoring reports, both entitled “Communities and Diamonds”, produced for the years 2000 and 2001.

These reports use a number of public statistics to determine how the EKATI and Diavik projects have affected “small local communities” (including Lutsel K’e, Rae Edzo, Rae Lakes, Wha Ti, Wekweti, Detah, and N’dilo) and Yellowknife. Because of its size, data for Yellowknife are reported separately. Indicators used to assess trends in social stability and community wellness include:

- Injuries and poisonings;
- Premature mortality from injuries, suicides, and in total;
- The number of suicides, teen births, and number of single-parent families;
- The number of children in care;



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Spousal assault complaints;
- The incidence of different types of crime;
- Incidence of communicable disease; and,
- Housing conditions.

An examination by De Beers of the trends and conclusions presented in the 2001 report suggests that the two existing diamond projects appear to have had little or no negative impacts on social stability and community wellness. This appears to be particularly true in the smaller communities. Some social conditions, such as the incidence of residential overcrowding and the percentage of the population with less than a Grade 9 education, have in fact improved considerably in these communities. Although there were negative trends in some of the indicators in Yellowknife, the report indicated that it was not clear that these were due to the mines. As was the case in the smaller communities, trends in some indicators have improved in Yellowknife. A survey of EKATI employees in 2000 generally supports the conclusion that mine employment has had mixed effects on individuals and families but that most effects are not negative.

### *Conclusions*

The Board is satisfied that the commitments made by De Beers will assist in reducing negative impacts of the development on social stability and will promote community wellness. It also accepts De Beers' assertion that socio-cultural impacts will vary among different communities and among different members in each community. This view is supported by the testimony of the various Parties to the EA, many of whom had very different views regarding the extent, and even the direction, of social effects.

The Board found it difficult, based solely on the limited evidence provided by De Beers, to assess whether the impacts of the SLDP on social stability and community wellness will be negative or positive. The Board suggests that De Beers could have provided empirical evidence to support its predictions of socio-cultural impacts and its assertion that "...the overall socio-economic impacts are acceptable" (De Beers' slide presentation at Public Hearing, Day 5, May 2, 2003, Snap Lake Diamond Project Socio-economic Impact Assessment, p. 32). The assessment of significance that follows is based on the Board's assessment of the information contained in the GNWT's monitoring reports described in the previous section entitled "Description of Issue".

Because the Diavik project had not yet begun operation at the time the GNWT's reports were completed, the reports reflect impacts only from construction of this project. However, participation by northerners in Diavik's construction has been sizeable. In 2001, Diavik's construction created the equivalent of 427 full-time jobs for northern workers. This level of northern participation persisted during the first six months of 2002 (Diavik Diamonds Project, Socio-Economic Monitoring Report to June 30, 2002, Table A3). The EKATI mine employed almost 1,000 northern workers during 2001 (BHP Billiton Diamonds Inc., Annual Report on Northern and Aboriginal Employment— 2001 Operational Phase, Tables 2A and 2B). By comparison, the SLDP expects to employ 300 northern



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

workers once operation begins (Response by De Beers to Review Board Information Request dated April 4 2003, response to Q1 (2) (i) (a) and supplementary to (c)).

Given the small size of the SLDP relative to the two mines considered in the GNWT's report, and the limited negative community impacts that the report suggests are associated with the two existing mines, it is reasonable to conclude that the negative impacts of the SLDP are also likely to be limited. The Board therefore concludes that, assuming implementation of the mitigation measures committed to by De Beers, the SLDP, in and of itself, will not likely have a significant negative impact on social stability and community wellness.

In the cumulative context, the Board is concerned that the pace of developments in the north has outstripped our collective ability to understand cumulative impacts and that too rapid a pace of development could impair the ability of communities to respond to the associated changes without significant social harm. The pace of development could lead to an inability on the part of communities to provide needed services to address negative socio-cultural effects.

In addition, multiple mine closures in 20 or 25 years could have serious negative impacts on social stability and community wellness. The timing of these closures, if no further reserves are identified, may create a "boom and bust" situation that has been identified in other resource development situations.

However, the Board is of the view that there is currently insufficient information to assess the severity of these future negative impacts. In addition, the Board acknowledges that development in the north has positive impacts as well on social wellness, by contributing to the ability of people in the NWT to choose the extent to which they participate in a traditional versus a wage-based lifestyle.

Based on the lack of clarity surrounding the balance of negative and positive impacts, on the statistical evidence provided in the GNWT report, and on the evidence provided to it during the EA process, the Board concludes that, at this point in time, cumulative impacts on social stability and community wellness are not likely to be significantly adverse.

### **2.17.4.2 Community Services and Housing**

#### ***Description of Issue***

Although De Beers committed to northern employment targets, it acknowledged that many of its northern-based employees would not be currently reside in the north but would relocate there. Of the total of 500 operating positions, De Beers estimated that 300 will be residents of the NWT and that, of those, 50% (150) will be new residents who have relocated from the south (Response by De Beers to Review Board Information Request dated April 4 2003, response to Q.1(2)(i)(a) and supplementary to (c)). Of these 150 new residents, 60-70% - that is, 90-105 workers - will move to Yellowknife while the rest will move into other communities (Response by De Beers to Review Board Information Request dated Apr. 4/03, response to Q.4(1)). Yellowknife will therefore require 90-105 new housing units and, assuming an average household size of 2.2, the total population of Yellowknife will





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

increase by 220 people (Response by De Beers to Review Board Information Request dated April 4 2003, response to Q.4(1)). De Beers was unable to estimate how the remaining 50 or so new NWT residents would be distributed among the primary and catchment communities.

De Beers was of the view that the amount of in-migration generated by the SLDP in itself would be small and suggested that, at least in Yellowknife, costs for education and community services could be borne by the existing fiscal structure (Response by De Beers to Review Board Information Request dated April 4 2003, response to Q.4(1)). The developer committed to providing “...*project-specific information to the planning authorities to ensure the relevant information related to Snap Lake can be considered in each community’s growth scenarios, infrastructure needs assessment, and public capital planning*” (De Beers Conformity Response, August 22 2003, Section 9.2.3, p. 45). De Beers contended that housing needed for SDLP workers relocating to the NWT would be provided by the private sector (Response by De Beers to Review Board Information Request dated April 4 2003, response to Q.4(1)).

In the cumulative context, De Beers acknowledged that a number of effects could be triggered by the increase in employment levels and disposable incomes, the increased demand for skilled labour, and the possibility of increased population (especially in Yellowknife) including:

- Improvements in the material quality of life of employees and employees’ families;
- Increased need for financial management skills training and services;
- Increased community divisions between “haves” and “have-nots”;
- Increased spending on addictive substances and an associated deterioration in employees’ and their family members’ lives; and,
- Increased need for social infrastructure and services such as education, training programs, health care, child care facilities, life skills and substance abuse programs.

(EAR, Section 12)

De Beers noted that “...*if investment into social capacity building of communities is not made, then a negative social scenario may result*” (EAR, p. 12-33).

The YKDFN, the NSMA, and the LKDFN noted that an increase in population in the primary communities would lead to increased demands on community services and that the resources to meet this increased demand were, in many cases, not available. There was particular concern that an increase in population could lead to housing shortages. LKDFN noted that “*currently, there are 31 applicants on the community waiting list for social housing... We are seeing mining employees moving away because there is no new housing and social housing becomes unaffordable*” (Public Hearing Transcripts, Day 5, May 2 2003, p. 202). The NSMA noted “...*chronic housing shortages and high levels of overcrowding in Aboriginal communities*” (Public Hearing Transcripts, Day 5, May 2 2003, p. 125).

The GNWT suggested that the mining industry was putting a strain on the availability of housing in the NWT. The GNWT acknowledged that it was not solely the problem of De Beers but suggested



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

that the developer work with the GNWT on this issue and that housing be an issue included in the Socio-economic Agreement.

The YKDFN suggested that some Aboriginal workers may not feel comfortable spending their time off in Yellowknife and might, instead, go to smaller nearby communities such as N'dilo or Dettah. The lack of accommodation in these communities might create pressures to house visitors in private homes.

### ***Conclusions***

The Board agrees that there will be impacts on community services, such as health care and education, and on the demand for housing, both from the SLDP alone and in conjunction with other developments. However, the Board concurs with De Beers that impacts from the SLDP in itself, will be sufficiently limited that, at least in Yellowknife where population increases are likely to be greatest, costs for community services can likely be borne by the existing fiscal structure. The Board is also of the view that the increased demand for housing, generated by the SLDP alone, will be small and that needed housing can be provided by the private sector and/or through existing mechanisms under the Northwest Territories Housing Corporation. Thus, the Board concludes that SLDP-specific effects on community services and housing will not likely be significantly adverse.

Notwithstanding this conclusion, the Board acknowledges that housing pressures will continue to be an issue in the NWT. The Board is of the view that the GNWT, and specifically the Northwest Territories Housing Corporation, has an increasingly important role to play in helping small communities predict population increases that will arise as a result of development and to plan for, and ensure the provision of, appropriate amounts and types of housing.

In the cumulative context, the Board is concerned that, under existing revenue sharing arrangements between the Governments of Canada and the Northwest Territories, the resources to provide for community social services may be lacking as a result of the rapid rate of natural resource development in NWT.

### **2.17.4.3 Cultural Well-Being**

#### ***Description of Issue***

De Beers recognized that *“the maintenance of cultural values is integral to the sustainability of the primary communities”* (De Beers Conformity Response, August 22 2002, Section 5.2, p. 27). The company also acknowledged that the traditional economy is still an important cornerstone to lifestyle and culture in the north and that *“over three-quarters of the people in the NWT consume harvested meat and fish”* (Public Hearing Transcripts, Day 5, May 2 2003, p. 31). De Beers recognized that its project would inevitably impact lifestyles and *“...possibly, the extent and nature by which cultural activities are practiced”* (EAR, p. 5-158). However, the company noted that *“based on the available data and the interviews that De Beers conducted in the primary communities, there is no clear causal*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*relationship between wage economy participation and the decline or increase in participation in traditional activities” (De Beers Conformity Response, August 22 2002, Section 5.2, p. 26). As a result, “it is not possible to predict with reasonable certainty whether individual and community involvement [in] mining activities will negatively or positively impact on the subsistence economy in communities” (De Beers Conformity Response, August 22 2002, Section 5.2, p. 27).*

With respect to language, De Beers noted that, due to a variety of factors, *“the use of Aboriginal languages has declined persistently in the NWT over the past two decades, as exemplified by the primary communities” (De Beers Conformity Response, August 22 2002, Section 7.1.2, p. 32). Although De Beers indicated that it was “...willing to work with Aboriginal communities because it is at the community level that Aboriginal languages are primarily learned and spoken...the primary responsibility for ensuring the survival of a language rests with the individual, the family and the community” (De Beers Conformity Response, August 22 2002, Section 5.2, p. 33).*

De Beers committed to a number of initiatives to protect and promote traditional practices and culture, including cross-cultural training, a cultural exchange program, Community Appreciation days, and possible funding for community-based cultural programs. De Beers also suggested that increased wage earnings could facilitate the practice of traditional activities by allowing people to buy equipment used for these activities and by creating business activities based on local culture, such as arts and crafts and traditional food catering (EAR, Executive Summary, p. xxi). The company also committed to *“...continue to co-operate with agencies responsible for monitoring this sector of the economy” (De Beers Conformity Response, August 22, 2002, Section 5.2, p. 26).*

The LKDFN described the results of a survey of mine employees that suggested that mine employment negatively affects participation in traditional activities, such as hunting, trapping, and harvesting. Based on the results of the survey, the sustainability and preservation of Aboriginal languages and culture are also points of concern. These concerns were echoed by the NSMA.

In addition, the LKDFN and the YKDFN felt that activities and traffic associated with the mine and with an increased population could put pressure on the land and resources, especially caribou. This, in turn, could further diminish traditional practices with spiritual, cultural, and economic implications. The LKDFN noted that its community depends on caribou hunting, fishing, harvesting and trapping. Similarly, the NSMA stated that it has *“...a strong subsistence economy and traditional land use they would like to see protected” (Public Hearing Transcripts, Day 5, May 2 2003, p. 121).* A related concern of the NSMA was that De Beers’ RSA was defined inappropriately and that there would be impacts on Métis fisheries outside the RSA.

Finally, the NSMA and the YKDFN were concerned that TK had been inadequately incorporated into mine design, predictions of impacts, and proposed monitoring programs.

In its “Communities and Diamonds” report for 2001 the GNWT provides some indication of trends in participation in traditional activities (using trapping as an indicator) and use of Aboriginal language. (A description of these reports is provided in Section 2.17.4.1) Data over the period from 1988/89 to



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

1998/99 show that “*the proportion of the population trapping fell in 1993, which coincided with the height of diamond exploration in the NWT. The level of trapping has since increased but not to its 1988 levels.*” The report suggests that changes in trapping activity could be related to mineral activity but also notes that “*...the price of furs also dipped during this period and is just beginning to recover. The separate effects of mineral activity and fur prices will need to be tested before conclusions can be made.*” (GNWT, “Communities and Diamonds”, 2001 Annual Report of the GNWT under the BHP Billiton and Diavik Socio-economic Agreements, p. 34).

With respect to the use of Aboriginal languages, the data suggest little change over the period 1989-1999 in the use of Aboriginal languages in small local communities. Over this period, the use of traditional languages in these communities remained steady at over 90% of the total population. Elsewhere in the NWT, Aboriginal-speaking populations “*...are slowly declining...[However] these trends were occurring prior to the development of the diamond industry and no apparent links between the diamond industry and languages can be identified without further information.*” (GNWT, “Communities and Diamonds”, 2001 Annual Report of the GNWT under the BHP Billiton and Diavik Socio-economic Agreements, p. 36).

### ***Conclusions***

Given De Beers’ conclusion that it could not predict whether the project’s impacts on subsistence activities would be negative or positive, the Board found it difficult, based solely on the evidence provided by De Beers, to determine whether the net effects of the SLDP on cultural well-being would be significantly adverse. The following assessment is therefore based in part on the evidence provided by the Parties and the information provided in the GNWT’s “Communities and Diamonds” reports.

The usefulness of the reports for assessing the impacts of past development on cultural wellness is limited by the fact that the most recent data available is 1998, for trapping, or 1999, for Aboriginal language use. The EKATI mine began operations in October, 1998 and construction of Diavik’s mine did not begin until December, 2000. Thus, the impacts of the mines on cultural well-being may not yet be reflected in the data.

More importantly, the data may reflect factors quite apart from the two diamond mines. As both the GNWT report and De Beers noted (De Beers Conformity Response, August 22 2002, Section 5.2, p. 33), the decline in the use of Aboriginal languages in the NWT is attributable to several influences including:

- Increased Aboriginal participation in a predominantly English labour market;
- The segment of the population that is most fluent in Aboriginal languages is aging;
- There is a lack of materials in Aboriginal languages used for leisure activities and increased access to other resources; and,
- There is a marked migration to larger mixed communities where support for Aboriginal languages is not as strong as in small local communities.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

(GNWT, “Communities and Diamonds”, 2001 Annual Report of the GNWT under the BHP Billiton and Diavik Socio-economic Agreements, p. 35).

The Board is of the view that the negative effects of the SLDP on cultural well-being will be negligible in comparison to that of the factors listed above. The Board therefore concludes that the effect of SLDP in itself on cultural well-being is unlikely to be significantly adverse.

In the cumulative context, the Board is concerned that communities in the north could be approaching thresholds past which cultural wellness could be seriously impacted. However, the Board acknowledges that there is insufficient information available to assess how close to these cultural thresholds the NWT currently is, or what the effects of breaching the thresholds will be. Based on the absence of threshold information and on the statistical evidence provided in the GNWT report, the Board concludes that, at this point in time, cumulative impacts on cultural wellness are not likely to be significantly adverse.

### 2.17.4.4 Socio-Cultural Suggestions

#### 2.17.4.4.1 Suggestions

**Although the Board has concluded that the SLDP is not likely to have a significant adverse impact, either by itself or cumulatively, on socio-cultural conditions, it is of the opinion that additional measures should be considered to ensure that impacts on socio-cultural conditions remain within acceptable levels and to ensure that significant adverse impacts are avoided in the future. To this end, the following suggestions should be considered for implementation:**

**(S34) De Beers should pursue joint ventures or partnerships with community-based organizations or businesses for the delivery of employee assistance support programs. This would facilitate the provision of services in a culturally appropriate way and is consistent with De Beers’ stated intention to consider using local resources for counseling (Technical Session Transcripts, Day 10, December 6 2003, p. 63). The Board recognizes De Beers’ commitment to provide substance abuse programs both at the mine site and in the communities and suggests that as many of the other programs as possible also be made available both on-site and in the communities.**

**(S35) In its Technical Memorandum, dated February 28, 2003, De Beers provided details related to its proposed “De Beers Canada Fund”. In this memorandum, De Beers indicated that initial funding for the Fund will be “...a minimum level of 1.0% of net annual after tax cash flow for the Canadian operations” (Technical Memorandum, De Beers Canada Fund, February 28 2003). The Board suggests that De Beers allocate a specific portion of the 1% amount to support communities impacted by the SLDP.**



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

(S36) The GNWT should produce standardized and consolidated annual reports on results achieved under the De Beers, Diavik and BHP Billiton Socio-economic Agreements.

(S37) The Board suggests that the GNWT should, under the NWT Cumulative Impact Monitoring Program, study the links between industrial development and socio-cultural conditions. This is important to predict the demands that further natural resource development will place on social and community infrastructure and services, identify critical thresholds, and suggest appropriate measures to address these issues.



Review Board Executive Director, Vern Christensen (left) with Board members (left to right) Danny Bayha, Bertha Rabesca and Charlie Snowshoe during a summer site visit to the Snap Lake Diamond Mine.

## 2.18 Effects of the Environment on the Development

### 2.18.1 Summary of Developer's Submissions

The EA Terms of Reference requested that De Beers assess the effects of the environment on the SLDP and activities forming part of the development, including the full range of environmental conditions (e.g., severe weather events, wet, dry and normal precipitation and extreme temperature spells). De Beers was also required to assess the influence of climate change on the local permafrost terrain and the integrity of the proposed development infrastructure.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers' EAR addresses the effects of the environment on the project both implicitly and explicitly. Severe weather events, wet, dry and normal precipitation, changes in water elevations in Snap Lake, flooding and extreme temperature spells, were described as part of the baseline characterization and were considered in the project design (e.g., North Pile, surface water collection and containment facilities) and throughout the impact assessment.

Other potential effects of the environment on the project were considered more explicitly. De Beers' EAR examined the presence and distribution of ground ice in the native undisturbed terrain and its effect on the stability of containment structures by first conducting subsurface investigations in the area of the proposed North Pile. The results of these investigations indicated that terrain units with organic soils, ice-rich soils or weak soils were localized and occurred predictably within the footprint of the North Pile. Beneath the shell containment structure of the North Pile, De Beers will remove all organic soils, weak mineral soils, ice-rich soils and any other soils deemed to be unsuitable, down to competent mineral soils or fractured bedrock. As such, containment structures would be constructed on a prepared foundation.

De Beers' EAR examined the potential effect of freeze-back of the 9 million m<sup>3</sup> of processed kimberlite in the North Pile on surface water quality. De Beers indicated that the entire pile will be frozen (to ground temperatures of approximately -0.2 Degrees Celsius) within two years after cessation of deposition of processed kimberlite, with the exception of an active layer on the pile's surface during warmer seasons. De Beers also carried out seepage modelling based on the assumption that the North Pile would be unfrozen. De Beers concluded that the perimeter collection system will effectively manage waters generated at the North Pile whether the pile is frozen or unfrozen. During operations, the collection system will direct water to the water treatment plant. In the post closure, seepage volumes from the North Pile are expected to be small in proportion to the surface runoff and the water quality is expected by De Beers to be acceptable for discharge to Snap Lake.

De Beers reported that based on a seismic hazard assessment for the SLDP site by Pacific Geoscience Centre, the proposed development is considered to be located within a Seismic Zone 0 of the current National Building Code, which is the negligible seismic risk category in Canada. Therefore De Beers concluded that based on the historical record, seismic events are unlikely to occur at the SLDP. De Beers added that there have been no seismic events recorded within 500 km of the site and no events exceeding a magnitude of five (5) (i.e., potentially damaging events) within 1,000 km. Buildings and structures will be constructed to meet applicable building codes.

Climate change was hypothesized by De Beers to result in thawing of permafrost within containment structures; pile materials and the site roads and airstrip. Additional consolidation of the processed kimberlite with resulting expulsion of pore water would occur. The EAR indicates that the North Pile has been designed to be stable even if the pile material remains unfrozen, and site roads and the airstrip are constructed of non-frost susceptible fill. The water management pond's retention dikes and dams are also founded on prepared bedrock.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The effect of pore water expulsion and seepage into surface waters during the post-closure phase was examined in the surface water quality assessment. De Beers concluded that the effect on surface water quality is low.

### **2.18.2 Summary of Responses from the Parties**

Regarding the effects of the environment on the project, Parties to the EA focused their responses on climate change and freezing of the North Pile.

It was INAC's opinion that the possibility of climate change must be anticipated over the next two 200 years. INAC representatives indicated that most of the climate models which address projections for the next 100 years predict a region of largely continuous permafrost for the Snap Lake environment. The freezing regime at the surface will be, for the foreseeable future, a regime which is dominated by winter conditions with temperatures below zero then dominated by summer conditions, with temperatures above zero. For that reason, INAC indicated that permafrost will be established in the pile. However, the time frame for the North Pile to freezeback to temperatures equivalent to that encountered in the surrounding undisturbed terrain could take decades and, possibly, one or two centuries after the deposition of the pile, irrespective of climate warming. INAC also noted that in a climate warming scenario, the length of time for freezeback, equivalent to a natural background condition will be extended.

INAC and other Parties to the EA questioned De Beers' prediction of when the North Pile would freeze completely and in the predicted time frame. The discussion by the Parties was that different rates of freezing of the processed kimberlite potentially result in different effects of the North Pile on surface water quality. Details regarding these issues are provided in Sections 2.3.3.1 through 2.3.3.5.

The issue of climate change is also discussed in terms of air quality in Section 2.12.3.2 of this report.

### **2.18.3 Conclusions**

In previous sections, the Board concluded that the temperature prediction model for the North Pile as applied by De Beers is adequate for the purpose of this EA and should not preclude the project from proceeding to the regulatory phase (see Section 2.3). The Board also concluded that there would be no significant adverse impacts on surface water quality as a result of seepage from the North Pile and but acknowledges that there is some degree of uncertainty regarding the prediction of the freezing rate of the pile (see Section 2.3.3.1).

The Board concludes that the effects of climate change have been considered and that significant adverse impacts to Snap Lake resulting from climate warming on the post-closure condition are unlikely.





## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

In all other cases, the Board is satisfied with the conclusions reached by De Beers. The Board concludes that the effects of the environment on the SLDP have been adequately considered by De Beers and that resultant environmental effects are not likely to be significant.

### **2.19 Accidents and Malfunctions**

#### **2.19.1 Summary of Developer's Submission**

De Beers followed a risk assessment approach to assess:

- Impacts of accidents and malfunctions at the proposed mine site on the proposed development (including underground mine workings) and the environment; and,
- Impacts of accidents and malfunctions on Tibbitt-Contwoyto winter road and Snap Lake winter access road connecting the mine to the Tibbitt-Contwoyto winter road.

The focus of De Beers' assessment was on those risks with the potential to impact the off-site environment or the long-term viability of the SLDP. Risks were estimated according to their predicted frequencies and seriousness of the environmental consequence that could result. The primary receptor examined was risks to aquatic life.

De Beers notes that the management of risks are integral to its policies, procedures, and operating systems, and that management systems will be in place to mitigate most environmental risks and limit environmental consequences. De Beers outlines a detailed spill contingency plan in Appendix III.9 of its EAR.

Twelve risk scenarios associated with the proposed mine site were assessed:

1. Crash of air craft transporting workers or fuel to site;
2. Loss of processed kimberlite: small volume release from breach of Dam 1;
3. Loss of processed kimberlite: large volume release from breach of Dam 2;
4. Loss of processed kimberlite: any release from breach of Dam 2;
5. Failure of North Pile: small release from shallow sump and erosion;
6. Failure of North Pile: large release from major slump flowing to Snap Lake;
7. Catastrophic failure of fuel storage system;
8. Failure of fuel distribution system;
9. Failure of water treatment system;
10. Power system failure;
11. Catastrophic geotechnical failure under Snap Lake impacting underground mine shaft; and,
12. Failure of kimberlite ore stockpile collection system.

According to De Beers' assessment, all risks from accidents and malfunctions at the proposed mine site were associated with the more minor environmental consequence levels of negligible and low



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

with the exception of one scenario (major failure of Dam 1) which would result in moderate environmental consequences. However, De Beers notes that this scenario is extremely unlikely, with a frequency of 1/10,000 years.

De Beers' risk assessment of accidents on the winter road (Tibbitt-Contwoyto winter road and Snap Lake winter access road) was based on the spill probability and the potential toxic effects of spills on aquatic life. Information about truck spill accidents on the winter road since 1983 was used to estimate future spill incidents.

Risk of a spill on the winter road affecting water bodies was defined by the potential for an accident and spill, the type and amount of hazardous material spilled, the effectiveness of the spill cleanup and the environmental effect of the residual material remaining. The materials examined with respect to spill scenarios included:

- Diesel;
- Gasoline;
- Lube oils, hydraulic fluids and oils, waste oils, transmission oils, drive oils;
- Ethylene glyco;
- Ammonium nitrate;
- Hydrofluoric acid; and,
- Slaked lime.

De Beers risk assessment showed that the risk of spills to aquatic life fell in the low-risk area because of a combination of low frequency and negligible to low environmental consequences ratings for each of the spill scenarios.

De Beers developed a preliminary Spill Contingency Plan (EAR, Appendix III.9) which applies to all operational activities at Snap Lake. In response to IR 3.3.3 from Environment Canada, De Beers committed to report all spills to the NWT Spill Line.

### 2.19.2 Summary of Responses from the Parties

Environment Canada and the Board expressed concern that the water management facilities may not be adequate to deal with unexpectedly large volumes of mine water combined with large runoff events or water treatment plant failures. This concern was dealt with through the developer's commitment to maintain 35,000 m<sup>3</sup>/d of excess treatment plant capacity, to maximize the storage capacity available in the water management pond and to flood the mine to prevent untreated mine water from being released into Snap Lake. Section 2.5 of this Report of EA also discusses storage capacity.

The YKDFN expressed several concerns relating to spills on the winter road related to highlighted at the November-December 2002 Technical Sessions and the Public Hearing:



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Incremental accumulation of smaller spills on the winter road and the potential effects on aquatic habitat; and,
- De Beers' risk assessment conclusions regarding spills on the winter road and potential effects on aquatic life.

### 2.19.3 Key Issues

Environmental Canada's issue regarding storage capacity of water management facilities was resolved prior to the Hearing. The remaining key issue considered by the Board is the potential effects of spills on the winter road.

#### 2.19.3.1 Winter Road Spills

##### *Description of Issue*

At the November-December 2002 Technical Sessions, the YKDFN expressed concern about the potential for incremental accumulation of smaller non-accidental, but unintentional, leaks of fuel, coolants and hydraulic fluids from damaged or poorly maintained haul trucks. The concern was that there is potential to harm lakes and streams at break-up. (tech report and tech sessions, p39 day 4 ). De Beers did not directly respond to YKDFN's issue regarding accumulation of smaller spills on the winter road; however, YKDFN did not bring this issue forward to the Hearing.

The YKDFN stated at the Public Hearing that De Beers' risk assessment of the environmental impacts from fuel, or chemical spills on the Tibbitt-Contwoyto Winter road are inadequate. A more conservative risk assessment is warranted given the fragile nature of the land and water over which the winter road runs, as well as a lack of baseline data for these water bodies. The YKDFN expressed two specific concerns:

1. The YKDFN stated that a worst case scenario was not examined for diesel spills into small lakes. The YKDFN indicated that the worst case scenario would be a malfunction of the check valves on trucks that prevent excessive flow out of trucks that break through ice. The concern is that the potential volume of diesel would be much greater than the 200 litres used by De Beers in its EAR, and that the environmental consequence would be greater than EA predictions. The YKDFN believes that this larger volume could create a situation where aquatic toxicity thresholds may be reached.
2. The YKDFN also stated that there is uncertainty in De Beers' prediction that the risks to fish-bearing lakes are at low risk. YKDFN were concerned about the potential effects of a hydrofluoric acid spill on fall-spawning fish eggs. This concern stems from the lack of data on spawning grounds in the fish-bearing lakes:

*“Without knowing where the spawning grounds for such fish are in affected...lakes over which the road runs, one cannot predict with certainty that because this spill*



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*has affected only a tiny fraction of the lake, that this won't result in a far more significant impact to the fish population in that lake.”*

(Tim Byers, YKDFN, Public Hearing Transcripts, Day 4, May 1, 2003, p. 135).

At the November-December 2002 Technical Sessions, De Beers stated that a rigid spill cleanup protocol on the winter road exists, and that there is a rapid response to any spill of any size on the winter road. De Beers further pointed out that:

*“I have been onsite now to see at least one breakthrough of a tanker and I have read reports of others. They have a characteristic way of going through the ice. Fortunately, the tractor stays up on the ice so the driver is fine, and the middle dolly breaks through first through the two trailers and the back tanker goes down first, and then the front tanker goes down. What is pretty neat about these things is that the tankers, even though they are fully loaded with fuel, float. So if the valving system doesn't shear off at the back when it goes through the ice, which often it doesn't and they are in the process now of strengthening those and changing that, then there is no spill or very little spill. So they just come along with another tanker and pump it out and then retrieve the truck, so that when you look at it from a scenario of, let's assume a breakthrough occurs, what are the consequences? The consequences in terms of spill historically have been pretty darn minor. Very few cases and very small amounts of fuel lost into open water.”*

(Don Hayley, EBA Engineering, Technical Session Transcripts, Day 8, December 4, 2003, p. 39)

### **Conclusions**

The Board is generally satisfied with De Beers' assessment of the effects of accidents and malfunctions on the environment. The Board is of the opinion that the predicted risk of spills on small fish-bearing lakes is reasonable. The Board notes that De Beers did not use a worst case scenario in its risk assessment of spills on the winter road. However, the Board is of the opinion that the necessary contingency and response plans for the winter road (Tibbitt-Contwoyto winter road and Snap Lake winter access road) and at the proposed Snap Lake mine are in place to minimize the potential impacts on the environment.

The Board concludes that significant adverse impacts on the environment as a result of accidents and malfunctions at the proposed mine site or along the winter road are not likely to occur.

## **2.20 Project Alternatives and Opportunities**

The Terms of Reference required that De Beers examine a wide range of mine development, production and technical alternatives and opportunities, including the economic feasibility of those alternatives that would mitigate impacts on the environment, or enhance the socio-economic



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

performance of the proposed mine. De Beers was also required to report on the costs of proposed development alternatives and the corresponding environmental benefits.



**Panel Chair, Gordon Wray (centre) with John McConnell (left) Vice-president, NWT Projects for De Beers Canada Mining Inc. Review Board legal counsel, John Donihee and Board Member Frank Pope in background.**

### 2.20.1 Summary of Developer's Submission

De Beers developed the SLDP through the examination and ultimate acceptance or rejection of design and operational alternatives based on various considerations such as practicality, availability, environmental effects, cost and community concern. Alternatives regarding the following aspects of the SLDP were examined: the site location and mine footprint, mining methods, waste rock and processed kimberlite management, water management, employee work schedule, employee living conditions, energy sources, power reduction, transportation, decommissioning and reclamation. Specific designs for the preferred alternatives will be examined during more detailed design stages.

From the outset of the planning process, De Beers decided to limit the size of the mine footprint to minimize the environmental effects of the project. As such, the mine footprint was largely limited to the northwest peninsula. This early decision also influenced subsequent decision-making regarding other aspects of the SLDP. For example, De Beers considered large open pit mining, small open pit mining, no open pit and various underground mining options. In order to minimize the mine footprint, underground mining using a modified room and pillar method was selected as the preferred mining method, despite the higher costs compared to open pit methods. The room and pillar mining method also offered advantages such flexibility, geotechnical stability, less disruption of the aquatic



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

environment (i.e., no need to drain or dike Snap Lake or to divert drainage systems) and cost effective production rate over other underground mining methods.

Waste rock and processed kimberlite management alternatives included various locations and pile sizes for the rock and processed kimberlite materials. Given De Beers' intention to minimize the project footprint and effects on the northwest peninsula, the volume of waste rock that would be placed underground was optimized and a single surface waste rock and processed kimberlite location (i.e., the North Pile) was selected.

In terms of water management alternatives, De Beers EAR documents how the evolution of the water management component of the SLDP design had evolved in response to changes in mining plans. For example, the North Pile sedimentation pond was deleted once a decision to install a treatment plant was made. Proposed discharge to the north arm of Snap Lake was rejected based on the results of water quality modeling and interference with water intakes.

Alternative forms of water treatment were reviewed by De Beers and a decision was made to implement conventional treatment technology consisting of a thickener and a final effluent filter.

De Beers selected the proposed operational employee work schedule (i.e., two weeks in and two weeks out) after listening to the opinions of potential employees. It was De Beers' opinion that this combination appeared to allow sufficient time for a combination of traditional and wage economy activities. During construction, a three week in and one week out schedule was selected. Similarly, De Beers' EAR indicated that it will continue to work with potential employees in determining the facilities available at the mine site, food alternatives, and interior and exterior building designs.

De Beers EAR examined a number of alternative sources for energy supply, including diesel power generation, wind turbines, solar energy, fuel cells and propane. De Beers concluded that:

- diesel power was the most reliable energy source;
- wind turbines and fuel cells were not yet technically or economically feasible;
- solar energy offered opportunities for specific mine applications; and,
- propane was substantially more costly than diesel.

As such, diesel was determined to be the preferred fuel. De Beers also committed to use low sulphur fuels where appropriate. De Beers also found no cost effective alternative to the use of the Tibbitt-Contwoyto winter road for the transportation of primary cargo.

De Beers' examined several decommissioning and reclamation alternatives. De Beers concluded that complete mine backfill and sealing will be implemented to minimize effects on surface from stored waste materials. Roadway and the airstrip infrastructure would be dismantled and the sites regraded to establish natural drainage patterns, despite the increased cost over the "leave in" option. In an effort to maintain a small footprint, De Beers decided to limit quarries to the North Pile area and a selected esker off the mine site and proposed that the land fill and landfarm sites would be located



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

within the North Pile. Lastly, the final contours for the materials remaining in the North Pile after mine operations cease, were selected in order to minimize the visual intrusion of the facility. De Beers recognized the importance of long-term monitoring for reclamation, re-vegetation and restoration of wildlife habitat. As such, De Beers will establish a reclamation monitoring program to assist the suitability and success of various reclamation activities.

### 2.20.2 Summary of Responses from the Parties

CARC and the YKDFN questioned the applicability of the paste technology proposed by De Beers. INAC considered the proposed mine plan to be sound and paste technology to be superior to the more conventional approach of damming large surface areas or infilling lakes to dispose of processed kimberlite. However, INAC shared the concerns of other Parties to the EA that there is no directly applicable precedent for the proposed tailings disposal because world-wide experience with kimberlite tailings paste is limited to non-arctic environments. INAC conceded that the production of tailings paste is not a new technology and noted that their key reservations regarding paste technology and waste disposal related mainly to the effect of effluent on surface water quality in Snap Lake.

During the EA process, Parties challenged De Beers' intent to allow the North Pile seepage to enter the North Inlet. De Beers responded with a modification to the EAR mine plan – construction of an interceptor ditch, a berm to encourage formation of a permafrost barrier to seepage, and a negative hydraulic gradient between the North Inlet and the North Pile. The effectiveness of this alternative is discussed in Section 2.3.3.4.

The GNWT suggested that the location of facilities to remediate hydrocarbon contaminated soils must be separate from other facilities and that a dedicated landfill site outside of the North Pile should be examined. The GNWT requested information regarding alternatives to the North Pile for the establishment and management of the landfarm and landfill locations.

During the EA process, Environment Canada, DFO and other Parties questioned the selection of the conventional water treatment technology. Concerns focused on the effectiveness of the proposed technology to minimize the effects of mine effluent, in particular TDS, on Snap Lake. Treatment of TDS by advanced technologies such reverse osmosis or ion exchange was considered by De Beers but rejected on the basis of cost and feasibility (De Beers Technical Memo February 8, 2003 *TDS Removal Technology for Mine Water Treatment at Snap Lake*). Further discussion of issues related to water quality is provided in Section 2.6 of this report.

CARC questioned whether there were any differences between the energy profile of the SLDP and the other diamond mines and if that difference in energy profile might lend itself to alternative energy use in any way. The GNWT indicated that the SLDP is a larger percentage user of electricity than the other mines, due to the fact that it is an underground operation and not a surface open-pit operation. With the Diavik and EKATI mines, approximately 66% of the fuel is used in transportation-related activities whereas that percentage is significantly lower at the SLDP.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

CARC also raised issues regarding GHG emissions and the possibility of providing hydroelectricity to the mine site. Further discussion on these issues is provided in Section 2.12 of this report.

During the EA process, questions were also raised regarding when the final decisions on permanent employee accommodations would be made and the nature/quality of camp facilities during mine construction. In addition, concerns were expressed regarding the selection of the fly in and out schedule and its effects on individuals, families and communities.

### 2.20.3 Key Issues

In the opinion of the Board, the key issues regarding alternatives relate to the choice of water treatment technology, landfarming and employee/worker schedule and living conditions. Issues regarding the effects of choice of diesel as the preferred fuel are addressed in Section 2.12 of this report.

#### 2.20.3.1 Water Treatment Technology

##### *Description of Issue*

In response to concerns of Environment Canada and DFO regarding water treatment technologies, De Beers provided a technical memorandum entitled *Summary of Water Treatment Process Development Selection and Comparison of Alternatives*. The alternatives to conventional treatment examined by De Beers included Ion Exchange, Reverse Osmosis. De Beers concluded that these technologies did not offer substantial environmental advantages over conventional treatment technologies. In fact, the analysis indicated that power requirements would necessitate approximately 700 more trucks of fuel/year and double of GHG emissions from the power plant. Off-site salt disposal would add to the transportation burden. Moreover, costs were substantially greater. De Beers indicated that their analysis regarding Reverse Osmosis concurred with conclusions reached in an assessment of applicable technologies for the NWT completed for the Department of Indian and Northern Affairs Canada<sup>13</sup> (INAC, 2002) which reject this technology on a practical basis due to high energy consumption and issues related to transportation and waste disposal.

Based on the review of De Beers' studies and discussions with De Beers, Environment Canada was satisfied that full consideration had been given to identify the best available practical treatment and that De Beers' commitments to monitor, adaptively manage, and use best available technology economically achievable will further minimize impacts on Snap Lake. At the Public Hearing, DFO noted that without additional data to support De Beers' choice of treatment approach, its reviewers

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<sup>13</sup> INAC, 2002. "Applicable Technologies for Management of Mining Effluent in the Northwest Territories" prepared for the Department of Indian and Northern Affairs Canada, by Lakefield Research and SENES Consultants Limited, April, 2002.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

could not assess whether the most environmentally beneficial approach was chosen, and whether impacts due to metals in the discharge have been mitigated to the extent possible.

### *Conclusions*

The Board concludes that De Beers has sufficiently examined the advantages and disadvantages of alternative water treatment technologies and is satisfied that conventional treatment technology is appropriate for the SLDP.

### **2.20.3.2 Landfarm and Landfill**

#### *Description of Issue*

In response to GNWT's concerns regarding the management of hydrocarbon contaminated soils and the location of facilities for remediation of such soils, De Beers indicated land farming will be used for remediating hydrocarbon contaminated soils. De Beers confirmed that the landfarm will be operated in accordance with GNWT guidelines. The landfill and the land farm will initially be placed in the eastern section of the North Pile. Once the eastern section of the North Pile nears completion, those landfill and landfarm sites will be closed and decommissioned. Any hydrocarbon contaminated soils still exceeding GNWT guidelines will be transferred to a second land farm, or taken off-site for disposal or treatment. De Beers indicated that land farms are a proven technology for remediating hydrocarbon contaminated soils in the North and that research supports the effectiveness of land farming in cold climates. Nevertheless, De Beers committed to monitoring the land farm to ensure effective performance and would consider alternatives to land farming (e.g. transportation to disposal facilities off-site) should management techniques prove ineffective in treating the soils.

Following the Hearing, the GNWT concluded that the proposed locations of the landfarm and landfill are acceptable - one in the eastern section and one in the western section of the North Pile for the life of the mine. The previous concept of mobile, temporary landfills and landfarms is not an option that the GNWT is prepared to support for this project.

De Beers indicated that a dedicated landfill site outside the North Pile was considered, and rejected in favour of the North Pile site for the following reasons:

- Runoff from the landfill will be collected by the North Pile water collection system and pumped to the water treatment plant. If the landfill were to be located outside the North Pile area, additional runoff collection systems would be required, resulting in more ditches, sumps, access roads, and overall greater land disturbance.
- The landfill is progressively capped as the landfill site is relocated within the North Pile area over the mine life. This will minimize potential wind erosion and generation of fugitive dust from the landfill. It also allows continuous closure of the landfill.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

- Because of efforts to reduce the waste stream and maximize recycling wherever possible, the amount of waste landfilled each year is expected to be small. Given this expectation, a large dedicated area, was not considered necessary for landfilling purposes.
- There will be mobile equipment, such as loaders and dozers, operating within the North Pile area on a regular basis for North Pile operations, allowing easy access to the landfill for management purposes. A dedicated, separate landfill facility outside the North Pile would require additional logistics to manage the facility.

### *Conclusions*

The Board concludes that landfarming can be cost-effective method for the remediation of hydrocarbon contaminated soils and that the selection of the North Pile as the location of landfarming activities is based on sound judgement. Landfarming as proposed by De Beers is not likely to result in significant adverse environmental effects, provided that it is conducted in accordance with applicable GNWT guidelines and given the commitment by De Beers to provide alternate treatment or removal from the site if the landfarming is ineffective.

The Board concludes that a landfill integrated into the North Pile as proposed by De Beers is an acceptable approach because the landfill is proposed to contain only inert solid wastes and to lie within the North Pile seepage water collection area such that additional water management developments are not required. It also concludes that landfarming can be a cost-effective method for the remediation of hydrocarbon contaminated soils. However, the Board is of the opinion that additional measures should be considered to ensure that remediation of the soils has been effective prior to mine closure.

The Board has concluded that two landfill sites integrated into the North Pile as proposed by De Beers are acceptable. However, the Board is of the opinion that additional measures should be considered to ensure that the landfill sites are operated according to design and, to this end, the following measures should be considered for implementation.

### *Suggestions*

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S38) The appropriate regulatory authorities should ensure that the landfarm and landfill operations are inspected to ensure conformity to GNWT guidelines and regulatory requirements.**



### **2.20.3.3 Employee / Worker Schedule and Living Conditions**

#### ***Description of Issue***

In response to concerns raised regarding employee accommodations, camp facilities during mine construction and the selection of the fly in and out schedule, De Beers indicated that consultations on the proposed two-week in and two-week out employee rotation would be completed during the construction period. De Beers indicated that construction employees would not all have to adhere to a three week in and one week out schedule because schedules would be tailored to the specific contractor of job function. De Beers also provided evidence from consultations and case studies regarding the effects of various rotational schedules of individuals, families and communities.

De Beers confirmed that final decisions regarding permanent employee accommodations will be made during the detailed engineering stage, prior to construction and that construction camp facilities would be temporary in nature similar to those used during its Advanced Exploration Program (i.e., recreation and fitness room, cafeteria style kitchen, shared bathrooms and single bedrooms).

#### ***Conclusions***

The Board concludes that continued consultation with prospective employees and other relevant stakeholders is necessary to optimize the design of employee accommodations and rotational schedules. In the opinion of the Board, sufficient experience exists in the mining industry and among stakeholders in the NWT regarding the design of construction camps, employee rotational schedules and permanent employee accommodations. As such, the Board is confident that these features can be optimized to ensure that effects on individuals, families and communities will be minimized.

## **2.21 Abandonment & Reclamation**

This section covers the progressive reclamation during construction, operations and also reclamation and abandonment following closure. It also covers post closure monitoring and maintenance.

### **2.21.1 Summary of Developer's Submissions**

De Beers submitted a "Decommissioning and Reclamation Plan" as part of the EAR in February 2002. A second report, the "Preliminary Mine Closure and Reclamation Plan", was submitted in February 2003 (after the November-December 2002 Technical Sessions). This Plan provides a more detailed and comprehensive description of the abandonment and reclamation for the site. The following summarizes the "Preliminary Mine Closure and Reclamation Plan", herein referred to as "the 2003 Plan".

De Beers has incorporated, where applicable, the principles, objectives and standards set out in the *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002). The 2003 Plan provides a



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

description of the progressive reclamation during construction and operations and the anticipated closure and reclamation activities on cessation of mine operations. It describes the areas of disturbance that will require reclamation, summarizes the proposed strategy and schedule for closure and reclamation of each area and outlines the work to be carried out. The 2003 Plan also includes detailed cost estimates for the reclamation work, alternatives and post-closure monitoring and maintenance.

The following principles have been established to guide the development of the overall plan:

- Plan and implement procedures in accordance with all applicable regulations;
- Apply cost effective and appropriate closure and reclamation practices to reduce environmental risks and allow traditional use of the land;
- Conduct studies to predict post-closure environmental effects;
- Maintain a program of progressive closure and reclamation as an integral part of project operations; and,
- Incorporate new reclamation methods and procedures.

De Beers is committed to reducing residual environmental effects at the site upon closure. It stated that reclamation work will form an integral part of the mine plan and will be carried out progressively during the life of the project. The project footprint has been kept to a minimum to reduce environmental impact and the need for reclamation.

The mining and water management plans have been developed to facilitate progressive reclamation as an integral part of operations (e.g., North Pile). All surface facilities have been designed to minimize reclamation requirements and to enhance the natural recovery of the areas affected by mining.

Interim reclamation measures, in case of temporary or indefinite shutdown of operations prior to final closure, have been included.

The general disposal method for reclaimed materials that forms the basis for the 2003 Plan is burial of all non-salvageable, inert solids in the North Pile and off-site shipment of salvageable and hazardous materials. De Beers has also detailed alternative disposal methods in the 2003 Plan.

De Beers will implement monitoring and maintenance programs during the closure and post-closure phases to prevent environmental degradation and measure the performance of the closure and reclamation procedures. The key objectives of the reclamation plan are:

- To protect public health and safety through the use of safe and responsible reclamation;
- To reduce or eliminate environmental effects once the mine ceases operations;
- To re-establish conditions that permit the land to return to a similar pre-mining land use; and,
- To reduce the need for long-term monitoring and maintenance by establishing physical and chemical stability of disturbed areas.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers believes that once the project is reclaimed, there should be no effects on traditional land use patterns. Although the project will induce lasting physical changes to the local topography, the proposed reclamation plan will minimize these effects and assure the biodiversity and sustainability of the renewable resources of the region.

De Beers sees the 2003 Plan as a draft document and a starting point in discussions with the communities and regulators during the next phase of permitting, leading to a consensus on the details of the Plan. Discussions with the communities will refine and add information based on TK.

The 2003 Plan contains a *Revegetation and Surface Materials Handling Plan*, providing detail on revegetation and soil considerations of De Beers' closure and reclamation planning. The components addressed in this Plan include:

- Progressive reclamation of the North Pile;
- Direct placement of surface materials;
- Salvage and stockpiling of surface materials;
- Use of salvaged peat and surface materials for future reclamation;
- Soil amendment options;
- Use of seed-mixes and northern species for revegetation;
- Transplanting; and,
- Monitoring.

The *Revegetation and Surface Materials Handling Plan* was prepared to meet the broad reclamation principle of the *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002), which is based on the 1994 Whitehorse Mining Initiative: *returning mine sites, and affected areas to viable and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities*. The policy does not provide guidelines as to the details of revegetation standards and measurable end points for measuring the reclamation goal.

De Beers notes in several instances that a reclamation monitoring program will be implemented and will evolve throughout the construction, operation and decommissioning phases of the project.

Throughout the construction and operation phases, De Beers has committed to monitor whether the actual impacts to ELC units exceed or differ (i.e., area or type) from those predicted in the EAR. The losses or alteration of ELC units due to the development of the proposed Snap Lake mine will be mapped annually and the aerial extent of change compared to predicted impacts. The Board notes that the GNWT recommended such a monitoring program in its February 14, 2003 Technical Report.

### 2.21.2 Summary of Responses from the Parties

There were responses from a number of Parties concerned about the lack of detail regarding De Beers' plans for abandonment and reclamation, especially relating to the review of alternatives, disposal methods for reclaimed materials and post-closure monitoring.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

At the November-December 2002 Technical Sessions, the following concerns were raised:

- The YKDFN had concerns about the length of time post-closure monitoring should continue in the northeast lake and also had concerns about what materials may be buried in the mine at closure.
- DFO asked about the goals for site reclamation and how De Beers would know when they have been achieved.
- INAC raised the question of options for alternative use of the site after closure and whether De Beers had consulted with Aboriginal groups in regard to alternative site use. INAC also asked how De Beers arrived at the abandonment and reclamation goals in the plan presented at the Technical Session and stated that the abandonment and reclamation plan may not have fulfilled the EA Terms of Reference, especially relating to rationale and alternatives for disposal of reclaimed materials.

Following the November-December 2002 Technical Sessions:

- The YKDFN recognized that De Beers committed to provide a complete list of materials to be buried in the landfill and underground mine at closure.
- INAC believed that there was uncertainty and a general lack of information explaining and supporting the abandonment and reclamation activities, as outlined by De Beers. This especially relates to the disposal methods, disposal location, rationale for the disposal option and the state to which the land will be reclaimed.
- The GNWT concluded that abandonment and reclamation standards are critical criteria for a healthy environment and a sustainable mining industry and did not believe that details for the Abandonment and Restoration should be delayed until the regulatory phase.

The following concerns were presented at the Public Hearing:

- The GNWT believes that the proposed closure and reclamation plan presented by De Beers does not provide a complete assessment of the site closure criteria for the Snap Lake project.
- The LKDFN would like to see the terms and conditions for abandonment and reclamation of the land more clearly defined and felt that the definitions and criteria for future reclamation should be developed based on traditional ecological knowledge. (De Beers did provide further clarification on these items to the LKDFN following the Hearing).
- The NSMA believes the current plan for decommissioning the mine facilities is vague. It expressed concern about materials buried on site or in the underground mine. It is concerned that the site will not be brought back to a pre-development state and that TK has not been incorporated into the abandonment and reclamation plan. It believes that plans for the decommissioning of the mine facilities must be developed prior to approval.

It is noted that the comments by the GNWT and NSMA were based on the Decommissioning and Reclamation Plan presented in the EAR and not the more recent 2003 Plan.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

The YKDFN outlined three issues concerning revegetation:

1. Contaminant uptake by vegetation establishing on the North Pile;
2. Lack of success criteria to determine when an impacted area has been successfully reclaimed; and,
3. Lack of measures identified to prevent non-native vegetation from being accidentally introduced.

The 2003 Plan outlines measures to prevent the introduction of non-native species, and the YKDFN were made aware of this at the Review Board's Pre-hearing Conference held in March, 2003. The YKDFN did not bring this issue forward to the Public Hearing.

The first two bullets above were brought forward to the Hearing by the YKDFN. At the Hearing, LKDFN also echoed YKDFN's concerns on these issues. These two issues are further discussed under Section 2.21.3.

Several of the Parties emphasized that TK should be incorporated in reclamation monitoring.

Building on the point above regarding GNWT's dissatisfaction with De Beers' assessment of site closure criteria, the GNWT further stated that “ *The necessary reclamation and revegetation activities to restore wildlife habitat will require long-term research and monitoring*” (Doug Doan, GNWT Public Hearing Transcripts, Day 1, April 28, 2003, p. 149).

### 2.21.3 Key Issues

Key issues relate specifically to the revegetation component of abandonment and reclamation. The Board, otherwise, concludes that the 2003 Plan will provide a satisfactory basis for further discussion with the communities and regulators. The issues of reclamation criteria and contaminant uptake by plants are further discussed below.

#### 2.21.3.1 Reclamation Criteria

##### *Description of Issue*

Several of the Parties to the EA and the Board expressed concern over the lack of measurable reclamation criteria or objectives. They questioned how De Beers would know when the reclamation goal was reached.

The YKDFN expressed concern about the lack of success criteria in De Beers' revegetation plan. LKDFN asked De Beers at the Hearing on what De Beers perceived to be the criteria for reclamation success. DFO inquired of De Beers at the November-December 2002 Technical Sessions as to how De Beers would know when it has achieved De Beers' stated goal of reclamation, and how De Beers



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

would measure the progress. The Board's consultants also remarked on the lack of specific objectives for revegetation and how the objectives would be met.

At the Hearing, GNWT indicated that De Beers does not provide a complete assessment of site closure criteria.

De Beers stated its goal<sup>14</sup> for reclamation in two ways:

- In its EAR, De Beers states that the "...objective of reclamation is to return the developed area to a condition of 'equivalent capability'. Applying appropriate mitigation methods and allowing adaptive management will allow the ELC resources to return to pre-development capability." (EAR p. 10-84). De Beers also uses the term "pre-development equivalent capability" (EAR p. 10-93). De Beers does not expand on what is meant by "predevelopment [equivalent] capability"
- De Beers later outlined its reclamation goal in its *Preliminary Mine Closure and Reclamation Plan* (February 2003). De Beers accepts, as its reclamation goal, the 1994 Whitehorse Mining Initiative principle of "...returning mine sites, and affected areas to viable and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. The *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002) states that the required standard of reclamation should be based on this principle.

De Beers stated at the Hearing that it has "*laid out a number of activities and criteria to meet*" its reclamation goal (Sandy Marken, Golder Associates for De Beers, Public Hearing Transcripts, Day 4, May 1, 2003, p. 93).

De Beers also states in the *Revegetation and Surface Materials Handling Plan* that:

- The end land-use objective is to re-establish a landform that is consistent with surrounding conditions and will be suitable for the establishment of native vegetation; and,
- The revegetation approach is designed to provide an erosion protection plant cover from a range of native plant species at a variety of densities that will promote succession to biodiversity levels consistent with pre-development conditions.

### ***Conclusions***

De Beers' clearly states its goal for reclamation in its *Preliminary Mine Closure and Reclamation Plan* (February 2003). However, the Board disagrees with De Beers that it has "*laid out a number*

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<sup>14</sup> De Beers appears to use the term objective where it should be more correctly be using the term goal. Objectives are measurable, while goals are not. The objective stated by De Beers in the first bullet is interpreted to be a goal by the Board.





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

*of...criteria to meet”* its reclamation goal. In its *Revegetation and Surface Materials Handling Plan*, De Beers does outline reclamation and revegetation activities and methods to be carried out during construction, operations and closure. De Beers does not, however, outline specific criteria to meet or measure the success of its reclamation goal. It is unclear how De Beers will know if a “self-sustaining ecosystem” has been reached for example, as stated in its reclamation goal. The Board believes, however, that De Beers provides sufficient foundation for the development of site-specific criteria.

The Board recognizes that the *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002) does not provide details as to measurable end-points for assessing reclamation success. It also recognizes that flexibility and adaptive management are important principles in the success of site reclamation. The Board feels that the commitments provided by De Beers with respect to reclamation are practical and will be integral to achieving De Beers’ reclamation goal.

In summary, the Board concludes that De Beers’ *Revegetation and Surface Materials Handling Plan* along with its commitments made in regard to reclamation provides a sufficient level of detail for the purposes of the EA. However, the Board is of the opinion that additional measures should be considered to ensure that De Beers’ reclamation goal is met.

### ***Suggestions***

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S39) Consistent with the *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002), De Beers should develop site-specific reclamation criteria prior to regulatory approval of this project.**

### **2.21.3.2 Contaminant Uptake by Plants**

#### ***Description of Issue***

The YKDFN and LKDFN are concerned that the plants that grow on the North Pile have the potential to become contaminated (by uptake of metals) if their root systems extend to the kimberlite below the 0.5 m thick granite rock covering. YKDFN pointed out that contaminated vegetation could have potentially harmful effects on the health of wildlife that ingest the vegetation.

De Beers “*does not expect that the plants will take up metals from the kimberlite in the North Pile...primarily because, none of them pose a concern due to low bio-availability. In other words, they are unlikely to be taken up by the plants*”. De Beers stated further that the metals have “*low toxicity, they are unlikely to be harmful, and/or low bioaccumulation, they are not likely to be passed up through the food chain*”.

(Dr. Robin Johnstone, Public Hearing Transcripts, Day 4, May 1, 2002, p. 37).



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

De Beers later indicated that the 0.5 m of granite cap on the North Pile should limit plant root penetration to the process kimberlite, and feel that it should be an effective mitigation. De Beers also indicated that it will monitor to see if there is root penetration to the processed kimberlite and if during this monitoring, the roots are noted to reach the kimberlite that it would then look at monitoring the plants for uptake of metals.

De Beers stated that monitoring priorities will be developed in conjunction with communities.

### *Conclusions*

The granite rock covering of the North Pile over the kimberlite provides a buffer between the surface soil and the kimberlite. The monitoring steps outlined by De Beers at the Hearing to identify the potential for metal uptake by plants are reasonable. In taking into consideration the mitigation measures proposed by De Beers and its commitment to monitor for the potential of metal uptake by plants, the Board concludes that significant adverse impacts on vegetation that grows on the North Pile, and on the wildlife that may eat that vegetation, are unlikely.



Review Board members Frank Pope of Norman Wells and Charlie Snowshoe of Fort MacPherson during a break in the panel proceedings.



## **2.22 Follow-up Programs**

### **2.22.1 Summary of Developer's Submissions**

De Beers describes proposed monitoring programs under each of the assessment chapters in its EAR, where applicable. De Beers' technical memorandum entitled, *Overview of Project Milestones and Monitoring and Management Programs for the Snap Lake Diamond Project, February 28, 2003* is particularly relevant to its proposed monitoring and environmental management of the SLDP. This memo was prepared in response to issues raised at the November-December 2002 Technical Sessions.

The technical memo discusses De Beers' approach to the development of:

- Socio-economic monitoring programs;
- Cumulative effects monitoring programs;
- Environmental monitoring programs; and,
- Environmental management programs (ISO 14001).

De Beers indicated that details of socio-economic monitoring programs are not discussed in the technical memorandum as they are to be included in the Socio-economic Agreement. With respect to cumulative effects monitoring, De Beers states that it will continue to collect project-specific data in a manner compatible with a regional monitoring program, and will continue to participate in discussions pertaining to the development of cumulative effects monitoring on a regional basis.

Regarding the environmental monitoring programs, De Beers outlines likely monitoring programs, including the purpose of monitoring, proposed methods of monitoring, and project phases (e.g., construction, operation, closure) in which the monitoring is proposed to occur. De Beers indicates that all environmental monitoring programs will be incorporated into an Environmental Agreement, and that it commits to revising the monitoring programs to include issues outlined in the Public Hearing, based on community and regulator input and licensing requirements. De Beers' priorities for monitoring are wildlife and wildlife habitat, aquatic effects, air quality, hydrogeology, hydrology, water quality, geology and terrain, ELC and biodiversity, heritage resources and non-traditional resource use.

In December 2002, the SLDP Environmental Management System was certified to ISO 14001, 96 standard. De Beers sees the Environmental Management System as a key feature in executing the its eight management programs:

- Reclamation and Closure;
- Spill Contingency;
- Emergency response;
- Water management;
- Waste management;



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

- Wildlife management;
- Quarry management; and,
- North pile development.

As part of De Beers' annual review of the Environmental Management System, an internal audit will be completed to monitor progress of ongoing activities and to measure effectiveness of programs in achieving objectives. Regular surveillance or maintenance audits are to be completed by an external auditor. The results of these audits will be available for review by interested Parties.

The technical memo also briefly discusses De Beers' plans for having the community provide input to the environmental monitoring and management programs. De Beers commits to meet with Aboriginal organizations and primary communities identified in the EA for input on all aspects of monitoring programs, including the incorporation of TK.

De Beers has emphasized throughout the EA process that it is committed to an adaptive management approach with respect to its monitoring programs. De Beers states that adaptive management will be used to check the results of monitoring and EA predictions, and that it will incorporate required changes into its mitigation and future monitoring programs. De Beers did not file an Adaptive Management Plan to the Public Record.

### **2.22.2 Summary of Responses from the Parties**

Several of the Parties to the EA, and particularly the NSMA, expressed concern over the lack of detail that De Beers provided with respect to monitoring of the various components of De Beers EAR. Specific monitoring issues raised by the Parties to the EA, the conclusions arrived at by the Review Board and the suggestions and recommendations made by the Review Board are discussed in previous sections.

With respect to adaptive management, the NSMA and the Board questioned De Beers at the November-December 2002 Technical Sessions on how it will be able to detect any changes of significance that would prompt an adaptive management response.

### **2.22.3 Conclusions**

The Board is of the opinion that rigorous monitoring and the implementation of appropriate management measures, where negative monitoring results are evident, are critical to the acceptability of this project from an environmental perspective. The Board's decisions in this Report of EA are based on the expectation that De Beers will fulfill all of its commitments, particularly those related to monitoring. The Board recognizes the value of De Beers' Environmental Management System (ISO 14001 certified) in placing internal and external checks in place to ensure the performance of its proposed environmental management programs.



## **Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project**

The Review Board notes that it has made suggestions and recommendations through this Report of EA that additional monitoring is required beyond what has been proposed by De Beers, including the need for an adaptive management plan. The Board accepts the adaptive management approach of De Beers. However, in the opinion of the Review Board an adaptive management plan with criteria and actions, against which monitoring programs can be measured is lacking. Such a plan would allow for the detection of changes that would prompt an adaptive management response and management of unforeseen environmental risk.

The Review Board concludes that the monitoring programs proposed by De Beers, combined with the measures recommended by the Board and requirements of regulators, are acceptable.

### **2.22.4 Suggestions**

**Based on the above conclusions, the following suggestion should be considered for implementation:**

**(S40) De Beers should develop a formal Adaptive Management Plan for incorporation into regulatory approvals, and any Environmental Agreement or Socio-economic Agreement.**



# Glossary of Terms

<b>Active layer</b>	The near surface portion in permafrost, which is subject to melting during the summer
<b>Adaptive management</b>	A management method that incorporates monitoring results and change resulting from new research that has been developed. It is an iterative and ongoing process.
<b>Algae</b>	Simple single-celled, colonial, or multi-celled, aquatic plants, aquatic algae are (mostly) microscopic plants that contain chlorophyll and grow by photosynthesis, and lack roots and stems (non-vascular), and leaves; they absorb nutrients (carbon dioxide, nitrate, ammonium, phosphate and micronutrients) from the water or sediments, add oxygen to the water, and are usually the major source of organic matter at the base of the food web in lakes; freely suspended forms are called phytoplankton; forms attached to rocks, stems, twigs, and bottom sediments are called periphyton
<b>Ambient</b>	The pre-existing sound environment of a location, prior to the introduction of, or in absence of noise from a specific source which also affects the sound environment of that location
<b>Benthic invertebrates</b>	Small animals without a spine that inhabit lake and stream bottoms
<b>Biodiversity</b>	The variety of life at all levels of organization from gene to landscapes, and the ecological and biological processes through which these levels are connected
<b>Catchment communities</b>	The northern workforce may be drawn in part from these communities; <i>e.g.</i> , Fort Resolution, Hay River, Hay River Reserve (located in Hay River), Fort Smith, Fort Providence, and Enterprise, which are located further away from the project site than the primary communities. De Beers does not necessarily propose to provide direct transportation to and from the mine site for employees from these communities.



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Chlorophyll</b>	One of the two pigments ( <i>chlorophyll a</i> and <i>chlorophyll b</i> ) responsible for the green colour of most plants. Chlorophyll molecules are the principal sites of light absorption in the light reactions of photosynthesis
<b>Chronic toxicity</b>	The development of adverse effects after an extended exposure to relatively small quantities of a chemical
<b>Closure</b>	<p>Closure refers to the final closure of the mining operation and is essentially the act of ceasing mining, processing and other production activities. However, the term closure is often used as a generic term for all activities associated with closure, including decommissioning and reclamation.</p> <p>A <i>temporary</i> closure (or shutdown) can be defined as a cessation of mining and processing operations for a finite period. Typically the mine would be put on a care and maintenance basis, while still maintaining safety and environmental stability. Possible causes for a temporary closure or shutdown could include major equipment failure, late delivery of essential equipment or supplies or a labour disruption. A temporary closure or shutdown would likely be in the order of three to twelve months.</p> <p>An <i>indefinite</i> closure or shutdown is defined as a cessation of mining and processing operations for an indefinite period with the intention of resuming operations in the future. Typically the mine would be put on a care and maintenance basis, while still maintaining safety and environmental stability. Possible causes for an indefinite closure or shutdown could be prolonged periods of depressed product prices, other adverse economic conditions or extended labour disputes.</p>
<b>Community services</b>	The wide range of services that support a community including utilities (water, sewer, electricity, roads and highways), social support services (including health, education and social services), and local and regional governance (town council or governing authority)
<b>Community wellness</b>	The physical and spiritual health of the residents of a community



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Connate</b>	Entrapped in sediments at the time of their deposition
<b>Contaminants</b>	A general term referring to any chemical compound added to a receiving environment in excess of natural concentrations; the term includes chemicals or effects not generally regarded as “toxic,” such as nutrients, color and salts
<b>Critical Load</b>	An estimate of the amount of acidic deposition below which no significant harmful effects occur to a specified component of a lake’s ecosystem (e.g., a valued fish species)
<b>Cryoconcentration</b>	<p>Dissolved solids often including ions exist in the porewater (any water that fills the voids of a particulate material). Due to the presence of ions and the particle size composition of the material, the phase change from liquid water to solid ice is gradual as temperatures drop below 0 °C. Therefore, in the particulate material, ice and liquid water can coexist at temperatures below 0 °C.</p> <p>Cryoconcentration is a term used to describe the change in porewater chemical concentrations that occurs due to freezing. At temperatures above freezing, a unit volume of porewater in the liquid phase has an initial concentration of chemicals. As the temperature drops and ice forms, the unit volume becomes part water and part ice. Chemicals are expelled from the water when it freezes but remain in any liquid water still present thereby raising the chemical concentration in the remaining liquid water.</p>
<b>Culturally appropriate</b>	The norms, values, customs, language and beliefs that a society shares
<b>Cumulative effects</b>	The predicated ambient environmental quality in the region at some future date; it includes an assessment of the cumulative impacts from the Snap Lake Diamond Project in combination with other existing, approved, or reasonably foreseeable developments in the region
<b>Cyanobacteria</b>	Aquatic and photosynthetic bacteria (live in the water and can manufacture their own food). They are usually unicellular, though they often grow in colonies large enough to see
<b>Cyanotoxins</b>	Toxin produced by some cyanobacteria





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Decommissioning</b>	As the act of permanently closing and removing the production facilities at a mine site. Often decommissioning is used as a generic term for all activities relating to closure and reclamation.
<b>Density Stratification</b>	An arrangement of layers based on density. Can refer to water with different physical or chemical properties in lakes
<b>Diffuser</b>	Located in Snap Lake and receives discharge from the water treatment plant; designed to optimize mixing in conformance with dispersion modeling results
<b>Direct, Indirect and Induced Impacts</b>	The SLDP would increase the demand for labour (employees) and commodities (the purchases of goods and services to build and operate the mine). This increased demand will produce three effects which are referred to as direct, indirect and induced impacts. The first is the impact of the mine which directly employs labour and purchases goods and services from other businesses which expand production to satisfy increased demand. These effects are termed the direct impacts. Secondly, there is a ripple effect these firms purchase additional inputs from other firms. This is called the indirect impact. Lastly, as all firms expand production, they also hire more staff and pay out wages thereby increasing the income received by workers. Households, after withdrawing a certain portion for taxes and savings, spend this income which in turn increases demand for other commodities. This is called the induced effect.
<b>Dispersion model</b>	A computer model that calculates a concentration or deposition value at a particular point; this value changes from hour to hour eventually reaching an absolute maximum concentration or deposition value for the particular point
<b>Dissolved oxygen</b>	The concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water; usually expressed in milligrams per litre (mg/L)
<b>Dyke</b>	A tabular igneous intrusion that cuts across the planar structures of the surrounding rock



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Ecological resilience</b>	Usually defined as the rate of ecosystem recovery following a disturbance or the capacity of an ecosystem to absorb disturbances
<b>Economic sustainability</b>	Using, developing and protecting resources at a rate and in a manner that enables people to meet their current needs and also provides that future generations can meet their own needs
<b>Ecosystem</b>	An integrated and stable association of living and non-living resources functioning within a defined physical location
<b>Environmental consequence</b>	The overall effect on the environment when the magnitude, geographic extent, duration, and irreversibility of the project's impact are considered together.
<b>Esker</b>	A long, low, narrow, sinuous, steep-sided ridge or mound composed of irregularly stratified sand and gravel that was deposited by a subglacial or englacial stream flowing between ice walls or in an ice tunnel of a continuously retreating glacier, and was left behind when the ice melted; it may be branching and is often discontinuous, and its course is usually at a high angle to the edge of the glacier; eskers range in length from less than a kilometre to more than 160 kilometres, and in height from 3 to 30 meters
<b>Eutrophication</b>	The process by which lakes and streams are enriched by nutrients (usually phosphorus and nitrogen) which leads to excessive plant growth – algae in the open water, periphyton (attached algae) along the shoreline, and macrophytes (the higher plants often called weeds) in the nearshore zone
<b>Exposure</b>	The contact reaction between a chemical and a biological system, or organism
<b>Ferrosilicon</b>	Agent used to make a dense separation medium for use in the dense media separation circuit; recovered within the plant for re-use
<b>Fiscal</b>	relating to taxation, public revenues, or public debt



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Fish habitat</b>	Fish habitat includes areas used for: spawning, nursery (used by developing embryos and young-of-the-year); rearing (used by sub-adult for foraging and refuge from predators), foraging (used by adult fish for feeding or periods between feeding events), and overwintering (used by all fish to survive winter under ice cover conditions).
<b>Footprint (mine)</b>	The Snap Lake land lease area (approximately 550 ha). The land area occupied by the project, including all man made structures and any other land disturbances required to construct and operate the mine.
<b>Formula Financing Grant (FFG)</b>	The FFG is the annual cash transfer from the federal government to the GNWT. The basic structure of the FFG is designed to represent the difference between the GNWT's expenditure needs and its ability and willingness to raise revenue.
<b>Fragmentation</b>	Examines the changes in landscape patterns as a result of natural or human disturbances; the process of reducing size and connectivity of habitats composing a landscape
<b>Fugitive dust</b>	Dust that is difficult to grasp or retain
<b>Gross Domestic Product (GDP)</b>	This refers to the value of total market production within a given geographical area for specific time period, and is measure in prices which prevail during the period being valued.
<b>Groundwater</b>	That part of the subsurface water that occurs beneath the water table, in soils and geological formations that are fully saturated
<b>Grout</b>	Thin mortar used for filling spaces; any of various other materials (as a mixture of cement and water or chemicals that solidify) used for a similar purpose
<b>Heath</b>	Any of a family (Ericaceae, the heath family) of shrubby dicotyledonous and often evergreen plants that thrive on open barren usually acid and ill-drained soil.
<b>Hydraulic conductivity</b>	Parameter that describes conductive properties of the rock mass with respect to groundwater flow



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Hydraulic head</b>	A body of water kept in reserve at a height
<b>Hydrogeology</b>	The study of groundwater
<b>Inert solids</b>	Are solid materials that will not dissolve or react with any other material. Specifically for this project these are non-salvageable, non-hazardous, components, equipment or materials recovered from the dismantling or demolition of the plant, buildings and other structures (such as structural steel or steel cladding, for example), which will be placed in the North Pile landfills for burial.
<b>In-migration</b>	The number of people that move into a community or region
<b>Instrumentation</b>	Mechanical, electrical or pneumatic devices used to assist in the direct survey and/or ongoing sampling of materials and structures for the purpose of measuring baseline data and real time changes
<b>Ion Exchange</b>	Treatment alternative which removes metals, ammonia and chlorides beyond conventional technology; a reversible interchange of one kind of ion present on an insoluble solid with the reaction being used especially for softening or demineralizing water, the purification of chemicals, or the separation of substances.
<b>ISO 14001</b>	International Organization for Standardization's certification program for environmental management
<b>Kimberlite</b>	An agglomerate biotite-peridotite that occurs in pipes especially in southern Africa and that often contains diamonds
<b>Labour force</b>	Includes all persons who were either employed or unemployed during the reference period (when the data were collected)
<b>Metavolcanic</b>	Consists mainly of well-foliated high-grade amphibolites



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Moraine</b>	A mound, ridge, or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited chiefly by direct action of glacier ice in a variety of topographic landforms that are independent of control by the surface on which the drift lies
<b>Natural Variation</b>	Disparity in an environmental condition that occurs under natural conditions, without human-induced disturbance.
<b>No net loss</b>	A term found in Canada's Fisheries Act. It is based on the fundamental principle of balancing unavoidable losses of fish habitat with habitat replacement on a project -by-project basis in order to prevent depletion of Canada's fisheries resources
<b>Non-acid generating</b>	Pure granitic rock that does not have structures containing visible sulphides
<b>Non-renewable resource</b>	It is a resource that is not capable of being replaced by natural ecological cycles. Normally all mining and oil and gas projects are non-renewable resources
<b>North pile</b>	An area for storing and containing the processed kimberlite material and potentially acid generating rock
<b>Northern employment targets</b>	Goals that De Beers has committed to with respect to the percentage of its total workforce that will be northerners. Specifically, De Beers made the commitment that 40% of its construction workforce, and 60% of its operations and closure workforce, would be northerners
<b>Nutrients</b>	Environmental substances (elements or compounds) such as nitrogen or phosphorus, which are necessary for the growth and development of plants and animals
<b>Passerines</b>	Small perching birds.
<b>Paste</b>	Residue separated in the preparation of various products (as ores) of a paste-like consistency



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Paste Technology</b>	The manufacture and discharge of blended particulate materials (water and processed materials) to a prescribed consistency (ranging from thick soup to that of typical plastic Portland cement concrete) that can be pumped through a hose or pipeline to a destination disposal site
<b>Periphyton</b>	A broad organismal assemblage composed of attached algae, bacteria, their secretions, associated detritus, and various species of microinvertebrates.
<b>Permafrost</b>	A permanently frozen layer at variable depth below the surface in frigid regions of a planet; permafrost reduces soil water infiltration
<b>pH</b>	The negative logarithm of hydrogen ion concentration; the pH scale is generally presented from 1 (most acidic) to 14 (most alkaline); a difference of one pH unit represents a ten-fold change in hydrogen ion concentration
<b>Phosphorus</b>	The Key nutrient influencing plant growth in lakes; phosphate is the amount of phosphorus in solution that is available to plants; total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form
<b>Phytoplankton</b>	Microscopic floating plants, mainly algae, that live suspended in bodies of water and that drift about because they cannot move by themselves or because they are too small or too weak to swim effectively against a current
<b>PM<sub>10</sub> and PM<sub>25</sub></b>	PM <sub>10</sub> refers to inhalable particulate matter; fine particles that are 10 microns or smaller in diameter. PM <sub>25</sub> refers to respirable particulate matter; fine particles less than 2.5 microns in diameter
<b>Polycyclic aromatic hydrocarbons PAHs</b>	A chemical byproduct of petroleum-related industry; aromatics are considered to be highly toxic components of petroleum products; PAHs, many of which are potential carcinogens, are composed of at least two fused benzene rings; toxicity increases along with molecular size and degree of alkylation of the aromatic nucleus
<b>Porewater</b>	Water in the pore space of a sediment or rock, where a pore is the openings between the rock mass or sediment particles



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Portal</b>	Portal is the main entrance to the underground mine for personnel and equipment
<b>Potential acid input (PAI)</b>	A composite measure of acidification determined from the relative quantities of deposition from background and industrial emissions of sulphur, nitrogen and base cations
<b>Potentially acid generating</b>	PAG - Metavolcanic rock and granitic rock with visible sulphides
<b>Primary communities</b>	Communities that De Beers has determined are likely to experience the greatest impacts, due to their proximity to the project site and expected contribution to the project workforce <i>e.g.</i> , Lutsel K'e, N'Dilo, Dettah, Gameti, Wha Ti, Rae/Edzo, Wekweti, and Yellowknife (including the North Slave Métis Alliance population). De Beers proposes to provide transportation from these communities to and from its mine site at no cost to its employees.
<b>Processed Kimberlite</b>	A manufactured material comprising a blend of water, gravel, sand and silt to clay sized particles derived from the mining and processing of kimberlite
<b>Progressive reclamation</b>	Is reclamation that can be carried out during the construction and operation phases of a mine prior to final closure. Typical examples include borrow pits and rock waste dumps. In the case of this project the processed kimberlite disposal area (the North Pile) will be progressively reclaimed during the life of the mine
<b>Rare plant potential</b>	A ranking based on the abundance of rare plant species present in an area



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Reclamation</b>	Reclamation is the process of “reclaiming” or recovering the land disturbed by a mining operation. Reclamation is usually carried out to fulfill the requirements of pre-determined objectives or standards. These objectives or standards are often set out in government reclamation policy and guidelines, a water licence or other regulatory requirements and authorizations. Reclamation normally includes items such as: removal of man made structures; contouring of roads, airstrips and waste dumps; short term collection and (possibly) treatment of runoff water; closure and covering of underground openings; re-vegetation where appropriate.
<b>Renewable resource</b>	A resources that is capable of being replaced by natural ecological cycles or sound management practices
<b>Residual impact</b>	The amount of impact remaining after mitigation
<b>Reverse Osmosis</b>	A method of obtaining pure water from water containing a salt. Pure water and the salt water are separated by a semipermeable membrane and the pressure of the salt water is raised above the osmotic pressure, causing water from the brine to pass through the membrane into the pure water
<b>Reversibility</b>	Changes that occur after the impact ceases allowing the environment to return to a capability or condition equivalent to the baseline
<b>Risk</b>	The likelihood or probability that the toxic effects associated with a chemical or physical agent will be produced in populations of individuals under their actual conditions of exposure; risk is usually expressed as the probability of occurrence of adverse effect, (i.e., the expected ratio between the number of individuals that would experience an adverse effect at a given time and the total number of individual exposed to the factor); risk is expressed as a fraction without units and takes values from 0 (absolute certainty that there is no risk, which can never be shown) to 1.0, where there is absolute certainty that a risk will occur





## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Risk assessment</b>	Process that evaluates the probability of adverse effects that may occur, or are occurring on target organism(s) as a result of exposure to one or more stressors
<b>Salvageable materials</b>	Are materials or equipment recovered from the dismantling or demolition of the plant, buildings or structures which can be removed from the site and re-cycled or re-used in another location. Usually salvageable materials must be at least of sufficient value to cover the costs of removal, transportation and sale
<b>Sensory Disturbance</b>	Mining activities that change the behavior of wildlife; can lead to increased levels of stress and energy expenditure in wildlife, and disruption of feeding and/or mating behavior.
<b>Slurry</b>	Watery mixture of insoluble matter (as mud, lime)
<b>Social cohesion</b>	What binds people and societies and together.
<b>Social stability</b>	strengthening individuals and families by reducing dysfunctional behaviour; developing individual skills that are transferable and can lead to providing economic sustainability; strengthening cultural preservation
<b>Socio-cultural</b>	“consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society.” (International Committee on Guidelines and Principles for Social Impact Assessment, Guidelines and Principles for Social Impact Assessment, May/94) Cultural impacts are included as part of the above definition but specifically involve changes to the norms, values, customs, language and beliefs that a society shares.
<b>Subsistence economy</b>	An economy where individuals produce to meet their own basic needs. Very little internal or external trade occurs
<b>Sustainability</b>	Support and/or preservation of (as in, Aboriginal languages, culture, etc.)



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Talik</b>	A permanent or temporary layer of unfrozen ground occurring above, within, or below permanently frozen ground, taliks commonly form beneath lakes in areas of permafrost
<b>Thermistor</b>	An electrical resistor making use of a semiconductor whose resistance varies sharply in a known manner with the temperature; monitors thermal regime
<b>Total dissolved solids</b>	The total amount of dissolved substances, such as salts or mineral s, in water remaining after evaporating the water and weighting the residue
<b>Total suspended particulate matter (TSP)</b>	The fraction of airborne particulates that will remain airborne after their release in the atmosphere; the average diameter is nominally of 30 µm (micrometres) and below
<b>Total Suspended Solids (TSS)</b>	The concentration of total suspended material in a waterbody as determined by an analysis of a representative subsample of an entire collected water sample
<b>Toxicity</b>	The inherent potential or capacity of a material to cause adverse effects in a lining organism
<b>Traditional economy</b>	An economy where individuals produce to meet their own basic needs. Very little internal or external trade occurs
<b>Traditional Knowledge (TK)</b>	Information obtained more often through observations during extensive time spent in one geographic location than through information obtained formally by the scientific method, <i>e.g.</i> , Aboriginal traditional knowledge
<b>Traditional plant potential</b>	A ranking based on the abundance of traditional plant species present in an area
<b>Uncertainty</b>	Inability to definitely know, which is related to natural variability (both spatial and temporal), model uncertainty, uncertainty of future emissions, measurement errors and data errors.
<b>Valued ecosystem component (VEC)</b>	A component of the environment that is representative of traditional, public and scientific values, <i>e.g.</i> , rare plant potential and traditional plant potential



## Report of EA and Reasons for Decision on the De Beers Snap Lake Diamond Project

<b>Wage economy</b>	When goods or services rendered to another are exchanged for money
<b>Weight of evidence approach</b>	A type of approach or analysis that considers all available evidence and reaches a conclusion based on the amount and quality of evidence supporting each alternative conclusion
<b>Zone of influence</b>	The geographic area where animal behavior and activities may be influenced by mining activities
<b>Zooplankton</b>	The animal portion of the living particles in water that freely float in open water, eat bacteria, algae, detritus and sometimes other zooplankton and are in turn eaten by fish



# Appendices

# **Appendix A**

## **List of Supplemental Technical Documents Submitted by De Beers**

## **Appendix A. List of Supplemental Technical Documents Submitted by De Beers**

- Potential Effects of Phosphorus Enrichment on the Productivity of Snap Lake, February 7, 2003
- Potential Effects of Increased Total Dissolved Solids on Aquatic Communities in Snap Lake, February 7, 2003
- Fish Habitat Information and Loss Accounting, February 10, 2003
- Snap Lake Technical Session Follow-up (PK Water Content), January 21, 2003
- TDS Removal Technology for Mine Water Treatment at Snap Lake, February 10, 2003
- Follow-up Information Regarding Socio-economic Cumulative Effects Assessment, February 13, 2003
- Summary of Water Treatment Process Development, Selection and Comparison of Alternatives, February 13, 2003
- Snap Lake North Pile Thermal Model, February 18, 2003
- Final Report on 2002 Soil Sampling Program Report for Environmental Health, January 2003
- Report on Baseline and Interim Wildlife Monitoring, Snap Lake Diamond Project 2002, January 2003
- Report on Baseline Wildlife Monitoring, Snap Lake Diamond Project 1999-2001, June 2002
- Snap Lake North Pile PK Frost-heave Testwork, February 27, 2003
- Snap Lake North Pile Seepage Collection, February 27, 2003
- Dissolved Oxygen Baseline for Snap Lake - 2003 Program, February 28, 2003
- Minewater Assessment and Variability, February 28, 2003
- North Pile Chemical Stability, February 28, 2003
- Algal Modeling Update, February 28, 2003
- Overview of Project Milestones and Monitoring and Management Programs for the Snap Lake Diamond Project, February 28, 2003
- De Beers Canada Fund, February 28, 2003
- Cemented Paste PK Kinetic Test Results, February 28, 2003
- Preliminary Mine Closure and Reclamation Plan, February 28, 2003
- Snap Lake Diamond Project Community Consultation Update, February 28, 2003
- Typical Materials Proposed for Burial, February 28, 2003
- Potential Overall Effects of the Changes in Water and Sediment on the Aquatic Communities of Snap Lake, February 28, 2003

# **Appendix B**

## **List of Issues Raised in the Snap Lake EA Process**

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Geotechnical/Geochemistry/Thermal

	Summary of Issue	Summary of Potential Impact
1	Stability of the North Pile - could be affected by seismic and transient pore pressures, use of full mix PK in shell, removal of soils at base of the pile, freeze thaw effects, global warming, erosion resistance and creep of ice rich layers, solifluction of shell slopes.	Failure and runoff of the pile could result in sediment delivery and untreated (adverse) water discharge to Snap Lake.
2	Geochemistry of North Pile - From the information provided by De Beers, it was suggested that contaminant loads potentially generated from the North Pile remain underestimated due to the slower freezing rates and warm [ground] temperatures, and that the potential increase in loads for specific chemicals of potential concern have not been identified. De Beer should estimate maximum additional increases for other contaminants so that potential receiving impacts can be evaluated.	Higher than anticipated contaminants loads from the North Pile could impact water quality and aquatic life in Snap Lake via direct seepage and release through the water treatment plant.
3	Contingency Planning for Poor Seepage from the North Pile - The conceptual contingency planning may not be adequate to address unexpected poor quality seeps from [processed] kimberlite or slower than anticipated freezeback of the pile.	Possible elevated long term "dissolved contaminant loads" in drainage from [processed] Kimberlite if seepage is poorer than anticipated or if freezeback is slower than anticipated could affect water quality and aquatic life in Snap Lake.
4	The existence of an existing stockpile of PAG rock was introduced by De Beers at the Technical Sessions and during a Break-Out Session on December 3rd that was not specifically mentioned in original EA. The characteristics and possible impacts of this pile are of interest to the EA.	This pile may represent a reclamation issue or may need to be accounted for in the water quality models.
5	A quality control program for construction materials is required that defines acid rock drainage, metal leaching and geochemistry criteria for identifying environmentally unsuitable materials; including the rationale for the proposed use of 0.3% sulphur as the "cutoff" for use of granite.	Without prescribed quality control measures to prevent the use of deleterious materials there could be potential acid rock drainage, metal leaching and geochemistry loads from the construction materials used for roads and other earthworks construction.
6	The current thermal model predictions (rates of freezing, distribution and proportions of frozen and unfrozen water in the pile) are inaccurate and may underestimate the time required and the completeness for freezing of the pile. <b>Note: the discussion at the Public Hearings that is referenced in the Report of the EA speaks to the broad issue under the Heading "Description of Temperature Model Discussions".</b>	Higher than expected cryo-concentration and sub-zero degree metal leaching [from the North Pile] or higher than expected rates of seepage from the pile may result in increased contaminant loading into Snap Lake.
7	In the February 2002 EA, De Beers used a Geothermal Flux value in their geothermal model that was lower than would be estimated from ground temperature data in holes TH02-01 and TH02-02	This input factor affects the predictions and interpretations of geothermal, geotechnical, geochemistry, hydrogeology and hydrology for North Pile behavior.
8	The geothermal-model-N-Factors used in the original EA by De Beers were not considered by some Parties to be conservative enough for predicting freezing rates in the North Pile.	This input factor affects the predictions and interpretations of geothermal, geotechnical, geochemistry, hydrogeology and hydrology for North Pile behavior.
9	In the February 2002 EA geothermal analyses, no sensitivity analyses were provided to show the influence on thermal (freeze-back) predictions for the North Pile, resulting from changes in thermal properties of soils analyzed.	The absence of such a sensitivity analysis limits the understanding of the relative importance of the input factors to the output of the geothermal model and, thereby, reduces confidence in the application of the model results to predictions of impacts.
10	DeBeers conducted one, unreplicated laboratory [frost heave] test but this did not completely resolved the uncertainties with respect to the potential for porewater expulsion during freezeback of the North pile. <b>Note the discussion at the Public Hearings that is referenced in the Report of the EA speaks to the broad issue under the Heading "Description of Cryoconcentration Discussions (Changes in Chemical Concentrations in Water in North Pile in Response to Freezing)"</b>	The amount, rate and quality of porewater expelled from the pile during freezing could affect the performance of the collection and treatment system and could have long term effects on prediction of post closure impacts.
11	The February 2002 EA had not clearly indicated plans by De Beers to try to delineate and address the possibility of ice-filled fractures in the bedrock beneath and in the path of drainage downstream of the North Pile.	The concern was that ice-filled discontinuities in the bedrock may exist, that could become paths of preferred flow of seepage from the North Pile to Snap Lake. This would be a particularly strong concern if thaw degradation of the ice in the discontinuities/"ice wedges" were to occur.
12	Water distribution and availability in North Pile is of concern and is affected by beach angles for PK, frost susceptibility, paste pumping technology, unfrozen zones in North Pile beneath temporary ponds.	Concern is for potential differences in predictions of volumes of seepage discharge water from the North Pile.
13	North Pile Perimeter Ditch Design and Efficiency - The February 2002 EA proposed partial interception of seepage from the North Pile by a perimeter ditch system and made predictions of the North Pile seepage volumes that would bypass the ditches and report direct to the north arm of Snap Lake. A revised and more robust ditch and seepage interception ditch was subsequently proposed.	Excellent performance of this collection ditch is important to the protection of Snap Lake and the concern was that higher than expected volumes of impacted seepage from the North Pile would by pass the ditch and report to Snap Lake.



## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Geotechnical/Geochemistry/Thermal

	Summary of Issue	Summary of Potential Impact
14	Climate Impacts on Tibbit to Contwoyto Lake Winter Road - The question raised was, in view of climate warming trends, is the assumed annual operating window for the winter road adequate for the proposed Snap Lake Mine life?	As a result of the Snap Lake Diamond Mine more traffic will develop on the winter road system therefore, concern was expressed over increased impacts along the road corridor for the operating window of the road over the design life of the proposed mine.
15	Impacts of aggregate use- terrain disturbance associated with ground ice thaw - A contingency plan for identifying and mitigating potential thaw degradation of massive ice in the esker borrow source was requested from De Beers.	Eskers can represent important wildlife habitat. Site degradation caused by uncontrolled thaw of massive ice that is exposed or thermally disturbed by excavation during extraction of borrow materials from the esker could cause loss of habitat.
16	Concern was expressed for additional seepage to the underground mine at frozen/unfrozen interfaces. Thaw degradation at these interfaces would be influenced by heat from the underground mine activities and from the resulting convective heat introduced by water infiltration at these interfaces. The water treatment facilities must have adequate capacity to treat all water and, any additional loads to Snap Lake introduced by increased inflow into the underground mine.	Excess water could exceed the capacity of the water treatment system resulting in the release of increased contaminant loads into Snap Lake.
17	Impacts of roads, airstrip, mill and ancillary facilities etc. on ground thermal regime - Concern was expressed for additional and altered subsurface drainage paths resulting from changes in the active layer thickness in areas disturbed by development. These concerns were compounded by potential climate change effects.	Degradation of the permafrost would potentially alter subsurface drainage patterns.
18	Water Management Pond - The concerns were 1) whether or not the integrity of dam at the Water Management Pond is in any way altered by permafrost degradation and, 2) have seepage losses from the Water Management Pond been include in De Beers water quality model and water management plan.	The water management pond can retain water not fit for discharge and, therefore, it's performance is important to the protection of Snap Lake.
19	Permafrost and Taliks - The concern was whether De Beers had enough information with respect to permafrost distribution and specifically taliks and the level of confidence in predicting locations and growth of taliks due to development and climate change.	Potential implications were raised for interaction (mixing) between surface water and groundwater at Taliks.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Hydrogeology

	Summary of Issue	Summary of Potential Impact
20	Are predicted mine groundwater inflow quantities valid?	Affects: size and cost of water treatment plant; mine pumping systems; economic viability of mine; and potential water quality impacts on Snap
21	Are the groundwater quality values (chloride, phosphorus and TDS) used in the impact assessment sufficiently conservative	Affects the required efficiency of the water treatment plant and potentially water quality in Snap Lake
22	Chloride in groundwater - confirmation of predictions, need to monitor	Changes to aquatic community of Snap Lake
23	Chloride in Snap Lake (not chlorine) - conservative analysis	Changes to aquatic community of Snap Lake
24	Water Quality - Effluent Discharge and total loadings - accuracy of groundwater model , including mine face interactions, and reduction of impact	TDS and metal levels in Snap Lake - effect on aquatic community
25	Water Quality - Effluent Discharge and total loadings - accuracy of groundwater model - mine face interactions	TDS and metal levels in Snap Lake - effect on aquatic community
26	Water Quality - Effluent Discharge and total loadings - reduction of impact	TDS and metal levels in Snap Lake - effect on aquatic community
27	Limited Data - Regional Groundwater Model and impact prediction models for quality and quantity	Inadequate baseline to support predictions of effects
28	Quality of Connate groundwater inflow. Vast majority of mine water impact to Snap Lake derived from connate groundwater inflow to mine. Concentrations will be "substantially higher" than indicated in connate water, mine discharge water and hence in Snap Lake and so EA underestimates effects.	Higher than expected impacts on lake water quality
29	Hydrogeology - Impaired Mixing of discharge water in Snap Lake in winter. No baseline under ice current data and assumptions on vertical mixing.	Increased TDS concentrations in lake water which flows into the mine results in positive feedback so that mine water concentrations increase.
30	Hydrogeology - Water Quality in Snap Lake - underestimation of in lake concentrations by 2-4 fold	EA underestimates effects to aquatic life
31	Mine Inflow - Model Calibration : De Beers have simulated hydraulic heads to develop the mine inflow model but have not provided suitable hydraulic head data to calibrate the mine inflow and claim that the in-situ head measurements requested are not suitable	Inaccurate estimates of mine water inflow may result in higher discharges to Snap Lake and resultant effects to aquatic life.
32	Mine Inflow - Derivation of field hydraulic data and elaboration of methods for their use in hydraulic model	Inaccurate estimates of mine water inflow may result in higher discharges to Snap Lake and resultant effects to aquatic life.
33	Mine Inflow - Groundwater inflow model needs to explicitly consider active hydraulic features with high hydraulic conductivities such as the Snap fault.	Inaccurate estimates of mine water inflow may result in higher discharges to Snap Lake and resultant effects to aquatic life.
34	Mine Inflow - Unrealistically low estimates of variance in groundwater inflow.	Inaccurate estimates of mine water inflow may result in higher discharges to Snap Lake and resultant effects to aquatic life.
35	Mine Inflow - Unrealistic and unsubstantiated formulas for calculating leakage factors for groundwater model - no basis in physical measurements	Inaccurate estimates of mine water inflow may result in higher discharges to Snap Lake and resultant effects to aquatic life.
36	De Beers provided 2 estimates of groundwater flow to N and NE lakes and accepted lowest. Better rationale is required and physical evidence of groundwater salinity to substantiate mixing. Flow of saline groundwater may accumulate in lake troughs and invalidate mass balance method.	Inaccurate estimates of groundwater flow may invalidate prediction of potential effects to North and NE lakes, including linkage to spawning habitat
37	Discrepancy between inflow to NE lake and outflow from source at North Lake.	Uncertainty in baseline conditions
38	DeBeers have not conclusively shown a downward gradient in groundwater flux. Groundwater contaminants may diffuse to Snap Lake post closure instead of moving away from Snap Lake by advective-dispersive transport.	Movement of contaminants to Snap Lake may impair water quality and aquatic life post closure.
39	Attenuation of groundwater contaminants prior to discharge to N and NE lakes post closure. Modeling of groundwater movement between mine (post closure) and N and NE lake.	Water quality impairment in N and NE lakes post closure and resultant effects on aquatic life
40	EA may have underestimated water quality effects on Snap Lake from groundwater released via mine water discharge due to : uncertainty in connate groundwater quality, upwelling of saline groundwater, "Recycling" of high TDS water from Snap Lake back to mine inflow and reduced mixing of dense discharge water under the ice in Snap Lake.	EA underestimates TDS concentrations in lake and underestimates impact of project on aquatic communities.
41	Pore Water - Northeast Lake and linkage to spawning habitat	Effects of groundwater contaminants on fish - post closure.
42	Groundwater Flow - Extent of taliks and their effects on groundwater flow	Inaccurate estimates of groundwater flow may result in higher discharges to Snap and other lakes and resultant effects to aquatic life.
43	Sediment quality from groundwater and metals in discharge	Toxicity to aquatic life in Snap Lake and in N and NE lakes post closure.
44	Regional Groundwater Model	Post closure movement of Groundwater beyond N and NE lakes
45	Groundwater Monitoring Program During Operations	Verification of EA Predictions

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Hydrology, Surface Water Quality and Aquatic Organisms & Habitat

	Summary of Issue	Summary of Potential Impact
46	Eutrophication assessment does not consider small bays or cyanotoxins. This has not been modeled or specifically addressed in a monitoring program	Localized nutrient enrichment, production of toxins by cyanobacteria and impacts of toxins on waterfowl and mammals
47	Lack of baseline data on zooplankton communities in smaller lakes which may be influenced by project. DeBeers collected fish data only and "assumed" zooplankton community. Have provided no details on impact assessment for zooplankton	No baseline information prevents assessment of response of smaller lakes in event of "worst case" scenario. No data to assess changes in fish diet.
48	Information requested on water level fluctuations near the North Pile to demonstrate no encroachment of water level on 50m buffer zone between North Pile and Snap Lake.	Buffers < 50m may not provide adequate protection of Snap Lake from seepage
49	Incremental accumulation of smaller, unintentional leaks of fuel, coolants and hydraulic fluids from damaged or poorly maintained haul trucks and other vehicles over each ice-cover season.	Potential to harm lakes and streams at break-up
50	Accuracy of phosphorus model for Snap Lake: accuracy of phosphorus inputs from mine water, adequacy of baseline data on phosphorus forms in Snap Lake and evaluation of phosphorus release from settled organic	Eutrophication, changes in algal community and dissolved oxygen
51	Area and volume of Snap Lake predicted to fall below CCME Guideline of 5.5 mg/L during mine life and timing of periods of low oxygen.	Oxygen depletion may reduce overwintering habitat for lake trout and other aquatic life, Cumulative effects with other stressors.
52	Effects of Total Dissolved Solids on Aquatic Community - No assessment of spatial change	Changes to aquatic community of Snap Lake
53	Effects of Total Dissolved Solids on Aquatic Community - No assessment of temporal change	Changes to aquatic community of Snap Lake
54	Effects of Total Dissolved Solids on Aquatic Community - Incomplete assessment of effects to lake trout	Changes to aquatic community of Snap Lake
55	Effects of Total Dissolved Solids on Aquatic Community - No assessment of effects on aquatic community	Changes to aquatic community of Snap Lake
56	Nutrients in Snap Lake - Attractiveness of Mixing Zone Temperature and nutrient conditions in mixing zone may attract fish	Impact to fish health during operations and after closure
57	Nutrients in Snap Lake - No quantitative assessment of responses to nutrient addition	Nutrient enrichment and changes to aquatic community
58	Nutrients in Snap Lake - accuracy of phosphorus model for benthic nutrient release	Nutrient enrichment and changes to aquatic community
59	Water Quality - Plume in Snap Lake - RMA Under Ice Model provides uncertainty in under ice concentrations	TDS and metal levels in Snap Lake - effect on aquatic community
60	Water Quality - Plume in Snap Lake - Spatial differences in water quality predictions - North Arm	TDS and metal levels in Snap Lake - effect on aquatic community
61	Water Quality - Plume in Snap Lake - Temporal - DeBeers do not assess chronic or interactive effects on organisms	TDS and metal levels in Snap Lake - effect on aquatic community
62	Aquatics Impacts - Need for discrete spatial analysis of effects	EA underestimates effects to aquatic community by averaging over lake and depths
63	Aquatics Impacts - Choice of 20% effect in 1% of lake area	EA underestimates effects to aquatic life
64	Aquatic Effects -Toxicant interaction. Failure to assess multiple stressors	EA underestimates effects to aquatic life
65	Aquatic Effects - Impact of mine closure on aquatic community which is "dependent" on mine conditions	EA does not assess all impacts to aquatic life.
66	Water Quality - Nutrient Inputs. Evaluation of ecological response (productivity and cyanobacteria) in absence of guidelines	EA does not assess all impacts to aquatic life.
67	Water Quality - Development of Monitoring Programs	Potential failure to assess response of Snap Lake to project activities
68	Water Treatment Plant and Waste Management Pond	Insufficient storage volume in WMP to address high natural inputs or down time at WTP.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Hydrology, Surface Water Quality and Aquatic Organisms & Habitat

	Summary of Issue	Summary of Potential Impact
69	WTP Effluent Mixing : Insufficient detail on density gradients and wind effects, no baseline information to validate.	EA underestimates TDS concentrations in lake by overestimating mixing
70	Water Quality Benchmarks - Use of EPA vs. CCME benchmarks underestimates impacts to lake from mine discharge	EA underestimates aquatic effects to Snap Lake by use of inappropriate toxicity criteria
71	Zooplankton Assessment Methods : Use of criterion of effect to 20% of species ignores keystone groups such as zooplankton which are among most sensitive. Loss of zooplankton may represent < 20% of species and not be considered significant, but functional importance to community may be > 20%.	EA Underestimates impacts to aquatic community by ignoring keystone species.
72	Water/Sediment/Biological data Baseline : Sufficient data to evaluate project but not to evaluate effects . DCMI to do statistical Power Analysis	Allows identification of impacts and verification of EA predictions in Aquatic Effects Monitoring Program
73	Underestimation of TDS and associated COPCs in waste water discharge and Snap Lake due to a) underestimation of groundwater and b) incomplete analysis of mixing in the lake.	EA underestimates TDS concentrations in lake and underestimates impact of project on aquatic communities.
74	Potential Impacts of TDS are Underestimated because a) EA underestimates likely concentrations in Snap Lake b) effects analysis does not consider relative changes in abundance within the aquatic community and c) effects analysis does not consider food web interactions	EA underestimates TDS effects on aquatic communities.
75	Nutrient Modeling underestimates loading of plant nutrients to Snap Lake such that project effects on productivity are underestimated	Enrichment of Snap Lake beyond EA predictions, increased plant growth and decreased oxygen.
76	Secondary effects of eutrophication - dissolved oxygen. The EA underestimates phosphorus loading to Snap Lake and, as a result, also underestimates the reductions in dissolved oxygen that will occur in response to increased lake productivity.	EA underestimates losses to aquatic habitat (particularly lake trout) and potential interactions of low dissolved oxygen with other toxicants in the lake.
77	Cumulative Effects Issues - Water: Assessment of cumulative effects is inadequate because a) EA underestimates impacts of project activities (TDS, metals, nutrients), b) interaction of project stressors is not evaluated and c) EA does not consider interactions within Lockhart Basin (i.e. fishing) or long range atmospheric transport and climate change	EA underestimates effects of project on aquatic life in Snap Lake and in Lockhart Basin
78	Fish Habitat Assessments - No Net Loss : DeBeers did not include fish habitat assessments of all lakes likely to be impacted in their EA and did not consider all components of fish habitat (I.e. seasonal)	Loss of fish habitat by failure to consider all potential habitat and account for it in NNL evaluation.
79	No baseline benthic data for areas of Snap Lake > 8m deep prevents analysis of project effects (low dissolved oxygen and increased TDS) on lake community	Project could affect benthic community, fish community and ecological interactions and
80	Inadequate assessment Spawning Habitat : DeBeers did not identify potential lake trout spawning habitat in vicinity of mine water discharge and North Pile seepage and did not evaluate spawning habitat for burbot or	Project may impair fish spawning through discharge of mine water and seepage from North Pile
81	Metals in Discharge will exceed regulatory limits and impair 1-10% of Snap Lake. DeBeers rely on dilution and not on treatment, have not considered toxicant interactions and toxicity tests may not reflect actual mine operations.	Toxicity of metals to aquatic life is unacceptable and will be greater than predicted.
82	TDS Mixing in Snap Lake : Effluent will not mix under ice as predicted because of density gradients and will settle to bottom.	EA underestimates TDS concentrations in lake and underestimates impact of project on aquatic communities.
83	Effects of TDS on aquatic life are underestimated and do not include the aquatic community	EA underestimates impact of project on aquatic communities.
84	Bioaccumulation of Metals : need more detailed analysis of Cd biomagnification, more paste backfill test results and proposals to reduce metals in mine water.	Cd may accumulate in the aquatic food chain
85	Nutrients and Fish Habitat : EA does not adequately consider effects of enhanced supply of available phosphorus on zooplankton, benthos or dissolved oxygen at depth.	Enhanced supply of available phosphorus will alter zooplankton and benthic communities and reduce dissolved oxygen concentrations in the lake.
86	Seepage of acid drainage from North Rock Pile may impair near-shore fish habitat - only 90% of seepage from PAG is captured and DeBeers have not quantified fish habitat in potential receptor area.	Seepage of acid drainage from North Rock Pile may impair near-shore fish habitat

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Hydrology, Surface Water Quality and Aquatic Organisms & Habitat

	Summary of Issue	Summary of Potential Impact
87	Maintenance of excess storage capacity to accommodate greater than expected minewater inflows or runoff.	Discharge of waste water to Snap Lake - impaired water quality and threats to aquatic life
88	Requests that DeBeers demonstrate that they reviewed available options and selected the Best Available Technology for treatment of mine waters, sufficient to demonstrate that dilution in Snap Lake was not substituting for treatment.	Discharge of poorly treated water and effects on water quality and aquatic life in Snap Lake
89	Phosphorus model did not account for all forms of potentially available phosphorus and may have underestimated response of Snap Lake to inputs of phosphorus from mine water.	Increased enrichment of Snap Lake may stimulate undesirable forms of algae and increased productivity may alter aquatic community and decrease dissolved oxygen at depth.
90	TDS Density Plume	Effluent will have a higher density than Snap Lake water and will sink to the lake bottom as it moves outside the mixing zone. This may result in areas of meromixis on a seasonal basis.
91	Treatment of Drinking Water for Giardia and Cryptosporidium	Effects on human health
92	Water Quality Impacts on North and Northeast Lakes - Post closure movement of contaminated groundwater.	Toxicity to aquatic life in N and NE lakes post closure.
93	Impact on Lake Sediments: metals in mine water discharge may react with fines and settle out in Snap Lake, which could result in contaminated sediments	Metals in mine discharge may contaminate lake sediments
94	Lake Level Fluctuation - map of surface area affected by fluctuating lake levels.	Effects of lake level fluctuations on fish habitat
95	Inadequate Baseline Data - Lake S-27.	No baseline fish data and lake is in project footprint.
96	North Pile - Residual Fe/ARD	Low pH seepage from kimberlite rejects may impair water quality in Snap
97	High Cd baseline concentrations in Snap Lake sediments.	Baseline may be artificially elevated because of project related activities during AEP
98	Baseline Aquatic Habitat-Rationale for selection of study sites	Reduce Uncertainty
99	Baseline Study Design-accounting for sensitivity and limits of system	Reduce Uncertainty
100	Baseline Data - not all potentially affected water bodies sampled	Inadequate Baseline
101	Fish and Fish Habitat - Cumulative Effects	Restrictive and incomplete CEA-
102	Potential Impact of Acidic Surface and Bog Waters - natural acids may deplete NP in waste rock pile	Seepage of acid to environment
103	Validity of Fish Population Impact Assessment - Failure to cumulate small impacts	Changes in Fish Populations in Snap Lake due to toxicant interactions and multiple stressors
104	Water Quality Modeling - Validity of DeBeers Mixing Model for Effluent in Snap Lake	Water Quality in Snap Lake and effects on aquatic life
105	Flocculent in MineWater Discharge and Spills	Effects to aquatic life
106	Effects of reduced lake levels and fluctuations on fish habitat - only a qualitative analysis provided.	Reduced lake levels may impact fish habitat
107	Definition of Impacts to Aquatic Community - Assessment Endpoint	Underestimate effects on aquatic life
108	Toxicity of Ionized Ammonia in Snap Lake	Underestimate effects on aquatic life
109	Demonstration of Treatment Plant Capabilities	Minimize impacts to Snap Lake
110	Toxicity of Paste Backfill	Groundwater Contaminants discharged to Snap Lake
111	Terrestrial effects of acidic precipitation	Interaction of acidic precipitation with terrestrial environment may adversely affect water quality.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Wildlife and Wildlife Habitat

	Summary of Issue	Summary of Potential Impact
111	Adequacy of assessment and lack of proposed monitoring regarding potential impacts on furbearers from the Tibbitt-Contwoyto winter road.	Potential negative impact on furbearer populations through influence on movement patterns and habitat use.
112	Lack of formal protocol for determining when an immigrant species would be monitored and/or studied.	Potential to "miss" effects on immigrant species.
113	Sufficient detail not provided concerning follow-up monitoring programs aimed at improving the ecological understanding of impacts on grizzly bears, wolverine, and caribou from diamond mining operations on the central barrens. It was suggested that a detailed monitoring program be put in place prior to the beginning of construction. It was suggested that the monitoring program should include ground-based caribou surveys to collect behavioural and movement information in important areas that may be affected by mine activity. The monitoring program should be coordinated with the other mines to ensure that there is a consistent approach and a better reflection of the trends in the wildlife populations.	Impacts of mine activity on grizzly bears, wolverines, and caribou may go undetected and uncorrected if a proper monitoring program is not in place that links and is consistent with other sites.
114	The Parties were concerned that there had not been sufficient collection and use of traditional knowledge to support and augment scientific knowledge. The Parties suggested that further use of TK could be used to fill in gaps in the baseline information and improve accuracy of predictions.	A failure to use all available information may lead to underestimating potential impacts on species like caribou, grizzly bears, and wolverines.
115	The methods proposed by De Beers for excavation of the esker south of the mine site are of concern. A site visit was requested to better understand reasons for proposed excavation methods and to be given opportunity to provide TK re. which species use eskers and how they use them	Proposed excavation methods may affect wildlife, e.g. caribou migration and bear/wolf denning.
116	Concern that not all appropriate information was included in an assessment of cumulative effects on wildlife. There was general concern that inadequate baseline information had been used to make predictions concerning cumulative effects. It was suggested that not all sources of human-induced grizzly bear and wolverine mortality were incorporated into the assessments for those species. Snap Lake cumulative effects assessment should be revised to include the proposed development of the Jericho mine.	Preparation of cumulative effects assessments without inclusion of adequate baseline and impact information may lead to uncertainty over accuracy of the predictions
117	De Beers would have benefited, in their cumulative effects analysis, from a regional perspective by including the "lessons-learned" from Ekati and Diavik. It was recommended that a regional cumulative effects monitoring program for bears and wolverines be established and that this be included in any Environmental Agreement.  Consistent application of the zone(s) of influence (ZOI). Populations can be impacted whether the home ranges of individuals overlap with several projects or not. It was stressed that where population size and dynamics are unknown, then habitat loss is a possible surrogate only if habitat units are calculated and not just total area lost. All available information should be used in CEA analysis.	The cumulative effects analysis undertaken for this process lacks in considering trends or changes that have taken place since the inception of BHP. The analysis in effect is an elaboration on direct effects and poorly captures potential cumulative effects. Further, poor technique and baseline data can skew outcomes. A failure to use all available information may lead to underestimating potential impacts on species like caribou, grizzly bears, and wolverines.
118	Lack of study to determine effects of increase in local human populations on wildlife populations.	An increased human population in the region could increase pressure on wildlife resources
119	Insufficient baseline data collected for caribou and that the available data was not fully utilized in impact assessments. Caribou abundance should be rated as "relatively abundant", rather than "relatively few", and confidence ratings should be downgraded. Conclusions concerning impacts could not be supported as they were based on poor measurability of benchmarks and that adequate baseline information was not available to make conclusions based on natural range of variability.	Inadequate baseline data and impact modeling could result in inaccurate predictions for impacts on caribou.
120	Ratings for residual impacts on caribou should be changed from "low" to "moderate" as the impact analysis was inadequate and details of mitigation were not provided.	Impacts on caribou may be greater than predicted by De Beers.
121	Not sufficient baseline data and analyses to reach the conclusions that impacts to grizzly bears and wolverines would be "low". Impact ratings and uncertainty levels should be increased. De Beers should take a more proactive approach to ensuring that their impact models were robust and utilized the best possible data.	Impacts on grizzly bears and wolverines may be greater than predicted by De Beers

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Wildlife and Wildlife Habitat

	Summary of Issue	Summary of Potential Impact
122	Waste management plan not provided as part of the EAR. Without details of the mitigation plan, there was uncertainty as to whether wildlife impacts from the mine would be as low as predicted.	Impacts on species attracted to the mine may be greater than predicted.
123	De Beers conducted annual surveys to provide an index of relative grizzly bear abundance within the RSA - Uncertainty as to whether this approach was sensitive enough to distinguish between residual impacts and natural variation in habitat use. Natural range of variability not known.	Impacts on grizzly bears may be greater than predicted by De Beers and survey methodology may not allow for adequate monitoring of effects.
124	Sensory disturbance from mine noise, truck and aircraft traffic, and other human disturbances has the potential to effect grizzly bear and wolverine movements and behaviour. Inadequate consideration as to how these potential impacts may affect indirect habitat loss for these species. Because data on movement patterns for species other than caribou had not been collected, Key Question W2 (What impacts will the Snap Lake Diamond Project have on wildlife movement and behaviour?) remained unanswered.	Impacts on grizzly bears and wolverines may be greater than predicted by De Beers
125	De Beers provided little evidence that additional baseline research, analysis, or effort was dedicated to grizzly bears or wolverines (species of Special Concern). A regional assessment of impacts on grizzly bear, etc. needs to be undertaken to account for all human impacts not just the mines and the road.	Impacts on grizzly bear and wolverine populations may be greater than predicted by De Beers
126	Disagreement with the conclusions of the EAR for impact ratings on migratory birds within the LSA and RSA - the environmental consequence predictions are not realistic.	Impacts on migratory birds may be higher than suggested by De Beers.
127	Parties were unsure about how blasting and road construction would affect nesting behaviour of raptors. Would blasting and construction be ceased during nesting season?	Impact of road construction and blasting on raptor nesting
128	If listed species require long-term data collection, is the baseline adequate? More data needed to reduce certainty	Impact assessment of COSEWIC listed VECs
129	Magnitude of impact on birds from facility noise, vehicles, and aircraft would be seasonally dependant. Wildlife management plan should include procedure for dealing with birds and nests	Impacts on birds
130	Wildlife injuries and disease related to the Snap Lake development	Influence wildlife populations
131	Consumption of contaminants by wildlife	Potential to impact wildlife itself and human consumers
132	Adequacy of baseline data for raptors	Inadequate baseline may affect EA predictions, which in turn determines
133	Compensation for loss of harvest - how will it be determined and administered. How can a loss be demonstrated?	Potential impacts to trappers / hunters (socio-economic implications)
134	Lack of thresholds to address cumulative effects.	Unforeseen impacts may go unchecked until it is too late
135	Potential conflicts with falcons (raptors) that try to nest on mine infrastructure	May influence nesting habits of raptors
136	Unclear of methods used by De Beers in its consideration of other developments in its cumulative effects assessment	Failure to consider all available information will affect the outcome of the cumulative effects assessment
137	COSEWIC listed species: Difficult to accept that changes in movement and behaviour of these species will reverse when no data was collected to map movement and corridors for these species. Long-term nibbling (cumulative) effect not considered	COSEWIC species are already in a vulnerable state and to not fully consider the impacts on their populations could put them in a more vulnerable state

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Economic

	Summary of Issue	Summary of Potential Impact
138	De Beers lack of commitment to specific targets for the employment of Aboriginal and other northerners. The GNWT states that if DeBeers had done a complete labour market analysis they would had been able to set specific quantitative targets.	Without quantitative targets, it is not possible to understand the extent of the impact that the Snap Lake Mine will have on the North.
139	Supply and cost of housing in most NWT communities - the proposed project would only worsen this problem. Cooperative housing is a potential solution and it was recommended that DeBeers seek an association to develop a business plan for an employee cooperative housing development in the NWT.	Lack of housing in most communities in the NWT - De Beers project will only add to the problem.
140	The GNWT wants De Beers to sign a Memorandum of Understanding (MOU) with the GNWT on the supply of rough from the Snap Lake mine. The MOU would be based on DeBeers' statements during the Technical Sessions that this commitment would form part of a Socio-Economic Agreement with the GNWT.	DeBeers' commitment to provide a supply of rough would help promote the expansion of the cutting and polishing industry in the NWT and help provide more benefits to the NWT.
141	Changes to production rate may have impacts on mine life, socio-economics of the project and the proposed mine site facilities.	Changes to the mine production rates has the potential to jeopardize predictions and mitigation measures outlined in the EAR
142	The estimates provided by De Beers for federal and territorial corporate taxes do not appear to be consistent with De Beers' estimate of the value of the project and the effective tax rates used in the analysis.	One of the major beneficial impacts of the proposed project will be tax revenues and it is important to have the best estimate available.
143	De Beers has not committed to "hiring targets" for Aboriginals or Northerners nor has it provided "spending targets" for the purchase of goods and services in the NWT.	One of the primary benefits to the NWT will be the economic benefits of the mine through employment and the provision of goods and services to the project. Without "targets" based on the Proponent's analysis there is in effect no estimate of the benefit of the project to the NWT.
144	De Beers did not provide an estimate of "other operating surplus" in its estimate of direct GDP. This results in an incomplete measure of the impact of the proposed project on territorial and Canadian GDP.	A complete estimate of the impact on the territorial or Canadian GDP will provide a more complete picture of the economic impact of the project and also provide the basis for the estimation of corporate taxes and royalties.
145	The amount of labour income and the number of persons employed for the induced impacts of the proposed project on the NWT economy do not appear to be consistent.	It will improve the analysis of the economic impact of the mine and the resulting socio-economic impacts.
146	There is no quantitative analysis presented in the cumulative effects section of the EA with respect to employment predictions. The Proponent has presented a list of projects and labour requirements but has not undertaken any analysis of the impact on the aggregate level of labour demand on the NWT labour market.	It will provide more evidence of the reasonableness of the expected employment and other economic impacts of the proposed project on the NWT economy. It will also could provide the basis for more detailed in-migration estimates and quantitative employment predictions.



## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Socio-cultural

	Summary of Issue	Summary of Potential Impact
147	De Beers "seems to have no interest in attempting to measure how successful or unsuccessful caribou might be in adapting to changes in their environment...the same could also be said for fish." Need for inclusion of TK in development of baseline and monitoring studies related to caribou and fish.	TK could help to determine criteria to use to evaluate and monitor changes and could assist in detecting changes in evaluation criteria (e.g. health).
148	Limited training and high labour demand from existing projects mean that little labour at the De Beers mine will be local resulting in substantial in-migration	Local employment/benefits will be minimal and new residents will place demands on local infrastructure and on renewable resources and wildlife.
149	Commitment by De Beers, made on Nov. 8/02, to re-analyse artifacts found at the site to determine if they contribute to knowledge about Metis heritage in the NWT has not been fulfilled.	Without this information, it is impossible to assess impacts on the NSMA's cultural resources.
150	The NSMA contends that a commitment by De Beers, made on Nov. 8/02, to the establishment and funding of a Traditional Knowledge program with the NSMA has not been fulfilled.	Absence of this program has prevented the NSMA from contributing TK to the project design, and will prevent the NSMA from making TK contributions to ongoing environmental predictions and monitoring.
151	Absence and/or inadequate analysis of baseline data regarding traditional land use	Lack of understanding of basis for and extent of TLU necessary for accurate prediction of economic and social impacts (including cultural survival, individual health, and stresses on wage economy and social cohesion) and for effective mitigation and monitoring of these impacts.
152	(a) Absence of baseline data regarding existing employment, skills, education, and barriers to employment of the NSMA. (b) De Beers has not explained how it will determine factors of job satisfaction.	(a) Baseline data is necessary for: (1) development of recruitment program specific to NSMA (2) development of training and education programs (3) monitoring. (b) If jobs are not satisfying, skilled aboriginals will leave the north.
153	Absence of baseline data re. existing housing in the NSMA community	Makes predictions about impacts on housing and related individual and
154	No description of "existing infrastructure environment" of the NSMA. Apparent lack of recognition by De Beers that NSMA receives no core funding from government.	"Existing infrastructure environment" may affect community's ability to adapt to change
155	Lack of analysis of project impacts on NSMA's use of indigenous language	Without this analysis, it is not possible to determine adverse impacts of the project on the use of indigenous language or to mitigate those impacts.
156	Spatial boundaries for the analysis of impacts on resource use was too limited. Regional Study Area (RSA) should be broader.	If RSA is made broader, the project may be found to have impacts on Metis fisheries and associated economy, cultural, spirituality, community health, and rights
157	Insufficient use of Traditional Knowledge in collecting baseline data. Unclear how TK will be integrated into the development of monitoring programs.	Affects assessment of effectiveness of monitoring programs.
158	Lack of baseline data re. wildlife abundance and movement in the study area and no clear information on current and future trapping and hunting that might be affected by the project.	Lack of baseline data means that an analysis of lost opportunities will not be possible and that compensation for those lost opportunities can not be determined.
159	Provision of medical services at mine site by "physician assistants"	Physician assistants are not recognized in NWT health legislation
160	(a) De Beers has provided insufficient detail re. proposed Employee and Family Assistance Program (EFAP). (b) Contractors and subcontractors would be responsible for their own EFAPs.	(a) Without specifics, it is impossible to assess the proposed EFAP as a mitigating measure. Also, De Beers' EFAP may duplicate existing programs. (b) There is no guarantee that contractors and subcontractors will provide the EFAPs that their employees will require. They may not have the resources to do so.
161	Impact management measures described under the headings of "sustainable social development", "substance abuse prevention and treatment", and "family support services" are proposed as partnerships but details are not provided re. De Beers' contributions (dollars, people, facilities) or the expected contributions by partners.	Without details regarding proposed partnership programs, one can not assess whether these programs will provide sufficient mitigation to offset negative impacts.
162	De Beers has failed to properly assess cumulative impacts on health and social service infrastructure.	In the absence of estimates regarding increased use of health and social services, impacts on infrastructure can not be assessed.
163	De Beers' choice of spatial boundaries for the SEIA is inappropriate given De Beers' goal to hire as many Northern residents as possible and given the current, limited, availability of labour in the SEIA study area as currently defined.	As currently defined, the SEIA study area limits the extent to which northerners will benefit from the mine. Also, without expanding the area, communities that might be affected by the mine may be excluded from mitigation measures proposed by De Beers for the Primary communities.
164	Direct flights to and from the mine site should be provided from all NWT communities, not just primary and catchment communities as currently defined. Also, flights transporting employees from the south should not go directly to the mine but should be required to stop in the NWT first to pick up northerners.	Not providing flights for NWT residents outside the primary and catchment communities will limit northern socio-economic benefits. Also, without this, and without other mitigation measures to offset the cost of living in the north, northerners could choose to move to a southern location reducing northern benefits.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Socio-cultural

	Summary of Issue	Summary of Potential Impact
165	The proposed composition of the Mine Management Advisory Committee - of De Beers reps and one rep from each of the primary communities. The MMAC should also include representation from the GNWT.	The composition of the MMAC proposed by De Beers will not fully represent the people of the NWT.
166	Parties disagreed with the conclusion by De Beers that diesel fuel is the most appropriate energy for power generation at the mine. De Beers has done little or no analysis of using hydroelectric power instead.	"The lack of support for hydroelectric energy and transmission capacity has significant socio-economic impacts on future energy supplies of NWT communities and impacts NWT obligations under the Kyoto Accord." It could also hinder future development of mineral resources in the NWT.
167	Although De Beers is negotiating with Primary Communities and with the GNWT with respect to Impact Benefit Agreements and a Socio-Economic Agreement respectively, the company has not made a firm commitment to the successful completion of these agreements.	In the absence of regulatory instruments, IBAs and an SEA provide legal instruments for the planning, monitoring and mitigating of socio-economic impacts of the project.
168	DeBeers cumulative impact analysis of the socio-economic effects concentrated on the predictions of effects from the BHP and Diavik projects. Chapter 5 of the EA report summarizes community data and approach followed. A supplemental after the technical sessions provides additional information. While consideration of previous projects to predict impacts is an acceptable approach, this project would have benefited from consideration of the monitoring data from the BHP and Diavik projects as a means of confirming the earlier predictions in their EA reports and grounding the analysis for this project. Further, the most recent baseline data appears to be from 1999 and possibly no more recent than the BHP and Diavik environmental assessments.	Recognizing that there will always be a timelag between data collection and reporting, it is still difficult to determine if there will be cumulative impacts when trends are not considered in the analysis and if the analysis completed did not benefit from the monitoring for change and socio-economic effects from the other diamond projects. The potential exists that the proposed mitigation will not be appropriate to the impacts identified.
169	Need for more flexible work schedule than 2 weeks in/2 weeks out OR need evidence from existing mines that this is not an issue	Flexibility of work rotation could affect traditional culture.
170	Concern re. potential cumulative effects associated with several mines closing within a few years of each other; "nibbling" residual effects that may warrant a collaborative mitigation approach with other companies and government.	Lack of sufficient analysis hinders assessment of impacts.
171	Concern that MMAC may not be able to remain independent and, as necessary, critical of mine management.	Affects effectiveness of continued consultation and mitigation programs.
172	The sustainability/preservation of aboriginal languages and culture is a concern. Are there thresholds beyond which traditions/lifestyles change irreversibly in the primary, and possibly catchment, communities?	Affects assessment of community impacts.
173	Compensation should be provided for lost opportunities with respect to hunting and fishing as a result of the mine.	Affects assessment of community impacts.
174	Incomplete planning w.r.t.: accommodation at mine site during construction and operations; control of communicable disease; measures to address gender equity; community participation and responsibilities w.r.t. monitoring; public reporting; and implementation of the Human Resources Development plan.	Affects assessment of socio-economic impacts and/or effectiveness of mitigation measures.
175	Inadequate amount and recording of community consultations	Could affect understanding of socio-cultural issues.
176	Need for support of Aboriginal language by using traditional languages when communicating with communities	Could impact on cultural well-being
177	Need for more detail re. training programs	Affects ability to assess likely success of achieving employment targets
178	There should be programs for and monitoring of gambling	Affects assessment of socio-cultural impacts
179	Insufficient TK consultation with result that De Beers' information re. use of area for trapping and wolf-hunting, and existence of traditionally significant areas, may be inaccurate	Affects assessment of socio-cultural impacts
180	Consultation by De Beers provided information and gathered TK but did not solicit opinions on project or what constitutes environmental protection	Limits community input into project design and management.
181	Compensation for trappers should not be done with individuals but through the YDFN representative bodies	Affects mitigation programs
182	CEA methodology issues	Affects ability to assess adequacy and accuracy of CEA
183	Asked for clarification of categories of impact analysis used in CEA	Affects ability to assess adequacy and accuracy of CEA
184	What activities and developments were considered but dismissed for the CEA and what information sources were used?	Affects ability to assess adequacy and accuracy of CEA
185	Inadequate baseline data - is De Beers prepared to redo?	Affects accuracy and completeness of EAR
186	Inadequate consideration of how project will affect individual communities	Affects ability to assess accuracy of impacts and adequacy of mitigation

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Socio-cultural

	Summary of Issue	Summary of Potential Impact
187	Conclusions re. impacts are too conditional, not "hard" enough	Affects ability to assess accuracy of impacts and adequacy of mitigation
188	Why did De Beers not use experience in South Africa and elsewhere to assess impacts?	Affects accuracy and completeness of EAR
189	What happens to mitigation measures proposed by De Beers if GNWT can only pay 25% of the cost (for example)?	Affects ability to assess adequacy of mitigation measures.
190	Need more details re. nature, cost, and likely success of partnership programs	Affects ability to assess adequacy of mitigation measures.
191	Will something like De Beers' Fund in Africa be set up here and, if so, what will it look like?	Affects ability to assess adequacy of mitigation measures.
192	Necessary to track success of education and training programs for individual Aboriginal groups	Affects ability to assess adequacy of adaptive management approach to mitigating impacts.
193	What measures and funding will there be for protection of Aboriginal language and culture? Are there thresholds beyond which these changes become irreversible?	Affects ability to assess adequacy of mitigation measures.
194	Need for measures to make Aboriginal workers feel comfortable on-site	Affects ability to assess adequacy of mitigation measures and ability to achieve employment targets.
195	Will De Beers consider partnering with other companies for the provision of EFAP?	Affects ability to assess adequacy of mitigation measures.
196	Will De Beers commit to programs to encourage people to relocate to the NWT from the south?	Affects ability to assess adequacy of mitigation measures and ability to achieve employment targets.
197	Timing of SEA, IBA's.	Affects ability to assess adequacy of mitigation measures.
198	Did De Beers consider an alternative mine life?	Did De Beers adequately consider alternatives to project
199	Need for culturally appropriate and relevant counseling services	Affects ability to assess adequacy of mitigation measures.
200	YDFN's "failure to consult" was due to a lack of people and resources rather than an unwillingness to meet. The consultation process is flawed and results in unequal participation by Aboriginal groups. Process for consultation should follow a different model.	Affects inclusiveness of process.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Air Quality and Waste

	Summary of Issue	Summary of Potential Impact
201	Discarded solid and liquid waste materials should be itemized so that communities know beyond a doubt what material is underneath the ground in the area that aboriginal people may use after mine closure. A list of those wastes that will be deposited in the landfill and in the depleted underground workings was requested	Possible impacts on future traditional land use
202	A single dedicated landfill site in a developed area such as a quarry should be utilized rather than a number of "temporary" or "mobile" locations within the North Pile.	Exposure of wildlife to hazards and potential for contaminated leachate
203	A storage facility for hydrocarbon contaminated soils should be utilized rather than a number of "temporary" or "mobile" landfarm sites within the North Pile.	Uncertain landfarming technology creates risk of contaminated leachate and location within the North Pile creates uncertainty regarding the available treatment timeframe
204	"... De Beers remains vague regarding commitments to adequately track emissions and conduct ambient air quality monitoring. This is a cause for concern". Recommendation for an air quality management plan	Emissions impact on air quality
205	Inclusion of PM10 and PM2.5 in regional air quality monitoring.	Cumulative deposition of particulates from Diavik and Ekati projects should be assessed by monitoring program.
206	Greenhouse gas emissions have been linked to global warming and the burning of diesel fuel at the Snap Lake mine represents an approximate 10% increase over the 1990 baseline year.	The burning of diesel fuel at the Snap Lake mine could affect the NWT's ability to contribute positively to Canada's Kyoto commitments and could contribute to global warming.

## Appendix B. List of Issues: De Beers Snap Lake Diamond Project EA

### Abandonment & Reclamation

	Summary of Issue	Summary of Potential Impact
207	Contaminant uptake by vegetation has not been fully considered. The likelihood of roots reaching deeper than the depth of granite cover (eventually drawing nutrients and potential contaminants) from the underlying kimberlite is not known	Contamination of vegetation, and potentially the wildlife that may ingest the vegetation in the future
208	De Beers has not answered the question of what measures they will use to prevent non-native vegetation from being accidentally introduced.	Potential change in plant species composition
209	Success criteria have not been developed to determine when an impacted area has been successfully reclaimed to sustainably productive natural habitat. De Beers' commitment (at the Tech Sessions, Day 6, p 1) to design protocols for gauging the success of reclamation is recognized	Restoration of productive habitat may be hindered
210	Details for the Abandonment and Restoration of the project should not be delayed until the regulatory phase	Unknown liabilities to the ecosystem
211	Uncertainty about the ecological capability of reclaimed landscape units since there is only a 'moderate' level of confidence that disturbed ELC units will be re-established in the long-term	Potential changes to composition of ELC units and wildlife habitat
212	Concern about what materials would be buried in the mine at closure. Request for a list of materials to be buried in the landfill and in the underground mine on closure.	Potential for long term contamination of the environment.
213	Concern about the lack of information regarding A&R activities, particularly disposal methods and locations, rational for options and the state to which the site will be reclaimed	Unknown liabilities to the ecosystem
214	Concern about the length of time post closure monitoring would be required for the northeast lake.	Long term environmental impact
215	What are the goals for reclamation and how will De Beers know they have been achieved?	Long term environmental impact
216	Options for alternative use for the site following closure and if First Nations had been consulted on this issue.	Provision for beneficial long term, post-closure use of infrastructure
217	Rationale for De Beers' approach to characterizing baseline biodiversity is unclear - appears that baseline biodiversity was only partially characterized	Impacts to biodiversity could be greater than EA predictions

# **Appendix C**

## **List of Recommendations and Suggestions**

## Appendix C: Listing of Recommendations and Suggestions

### RECOMMENDATIONS

(R1) Section 2.4.3.2

The Board recommends that De Beers monitor TDS and flow of the mine water discharged to Snap Lake. Continuous conductivity recordings can be made as a surrogate upon verification of a quantifiable and statistically significant relationship between TDS and conductivity. The monitoring program should, where appropriate, include boreholes drilled in advance of mine development in order to provide advance warning of unanticipated changes in water quality.

(R2) Section 2.4.3.2

The Board recommends that De Beers track loadings of TDS, Ca and Cl discharged to Snap Lake as a condition of the Production Water Licence and that De Beers file reports at a frequency to be determined by the Mackenzie Valley Land And Water Board. The reports shall, at a minimum, include:

- TDS concentrations in discharged water;
- Volume of water discharged;
- Cumulative annual loading of TDS to Snap Lake; and,
- Comparisons of these observed loadings to the EA predictions.

(R3) Section 2.4.3.2

These reports shall be compared to predicted loads to determine the need for additional mitigation (e.g., grouting) or cessation of water discharge if loads exceed the Production Water Licence limit.

(R4) Section 2.6.4.1

The Mackenzie Valley Land and Water Board shall develop the terms and conditions of an AEMP as part of the Production Water Licence for the SLDP. The AEMP shall include the commitments made by De Beers during the EA process and specific recommendations made in other parts of this report.

(R5) Section 2.6.4.3

The Production Water Licence for the Snap Lake project shall specify that the whole lake average TDS concentration in Snap Lake not exceed 350 mg/L at any point in the mine life. This shall be achieved through a total annual load which will not exceed the loads used by De Beers to drive its EA predictions in each year of the mine life.

(R6) Section 2.6.4.3

The Board further recommends that the Production Water Licence provide for the calculation of the total annual TDS load to Snap Lake, for every year of the project, on the basis of the data De Beers used to compile Figure 9.4-13 in Section 9.4 of its EAR.

## Appendix C: Listing of Recommendations and Suggestions

(R7) Section 2.6.4.3

The Board further recommends that the Production Water Licence require De Beers to monitor TDS levels and the quantity of the mine water discharged to achieve compliance with the loading limit for TDS. Details pertaining to this were given in the recommendation made in Section 2.4 (Hydrogeology).

(R8) Section 2.6.4.4

De Beers develop a monitoring and Adaptive Management Plan to address uncertainty in lake mixing and density stratification. This shall include a monitoring program sufficient to provide early warning of persistent density stratification and a description of thresholds and mitigation measures such as tempering of the effluent stream or mechanical mixing. This recommendation could be implemented through the Production Water Licence AEMP recommended earlier in this report.

(R9) Section 2.6.4.4

The Board further recommends that the Production Water Licence include requirements to implement an Adaptive Management Plan to mitigate density stratification in Snap Lake.

(R10) Section 2.7.4.3

In order to ensure that the response of the Snap Lake aquatic community remains within the range predicted by De Beers and to prevent significant adverse impacts to the aquatic community of Snap Lake the Board recommends that the Production Water Licence for the SLDP shall specify that the whole lake average TDS concentration in Snap Lake not exceed the 350 mg/L in the EA predictions by De Beers. This can be achieved by an annual loading limit for TDS which is not to exceed the annual load used by De Beers to conduct its impact assessment.

(R11) Section 2.7.4.3

The AEMP shall be comprehensive enough to verify De Beers' EA predictions that changes to the aquatic community of Snap Lake will be of low magnitude. The monitoring program should incorporate the results of a statistical power analysis to guide sampling and interpretation of changes.

(R12) Section 2.7.4.3

The Production Water Licence for the SLDP shall also include a requirement for routine testing of the acute and chronic toxicity of the final mine effluent to aquatic life to confirm testing done by De Beers in the earlier stages of the project and to ensure that significant adverse impacts do not occur.



## Appendix C: Listing of Recommendations and Suggestions

(R13) Section 2.10.3.2

De Beers shall, in consultation with the GNWT, develop a Caribou Protection Plan that imposes increasingly stringent mitigation measures as the number of animals potentially exposed to disturbance from the site increases. This plan could be modeled on the caribou protection measures included as terms and conditions of land use permits by INAC in the past.

(R14) Section 2.10.3.2

De Beers shall, in consultation with the GNWT, develop a monitoring program to test the predictions of the EAR for grizzly bears, wolverines, and caribou and to further the scientific understanding of behavioural responses of these species to mine-related disturbance.

(R15) Section 2.10.3.2

De Beers shall evaluate and incorporate the results of the project-specific monitoring into the Wildlife Management Plan (see recommendation 2.5.3.3.2) to minimize impacts on grizzly bear, wolverine, and caribou behaviour and movement.

(R16) Section 2.10.3.2

These measures should be incorporated where possible in land use approvals and as part of the Environmental Agreement.

(R17) Section 2.10.3.3

De Beers shall, in consultation with the GNWT, develop a comprehensive waste and odour management strategy to minimize the attraction of carnivores to the site. The strategy must identify and describe details of design features, operational measures, employee/contractor staff awareness and training, for handling of food, food waste and other wastes throughout the mine site and specifically for the incinerator, landfill site, kitchens, camps and personnel quarters.

(R18) Section 2.10.3.3

De Beers shall, in consultation with the GNWT, develop a comprehensive on-site Wildlife Management Plan that limits the attractiveness of the mine site to carnivores and includes protocols for dealing with on-site wildlife encounters. The requirement for the on-site wildlife management plan shall be incorporated into the proposed Environmental Agreement.

(R19) Section 2.15.3.2.2

De Beers shall design and implement a pre-construction baseline data collection program for caribou within the RSA, in cooperation with the GNWT, Aboriginal groups, and renewable resource users. This program shall be designed such that it can contribute to regional monitoring initiatives.

## **Appendix C: Listing of Recommendations and Suggestions**

(R20) Section 2.15.3.2.2

De Beers shall design and implement a specific monitoring program to detect effects of the SLDP and the Snap Lake winter access road on caribou behaviour. The requirement for this program shall be included in the Environmental Agreement.

(R21) Section 2.15.3.2.2

The GNWT shall, within 24 to 36 months, develop a model that detects and evaluates the effects of development on caribou movements and populations in the Slave Geological Province. This model shall enable the setting of thresholds of allowable caribou disturbance for use in future EAs in the Slave Geological Province

(R22) Section 2.15.3.2.3

De Beers include, as part of its on site Wildlife Management Plan, an awareness and training program designed to reduce carnivore mortality at the site.

(R23) Section 2.15.3.2.3

De Beers shall design and implement a pre-construction grizzly bear and wolverine baseline monitoring program, in cooperation with the GNWT and in consultation with renewable resource users within the RSA.

(R24) Section 2.15.3.2.3

The GNWT shall develop a standardized set of procedures for monitoring grizzly bear, and wolverine populations, behaviour and movement, for use at the SLDP and other developments in the Slave Geological Province. These procedures shall be developed in consultation with TK holders and made available to De Beers and others within 24 months.

(R25) Section 2.15.3.2.3

GNWT shall evaluate the likelihood of adverse cumulative effects on grizzly bear and wolverine populations in the Slave Geological Province. Based on this information, the GNWT shall develop a quantitative threshold of allowable bear and wolverine mortality for use as an indicator of likely significance for future EAs. This work shall be completed within 24 months.

(R26) Section 2.15.3.2.4

The Board recommends that the Government of Canada take the lead in implementing a regionalized, multi-party response to the monitoring for and management of cumulative effects in the Slave Geological Province preferably under the umbrella of the CEAM Strategy and Framework.

(R27) Section 2.15.3.2.4

The GNWT shall undertake a review of grizzly bear and wolverine populations in the Slave Geological Province to determine if current management measures relating to direct kills are adequate to deal with potential cumulative effects and to develop a response where significant

## Appendix C: Listing of Recommendations and Suggestions

adverse impacts are identified. This review should be used to contribute to any cumulative effects monitoring and management program for the Slave Geological Province.

(R28) Section 2.15.3.2.4

De Beers, and the Government of Canada and the GNWT shall negotiate and sign an Environmental Agreement prior to the issuance of a Production Water Licence.

(R29) Section 2.15.3.2.4

The Government of Canada and the GNWT shall ensure that the De Beers Environmental Agreement is consistent with those negotiated for similar mines within the Slave Geological Province.

(R30) Section 2.15.3.2.4

The Government of Canada and the GNWT shall ensure that any future Environmental Agreements be negotiated during the EA process so that a draft Agreement can be entered into evidence for consideration by the Board so that it can be satisfied that cumulative effects are being addressed and mitigated.

(R31) Section 2.15.3.2.4

The Government of Canada and the GNWT, De Beers, Diavik, and BHP Billiton shall work towards consolidating the Environmental Agreements for these developments within 24 months. The consolidation should result in a standard agreement which can be used for future mines in the Slave Geological Province.

(R32) Section 2.15.3.2.4

The Government of Canada, along with all other interested Parties, shall take immediate action to implement the *Blueprint for the Cumulative Effects Assessment and Management Strategy and Framework in the NWT and its Regions*. The Board further recommends that the Government of Canada allocate long-term, stable funding to this initiative for a term of no less than ten years.

(R33) Section 2.15.3.2.4

The Government of Canada shall take immediate action to complete an environmental audit as required by Part 6 of the MVRMA including the establishment of a baseline of environmental conditions and trends that may be used in future application of Part 5 of the MVRMA.

## **Appendix C: Listing of Recommendations and Suggestions**

(R34) Section 2.15.3.2.4

The Government of Canada and the GNWT in consultation with the REVIEW BOARD, shall within 12 months undertake an analysis of the role of Environmental Agreements in the evolution and operation of the environmental regulatory regime in the NWT.

(R35) Section 2.15.3.2.4

The Government of Canada and GNWT should consider the feasibility of establishing a research-based institute devoted to improving the scientific understanding of baseline conditions and environmental responses to renewable and non-renewable developments within the Slave Geological Province.

(R36) Section 2.16.4.1

The GNWT Socio-Economic Agreement shall include the commitments given by De Beers to employment (including training targets) and procurement targets, and the provision of rough diamonds from the proposed Snap Lake mine to the local NWT secondary diamond industry.

(R37) Section 2.16.4.1

De Beers and the GNWT shall negotiate and sign the Socio-economic Agreement prior to the issuance of a Production Water Licence.

## Appendix C: Listing of Recommendations and Suggestions

### SUGGESTIONS

(S1) Section 1.5.3

The Government of Canada consider the development of a method for providing participant funding at the EA level under the MVRMA. This funding should be primarily targeted at NWT residents and communities, including Aboriginal and non-aboriginal groups. The method should include the establishment of an independent authority to administer the funds that is applicable at both EA and environmental impact review levels.

(S2) Section 2.3.3.5

The Board suggests that geotechnical monitoring be required in the terms and conditions of the Production Water Licence to verify EA predictions over the life of the mine, including reclamation and closure of the mine.

(S3) Section 2.3.3.5

The Board suggests that an Adaptive Management Plan be prepared for approval as part of the Production Water Licence to ensure that contingency plans are in place in terms of geotechnical performance of the North Pile.

(S4) Section 2.4.3.1

The Board suggests that De Beers monitor the quantity of mine inflow and provide an annual update to its mine water discharge model to verify EA predictions of groundwater inflow, anticipate the need for mitigation, and manage groundwater quantities within the range of De Beers' EA predictions. The monitoring program should, where appropriate, include boreholes drilled in advance of mine development in order to provide advance warning of unanticipated changes in hydraulic conductivity.

(S5) Section 2.4.3.1

Monitoring results should be reported, at a frequency to be determined by the Mackenzie Valley Land and Water Board, and used as input to the loading calculations to determine the need for additional mitigation ( e.g., grouting) or cessation of water discharge if TDS loadings exceed the Production Water Licence limit which is recommended by the Mackenzie Valley Land and Water Board.

(S6) Section 2.4.3.1

The Board suggests that the groundwater quantity monitoring program be included among the terms and conditions in a Production Water Licence.

## Appendix C: Listing of Recommendations and Suggestions

### (S7) Section 2.5.4

The Board suggests that De Beers monitor:

- Lake elevation of Snap Lake;
- Discharge of water from Snap Lake;
- Inflows to the water management pond from underground workings and surface drainage;
- Quantity of North Pile seepage; and,
- Quantity of water discharged to Snap Lake from the mine.

### (S8) Section 2.4.4

The Board suggests that these monitoring parameters be included among the terms and conditions in a Production Water Licence.

### (S9) Section 2.6.4.2

The AEMP which was recommended as a component of the Production Water Licence (Section 2.6.4.1) should include the requirement to verify EA predictions of changes in trophic and dissolved oxygen status of Snap Lake by the monitoring of:

- Dissolved oxygen concentrations in profiles at deep portions of Snap Lake with monitoring occurring under the ice in winter conditions and in late summer;
- Concentrations of total phosphorus, orthophosphate and organic phosphorus in connate groundwater and mine effluent on a regular basis and in Snap Lake under the ice in March and in early summer;
- Concentrations of chlorophyll “a” in Snap Lake in early summer after the loss of ice cover and in mid summer; and,
- Algal biomass and species community composition for phytoplankton and periphyton in Snap Lake in mid-summer. The monitoring should include measures of cyanobacteria biomass and species composition and cyanotoxins in the event that algal community composition shifts to favour cyanobacteria.

### (S10) Section 2.6.4.2

Monitoring results should be used to assess the need for mitigation (*e.g.*, grouting of mine water inflows, enhanced waste water treatment or reduced waste water discharge).

### (S11) Section 2.6.4.5

The AEMP should include assessment of cadmium and chromium levels in fish in Snap Lake.

## Appendix C: Listing of Recommendations and Suggestions

### (S12) Section 2.7.4.1

The Board suggests that De Beers develop a draft comprehensive AEMP for the SLDP to support its Production Water Licence Application. The Program design should include a statistical power analysis to determine the sampling intensity required to identify the changes De Beers has predicted for Snap Lake. This proposal should be reviewed by the Mackenzie Valley Land and Water Board for consideration as part of the licence AEMP.

### (S13) Section 2.7.4.1

The program should address characterization of baseline conditions and detection of responses in the:

- Algal community (taxonomy and biomass of phytoplankton, including cyanobacteria);
- Zooplankton community composition;
- Benthic community in deep areas where dissolved oxygen is predicted to decline;
- Fish diet; and,
- Fish growth.

### (S14) Section 2.7.4.1

The Board also suggests that the AEMP design incorporate Traditional Knowledge gained through consultations with TK holders.

### (S15) Section 2.7.4.2

The AEMP should include the following as indicators of nutrient enrichment in Snap Lake:

- Total phosphorus, orthophosphate and organic phosphorus in Snap Lake;
- Nitrate, nitrite, ammonia and Kjeldahl nitrogen in Snap Lake;
- Chlorophyll “a” and algal biomass and composition of the phytoplankton community; and,
- Quantification of baseline levels of cyanobacterial toxins in Snap Lake and a requirement for routine monitoring of cyanotoxins if cyanobacterial species increase to 30%<sup>1</sup> of the algal community biomass. The Board notes that the figure of 30% does not represent a critical threshold of effect..
- Under ice dissolved oxygen profiles in deep areas of Snap Lake.

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<sup>1</sup> The study by Prepas *et al.* (2002) did not identify a critical threshold of effect. That study, however, did document a ten-fold increase in cyanotoxins when cyanobacteria increased by approximately 50% - from 43% to 67% of the algal community biomass. A trigger of 30% is therefore suggested by the Board as an indicator of change, in that it represents more than a 50% increase from the existing cyanobacterial contribution to algal biomass of <20% in Snap Lake.

## Appendix C: Listing of Recommendations and Suggestions

(S16) Section 2.7.4.2

The AEMP should be linked to an Adaptive Management Plan and mitigation activities such as grouting, phosphorus abatement programs on site, enhanced sewage treatment, or artificial aeration.

(S17) Section 2.7.4.4

The AEMP should include assessments of trace metal burdens in fish and invertebrates collected near the diffuser; at the start of the project and at five year intervals throughout the mine life to confirm EA predictions.

(S18) Section 2.7.4.6

The Board suggests that design and implementation of the AEMP include a broad range of indicators of water quality and aquatic biology sufficient to assess the response of Snap Lake to all aspects of the SLDP and that it incorporate Traditional Knowledge to assist in the design, implementation and interpretation of results.

(S19) Section 2.7.4.7

DFO and De Beers should negotiate an agreement to ensure No Net Loss of fish habitat and ensure that the results are communicated to Aboriginal groups who were Parties to this proceeding.

(S20) Section 2.8.4

The Board suggests that land use approvals require the assessment of ground ice conditions in the esker prior to excavation activities during the construction phase and for incorporation in De Beers' Quarry Management Plan .

(S21) Section 2.10.3.1

De Beers should design a project-specific monitoring protocol to test for behaviourally-induced habitat avoidance effects as a result of the project, and include this in an Adaptive Management Plan. There is a need to develop scientifically sound research projects to address this issue and to examine the relationship between project activities and a reduction in habitat effectiveness. This protocol should apply to grizzly bear, wolverine and caribou and should be developed in consultation with the GNWT and TK holders.

(S22) Section 2.10.3.1

The GNWT, using results gained from the monitoring undertaken in the above suggestion and information from the other mines, should evaluate whether there is a population level avoidance response to the SLDP.



## Appendix C: Listing of Recommendations and Suggestions

(S23) Section 2.11.4

Given De Beers' acknowledgement that Aboriginal groups have used the study area for traditional purposes, these groups should be involved in project related monitoring activities to ensure that mitigation measures are successful, particularly with respect to impacts on renewable resources. Appropriate training should be provided by De Beers to individuals involved in these monitoring activities

(S24) Section 2.11.4

The Board suggests that De Beers ensure that employee and contractor awareness programs highlight the importance of the fishing and hunting policy for Snap Lake.

(S25) Section 2.12.3.1

The Government of Canada and the GNWT should ensure that any Environmental Agreement include commitments by De Beers to:

- a) Meet all applicable air quality criteria and standards both within the active mine area where workers may reside during work rotations and within the LSA and RSA; and,
- b) Design and implement a comprehensive emission and air quality monitoring strategy to ensure that emissions are tracked and contaminants of potential concern are monitored. This monitoring program should include monitoring of both PM<sub>10</sub> and PM<sub>2.5</sub> within the active mine site and within the LSA and RSA. De Beers should design the program in consultation with Environment Canada and the GNWT.

(S26) Section 2.12.3.2

The Government of Canada and GNWT should ensure that any Environmental Agreement include the following commitments by De Beers:

- a) Maximum use of low sulphur diesel by De Beers; and,
- b) Reporting by De Beers to Governments on GHG emissions on an annual basis.

(S27) Section 2.13.4

The Government of Canada and the GNWT should ensure that any Environmental Agreement includes the commitments made by De Beers to design and implement a noise monitoring and abatement strategy to ensure that noise emissions are as low as reasonably achievable with best available technology. This monitoring program should include periodic monitoring of noise both within the active mine area, and within the LSA and RSA. De Beers should design the program in consultation with the GNWT.

(S28) Section 2.14.3.1

The follow up and monitoring programs that will be carried out by De Beers should be utilized by the GNWT where appropriate to monitor adverse impacts on wildlife and human health.

## Appendix C: Listing of Recommendations and Suggestions

(S29) Section 2.15.3.2.1

The GNWT should develop cumulative effects thresholds relating to direct and indirect habitat loss for various wildlife species of management concern (e.g., caribou, grizzly bear, wolf, wolverine) as a wildlife management tool for use in responding to development in the Slave Geological Province.

(S30) Section 2.15.3.2.1

The GNWT should within 24 to 36 months develop a standard methodology or model for quantifying direct and indirect wildlife habitat loss. The GNWT should encourage developers of future developments to utilize these models for purposes of impact assessment.

(S31) Section 2.16.4.4

The Board suggests that the Government of Canada and the GNWT examine the feasibility of establishing a fund financed through a portion of non-renewable resource revenue to be used for the promotion of economic diversification and sustainable economic development in the NWT.

(S32) Section 2.16.4.5

The Board suggests that the Government of Canada conclude negotiations on a royalty revenue sharing agreement with the GNWT within 24 months in order to ensure that all royalty revenues generated by the SLDP, and other non-renewable resource developments, accrue to the GNWT and residents of NWT in a manner similar to that enjoyed by Southern Canadians.

(S33) Section 2.16.4.5

The Board suggests that GNWT examine its current tax structure including the payroll tax to determine if more revenues can be raised from non-renewable resource development activities to help offset increased costs and promote the objectives of economic sustainability and diversification.

(S34) Section 2.17.4.4.1

De Beers should pursue joint ventures or partnerships with community-based organizations or businesses for the delivery of employee assistance support programs. This would facilitate the provision of services in a culturally appropriate way and is consistent with De Beers' stated intention to consider using local resources for counseling (Technical Session Transcripts, Day 10, December 6 2003, p. 63). The Board recognizes De Beers' commitment to provide substance abuse programs both at the mine site and in the communities and suggests that as many of the other programs as possible also be made available both on-site and in the communities.

## Appendix C: Listing of Recommendations and Suggestions

- (S35) Section 2.17.4.4.1  
In its Technical Memorandum, dated February 28, 2003, De Beers provided details related to its proposed “De Beers Canada Fund”. In this memorandum, De Beers indicated that initial funding for the Fund will be “...a minimum level of 1.0% of net annual after tax cash flow for the Canadian operations” (Technical Memorandum, De Beers Canada Fund, February 28 2003). The Board suggests that De Beers allocate a specific portion of the 1% amount to support communities impacted by the SLDP.
- (S36) Section 2.17.4.4.1  
The GNWT should produce standardized and consolidated annual reports on results achieved under the De Beers, Diavik and BHP Billiton Socio-economic Agreements.
- (S37) Section 2.17.4.4.1  
The Board suggests that the GNWT should, under the NWT Cumulative Impact Monitoring Program, study the links between industrial development and socio-cultural conditions. This is important to predict the demands that further natural resource development will place on social and community infrastructure and services, identify critical thresholds, and suggest appropriate measures to address these issues.
- (S38) Section 2.20.3.2  
The appropriate regulatory authorities should ensure that the landfarm and landfill operations are inspected to ensure conformity to GNWT guidelines and regulatory requirements.
- (S39) Section 2.21.3.1  
Consistent with the *Mine Site Reclamation Policy for the Northwest Territories* (INAC 2002), De Beers should develop site-specific reclamation criteria prior to regulatory approval of this project.
- (S40) Section 2.22.4  
De Beers should develop a formal Adaptive Management Plan for incorporation into regulatory approvals, and any Environmental Agreement or Socio-economic Agreement.

# **Appendix D**

## **List of De Beers Commitments**

## **Appendix D. List of De Beers Commitments**

The table below summarizes the specific commitments made by De Beers Canada Mining Inc. throughout the EA process. This table updates the commitment table provided by De Beers in its April 14, 2003 response to the Review Board's April 4, 2003 question regarding commitments (Q.9). An asterisk (\*) indicates the additional commitments noted by the Review Board.

The commitments were taken from De Beers' Environmental Assessment Report (EAR), Information Requests (IRs), North Lakes Report, Conformity Response, November-December 2002 Technical Sessions, De Beers' Technical Memos, De Beers' meetings with intervenors, Public Hearing, and various pieces of correspondence.

Where commitments were made but are not contained in the table, De Beers is still expected to meet those commitments.

Component	Commitment
<b>Project Description</b>	
Consultation	<ul style="list-style-type: none"> <li>As stated in Section 3.1.3 of the EAR, any substantial changes in the current project description will be addressed through the appropriate land use permit and water licence applications to the Mackenzie Valley Land and Water Board. De Beers will conduct consultation with all affect parties should this occur (IR 3.11.3d)</li> </ul>
North Pile - construction	<ul style="list-style-type: none"> <li>De Beers committed to the North Pile shell construction method represented by Sections A and C of both Figures 7.11 and 7.12 taken from the report entitled, "Snap Lake Diamond Project Surface Engineering Optimization Study North Pile Management". The slide presentation added clarity with respect to the starting shell configuration that will be in force in both the Starter Cell and the East and West Cells. Other shell configurations will be tested, however, they will not be used until proven capable of providing equal or better long term pile stability and appropriate protection to the environment (Technical Sessions, Day 7, 3 December 2003, PowerPoint presentation)*</li> <li>De Beers committed to shell construction on a prepared foundation. The shell will be constructed on competent bedrock or competent mineral soils over bedrock and approved by a qualified professional (Technical Sessions Day 7, 3 December 2002; IR 2.4.30)*</li> </ul>
North Pile - monitoring	<ul style="list-style-type: none"> <li>Starter cell monitoring to provide advanced indications of conditions expected in the pile as a whole. Additionally, monitoring of the starter cell will continue during full-scale deposition.</li> <li>A ditch will be designed and constructed to minimize, if not eliminate altogether, seepage from the North Pile area to Snap Lake by establishing a reversal of the hydraulic gradient between the North Pile and Snap Lake. This reversal will change the seepage flow direction and will result in water from the North Arm of Snap Lake seeping into the collector ditch.</li> <li>Frozen seepage barriers will be established through the construction of embankments between the ditch and the lake. In time, the embankments will raise the level of permafrost above the level of the ditch bottom, thereby creating a seepage barrier. The barrier will force seepage from the North Pile upwards, into the ditch.</li> <li>Where necessary, modifications will be made to the design and operation of the East Cell and West Cell ditches to improve their effectiveness (North Pile Chemical Stability Technical Memo, 28 February 2003)</li> </ul>
Land farm	<ul style="list-style-type: none"> <li>De Beers is committed to monitoring the land farm to ensure effective performance and would consider alternatives to land farming should management techniques prove to be ineffective in treating the soils (Public Hearing Transcripts, Day 2, 29 April, 2003)*</li> </ul>
<b>Project Alternatives</b>	
Energy Alternatives	<ul style="list-style-type: none"> <li>De Beers commits to supporting opportunities to position sustainable hydro-electric power development with NWT Power Corporation (Technical Sessions, 25 November – 06 December 2002). A March 5, 2003 letter (from AMEC) confirmed De Beers interest to purchase reliable hydroelectric power for the Snap Lake site, prior to planned facility start up in mid-2007 (23 May 2003 GNWT letter to Review Board)*</li> </ul>

Component	Commitment
<i>Socio-Economics</i>	
Aboriginal Traditional Practices	<ul style="list-style-type: none"> <li>• De Beers will actively support the promotion of traditional cultural practices in the primary communities. (EAR, Section 5.3.4.3.7, IR3.5.14)</li> <li>• De Beers may assist with funding support to existing or emerging community-based programs or agencies with the mandate to strengthen Aboriginal culture in the primary communities. In addition, De Beers will work with community and government educational agencies to promote attaining Aboriginal culturally appropriate resources for local schools. (EAR, Section 5.3.4.3.7, IR3.5.14)</li> <li>• De Beers will arrange to provide cross-cultural training to all onsite staff. (EAR, Section 5.3.4.3.6, IR3.5.14)</li> <li>• In collaboration with the community liaison personnel, De Beers will organize Community Appreciation Days. (EAR, Section 5.3.4.3.6, IR3.5.14)</li> <li>• In collaboration with community liaison personnel, De Beers will develop a cultural exchange program to provide non-Aboriginal site employees with the opportunity to spend 2-3 days with Aboriginal employees while participating in traditional land practices. (EAR, Section 5.3.4.3.6, IR3.5.14)</li> <li>• De Beers will make every reasonable effort to reflect Aboriginal culture at the site. (EAR P. IV.1-30)*</li> </ul>
Administration of the De Beers Canada Fund	<ul style="list-style-type: none"> <li>• De Beers is committed to social investment in all the countries where it operates (IR 2.5.2c)</li> <li>• A small (three person) centralized Fund Committee based in Toronto, will be established and responsible for: <ol style="list-style-type: none"> <li>1. Ensuring governance</li> <li>2. Alignment with overall corporate global social investment policy</li> <li>3. Allocation of funds between the fund committees in Canada</li> <li>4. Communication with wider corporate interests</li> </ol> </li> <li>• A local Fund committee will be established in the Northwest Territories (representing Snap Lake), and will consist of a minimum of seven permanent voting members, made up as follows: <ol style="list-style-type: none"> <li>1. Two De Beers appointed representatives, one of whom will be Chairman, and who will have the casting vote.</li> <li>2. One employee representative, elected by employees.</li> <li>3. Two community representatives, from the main Aboriginal communities affected by the company projects. These representatives will serve a maximum term of office of two years, and the positions will then be rotated between the various Aboriginal communities.</li> <li>4. Two other representatives, from communities such as Yellowknife, or from local social service organizations. These positions will be identified, and invited to serve, by the five representatives referred to in 1, 2 and 3 above.</li> </ol> </li> <li>• The main purposes of this committee will be to screen all grant applications, approve allocation of available funds, ensure funds are correctly distributed and that good governance practices are in place, monitor grant supported projects on an ongoing basis and network with other organizations involved with similar work (e.g., other industry stakeholders, government agencies, communities, non-government</li> </ul>

Component	Commitment
	<p>organizations).</p> <ul style="list-style-type: none"> <li>Initially funding for the Canadian De Beers fund at a minimum level of 1.0% of net annual after tax cash flow for the Canadian operations (De Beers Canada Fund Technical Memo, 28 February 2003)</li> </ul>
Community Needs	<ul style="list-style-type: none"> <li>De Beers will work with the primary communities to seek a balance between the company's corporate needs and the social, economic and environmental needs of the primary communities (IR 4.11.6)</li> <li>Review counseling service provided to De Beers employees by a southern consulting company and consider using a more culturally appropriate method (Technical Sessions, 25 November – 06 December 2002)</li> <li>De Beers will provide project specific information to the planning authorities to ensure the relevant information related to Snap Lake can be considered in each community's growth scenarios, infrastructure needs assessment, and public capital planning. In addition, as appropriate, De Beers could take part in the community and public planning sessions. (Conformity Response, August 2002, Sec. 9.2.3)*</li> </ul>
Consultation	<ul style="list-style-type: none"> <li>Significant change (increase or decrease) in the mine production rate would be done in consultation with all stakeholders (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
Diamond Branding	<ul style="list-style-type: none"> <li>If in 4 to 5 years, when Snap Lake diamonds come into production, the diamond market is showing a possibility to accommodate more Canadian branded goods, De Beers would re-assess their current position (marketing opportunities will be met in the near future) and initiate branding if it would be to their benefit (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
Diamond Sorting	<ul style="list-style-type: none"> <li>De Beers will set up a Yellowknife diamond sorting facility- the degree to which it will be sorted is yet to be determined and dictated by Canadian regulations. A skilled individual from the London office of the Diamond Trading Centre will be seconded to manage this facility. This individual will carry out the recruitment and training of northerners with the objective of developing a skilled team of rough diamond sorters to meet De Beers' local requirements (Conformity Response, August 2002, Section 8.3; Technical Sessions, 25 November – 06 December 2002)</li> <li>Over the first five years of mine operations, De Beers undertakes to train rough diamond sorters in excess of its local needs (Conformity Response, August 2002, Section 8.3)</li> </ul>
Health	<ul style="list-style-type: none"> <li>De Beers is interested in promoting and maintaining a healthy workforce. As part of this approach, De Beers will require its catering contractor to understand diabetes issues concerning all workers and will require the contractor provide foods that are appropriate to those at risk (IR 4.11.9a)</li> </ul>
Hiring Priorities	<ul style="list-style-type: none"> <li>De Beers has committed to hire as many qualified Aboriginal people as possible in all phases of the project, as well as those willing to undergo training during all phases of the project (IR 1.41a, 2.5.8a, 2.5.46d)</li> <li>De Beers' contractors are subject to De Beers' policies and commitments (Technical Sessions, 25 November – 06 December 2002)</li> <li>De Beers will actively support and encourage the participation of women on an equal basis with men in all aspects of work related to Snap Lake. De Beers will work to create formal partnerships with the following organizations to promote women in trades and mining occupations:</li> </ul>



Component	Commitment
	<ul style="list-style-type: none"> <li>⇒ Skills Canada;</li> <li>⇒ Native Women’s Association of the Northwest Territories;</li> <li>⇒ NWT Status of Women Council;</li> <li>⇒ Aurora College; and,</li> <li>⇒ The Government of the Northwest Territories Department of Education, Culture and Employment.</li> <li>• To promote women in mining occupations and in jobs at Snap Lake, De Beers will: <ul style="list-style-type: none"> <li>⇒ offer scholarships to females attending college and university programs related to mining;</li> <li>⇒ offer a “Summer Student Employment Program” and actively encourage women to apply;</li> <li>⇒ create a promotional campaign targeting young women for jobs at Snap Lake;</li> <li>⇒ create and offer a “Female Role Model School Visit” program to promote women working at Snap Lake;</li> <li>⇒ offer awards to elementary and high schools for success in math and science by female students;</li> <li>⇒ develop and offer a “Women in Trades” program in the primary communities;</li> <li>⇒ offer tours of the mine aimed at women interested in the mining field at Snap Lake;</li> <li>⇒ offer scholarships and awards for all women in apprenticeships programs at Snap Lake; and,</li> <li>⇒ offer remedial training programs and personal development strategies to women who may not possess all of the requisite skills and knowledge for particular positions (IR 3.5.8a)</li> </ul> </li> </ul>
Procurement Targets	<ul style="list-style-type: none"> <li>• De Beers committed to procurement targets [Construction 35-40% and operations and closure at 35-45%] in its response to a question from the chairman. De Beers had committed to giving an answer to this question during the Hearing in its response to the MVIERB questions of April 3rd (Public Hearing Transcripts, Day 5, 2 May 2003, p. 79)*</li> </ul>
Hiring Targets	<ul style="list-style-type: none"> <li>• De Beers committed to northern hiring targets [Construction, 40%, operations and closure at 60% Northern workers] in its response to the Review Board’s questions of April 4, 2003. De Beers reaffirmed this commitment during the Hearings and agreed to include them in the Socio-economic Agreement (Public Hearing Transcripts, Day 5, May 2, 2003)*</li> </ul>
Rotation Schedule/Point of Hire	<ul style="list-style-type: none"> <li>• De Beers committed that they will have a 4-3 (four days in and three days off) rotation for their management employees and expect that the majority will relocate to the NWT. In addition the company has developed a northern allowance program to encourage all employees to move north (Responses to the Review Board April 4, 2003 Questions - Q2.1 and Q2.2)*</li> </ul>
Impact Management Measures (IMM)	<ul style="list-style-type: none"> <li>• In recognition of the challenges currently faced in the primary communities, De Beers has identified a number of impact management measures that immediately and over the long term will assist Aboriginal people and northerners to become qualified for positions at Snap Lake.</li> </ul>

Component	Commitment
	<p>These impact management measures include (EAR, Sections 3.9, 5.3.4):</p> <ul style="list-style-type: none"> <li>⇒ partnerships with communities;</li> <li>⇒ development of a recruitment and employment strategy for an Aboriginal and northern workforce;</li> <li>⇒ hiring priorities;</li> <li>⇒ recruitment and employment strategies;</li> <li>⇒ literacy training;</li> <li>⇒ on-site learning centre;</li> <li>⇒ employment training programs;</li> <li>⇒ substance abuse, prevention and treatment programs;</li> <li>⇒ community liaison personnel (also see last bullet under IMM*);</li> <li>⇒ family support services;</li> <li>⇒ money management training;</li> <li>⇒ transportation to site;</li> <li>⇒ cultural awareness programs; and</li> <li>⇒ aboriginal traditional practice support (IR 2.2.5a)</li> </ul> <ul style="list-style-type: none"> <li>• De Beers is committed to implementing the impact management measures. Details of how these impact management measures will be implemented on an individual community basis will be contingent on the needs in the community, and the partnerships De Beers will form with the federal and territorial governments, community agencies, and each primary community (IR 4.11.3a; Conformity Response, August 2002, Section 2.5.3)</li> <li>• De Beers has committed to build long term relationships with communities and the measures it will take in trying to achieve and maintain open and positive relations (IR 2.5.7g)</li> <li>• De Beers committed to two liaison personnel. It is certainly our [De Beers] preference that, of the two, one would be fluent in Chipewyan and one would be fluent in Dogrib (Public Hearing Transcripts, Day 5, 2 May 2003, p. 73)*</li> </ul>
Literacy Programs	<ul style="list-style-type: none"> <li>• Through the Impact Management Measures, De Beers has made a commitment to contribute to the improvement of literacy and technical skills of the Aboriginal (and non-Aboriginal) population of the primary communities (EAR, Section 5.3.4)</li> <li>• De Beers is committed to ensuring the provision of literacy programs both on-site to its employees, and in the primary communities. In both cases, De Beers will work with community agencies to ensure that literacy programs will be directly linked to on-going community programs and education efforts, so that participants may further improve their qualifications towards employment. All employees will be eligible to enrol in the program (EAR, Section 5.3.4.2.3; Conformity Response, August 2002, Section 7.2)</li> <li>• Literacy programs on-site will be linked to the company's recruitment and employment strategy to permit employees to take advantage of career advancement opportunities (EAR, Section 5.3.4.2.3)</li> <li>• De Beers, through its community liaison personnel, will assist communities and existing local learning institutions to encourage community members (including on-site employees) to upgrade their literacy levels (EAR, Section 5.3.4.2.3)</li> </ul>

Component	Commitment
	<ul style="list-style-type: none"> <li>De Beers will work with the NWT and federal governments to encourage continued and adequately funded and delivered mechanisms for community based literacy programs in the primary communities (EAR, Section 5.3.4.2.3)</li> </ul>
Mine Management Advisory Committee (MMAC)	<ul style="list-style-type: none"> <li>It is De Beers' intention to initiate the Mine Management Advisory Committee prior to the start of construction and to continue it through the closure phase of the mine (IR 1.30a)</li> <li>It is De Beers' intention there will be no fewer than four meetings a year [for the Mine Management Advisory Committee], with at least one meeting to be held on the mine site (IR 1.30b)</li> <li>Membership of the Mine Management Advisory Committee is to consider a Yellowknife and GNWT representative (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
Money Management	<ul style="list-style-type: none"> <li>De Beers will provide money management training in each of the primary communities for employees and their spouses. Training will be mandatory within the first six months for all newly hired employees. Workshops (requiring two to three evenings) will be provided in the communities, during employees' off-site rotation. The training will focus on family financing and saving strategies. (EAR, Section 5.3.4.3.4; IR 3.5.14)</li> <li>Employees and their families will be able to access money management assistance services through a toll-free telephone line (EAR, Section 5.3.4.3.4; IR 3.5.14)</li> <li>De Beers will seek collaboration with recognized financial institutions to establish internet and telephone based banking services in the primary communities (Section 5.3.4.3.4)</li> </ul>
Monitoring – Traditional Knowledge (TK)	<ul style="list-style-type: none"> <li>De Beers will continue to facilitate the collection of traditional knowledge and will develop environmental monitoring programs that incorporate both traditional knowledge and science for the Snap Lake Diamond Project. (IR 1.42b, 2.2.13b; EAR Table 14.2-1)</li> </ul>
Monitoring – Socio-economic	<ul style="list-style-type: none"> <li>De Beers is committed to socio-economic monitoring that would monitor the effectiveness of project related mitigation within their control (IR 2.2.11)</li> <li>De Beers will consider participating in community based monitoring initiatives for socio-economic impacts where they would contribute to this monitoring goal. De Beers' preference is to participate in established monitoring programs rather than creating additional ones (IR 2.2.11)</li> <li>The Mine Management Advisory Committee will include representation from each primary community and through that feedback provide a form of monitoring to each community (EAR, Section 3.9.1.1; IR 2.2.11)</li> <li>De Beers "is committed to continue to co-operate with agencies responsible for monitoring this [traditional activities] sector of the economy." (Conformity Response, August 2002, Section 5.2)*</li> </ul>
Partnerships	<ul style="list-style-type: none"> <li>Recognizing the importance of social and economic sustainability to the communities, De Beers will seek ways to optimize social and economic benefits to individuals, their families, and their communities from this development so that benefits will last long after the mine has closed (IR 2.2.6c)</li> <li>De Beers is committed to playing a substantial role in facilitating the</li> </ul>

Component	Commitment
	<p>development of partnerships, within the purview of what a proponent can do and what a partner with government departments and communities can do (EAR Section 5.3.4.1.2; IR 2.2.6c)</p> <ul style="list-style-type: none"> <li>• De Beers is fully committed to developing partnerships that will prepare community residents for employment at Snap Lake Diamond Mine. This will include the development of partnerships and support to all educational systems in the North, including Northern Colleges, Boards of Education, the Department of Education, Culture and Employment, as well as private educational institutions and training organizations (IR 2.5.44a)</li> <li>• De Beers will work with governments and primary communities in the areas of substance abuse prevention, treatment and awareness, and support initiatives and resources related to substance abuse in these communities. This could be comprised of on-site and community-based substance abuse prevention programs, substance awareness and prevention in schools and on-site. De Beers will support addictions treatment programs, and successful completion, combined with upgrading and skill training, will be linked to the recruitment and employment strategy (IR 3.5.14)</li> </ul>
Purchasing	<ul style="list-style-type: none"> <li>• It is De Beers' intent to maximize northern purchasing as much as possible during all phases of the project. (IR 1.28b; Technical Sessions, 25 November – 06 December 2002)</li> </ul>
Recruitment, Training & Employment	<ul style="list-style-type: none"> <li>• Regarding De Beers' commitments to contribute to the improvement of technical skills among the Aboriginal population (EAR, Section 5.3.4.2.5): <ul style="list-style-type: none"> <li>⇒ De Beers will work in partnership with the communities, the GNWT, the federal government, local learning institutions, and potentially other mining companies to implement long-term employment training programs. These programs will focus on both upgrading and mine employment training. They will be offered to employees on site, and, as appropriate and feasible, to others in the communities.</li> <li>⇒ The three components of the employment training programs are: pre-employment upgrading; mining job apprenticeships; and mine employment training. The details of the employment training programs will be contingent upon the partnerships De Beers will form with other parties.</li> </ul> </li> <li>• De Beers is developing a detailed Human Resources Development Plan. The Plan will include pre-employment programs, wellness initiatives, financial management skills development, and initiatives for advancement in the labour force (IR 1.1.20c, 2.2.6d, 3.11.6b)</li> <li>• The number of training positions outlined in the EA (10 apprenticeships, 20 underground and 10 within three years of production) are minimums, and it is De Beers desire to see these increase over time (Technical Sessions, 25 November – 06 December 2002)</li> <li>• The training needs assessment will identify the existing education and skill levels among the Aboriginal and northern workforce, so that work can be offered to new recruits and opportunities for advancement can be offered to existing employees (EAR, Section 5.3.4.2.2)</li> <li>• De Beers is committed to publishing a Snap Lake business opportunity profile. De Beers will also be preparing an annual procurement report that will be provided to the MMAC and the public. De Beers will commit to providing a copy of it to the GNWT (EAR, Section 14; IR2.5.8b)</li> <li>• De Beers supports GNWT efforts in building secondary industry in the</li> </ul>

<b>Component</b>	<b>Commitment</b>
	<p>north and will be entering into discussions around this during Socio-economic Agreement negotiations over the next few months (Technical Sessions, 25 November – 06 December 2002)</p> <ul style="list-style-type: none"> <li>• The Career and Technical Centre, developed in partnership, will be used by the Yellowknife Catholic Schools and other organizations to introduce trades training to middle and high school students to the larger community. De Beers has committed to contributing a hundred thousand (100,000) each year to the project for each of the next five (5) years. (Public Hearing Transcripts, Day 1, 28 April 2003, p. 53)*</li> <li>• Policies will be established to address the issue raised that it is problematic that mine workers are not able to leave the mine for family emergencies (e.g. illness) without risking losing their jobs." (EAR p. IV.1-34)*</li> </ul>
Employee Benefits	<ul style="list-style-type: none"> <li>• Northern benefits and relocation packages have been established for De Beers employees (Technical Sessions, 25 November – 06 December 2002)</li> <li>• De Beers commits to the protection of employee pension plans from the vagaries of mismanagement, no matter the company turnover (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
Supply of Rough	<ul style="list-style-type: none"> <li>• If at the time that Snap Lake starts production significant further supply of is required for viable manufacturing businesses approved by the GNWT (in excessive of available rough from Ekati and Diavik), De Beers could facilitate the supply of suitable DTC assortments of rough either directly from the DTC through the DTC's own clients, or through a trading subsidiary of the DTC (Conformity Response, August 2002, Section 8.3)</li> <li>• De Beers intends to offer access to rough diamond production as part of the IBAs (Conformity Response, August 2002, Section 8.3)</li> <li>• Supply of rough diamonds provided to partners identified in impact benefit and socio-economic agreements will be certified NWT Snap Lake production (Technical Sessions, 25 November – 06 December 2002)</li> <li>• During the technical sessions De Beers made the commitment to try and work with the GNWT to come up with a facility for the provision of rough, to one or more NWT cutters and polishers. De Beers reconfirmed this at the public hearing (Public Hearing Transcripts, Day 5, May 2, 2003, p. 81)*</li> </ul>
Transportation to Site	<ul style="list-style-type: none"> <li>• For the primary communities other than Yellowknife, Rae-Edzo, Dettah and N'Dilo, De Beers will provide flights to and from the mine site that do not pass through Yellowknife. Snap Lake employees from Yellowknife, Rae-Edzo, Dettah and N'Dilo will travel through Yellowknife due to their close proximity to one another. (IR 3.5.14)</li> <li>• Provide air transport from Hay River for employees residing south of Great Slave Lake. (Technical Sessions, 25 November – 06 December 2002)</li> <li>• De Beers stated that the point of hire for all southern employees would be in the NWT and that De Beers would not pay the transportation costs for employees living in the south to the NWT. (Public Hearing Transcripts, Day 5, 2 May 2003, p. 74)*</li> </ul>
<b>Resource Uses</b>	
Cut-off Values	<ul style="list-style-type: none"> <li>• De Beers to take another look at the cut-off value for granite using the appropriate data, closer to the regulatory phase (Geochemistry conference call notes, 11 February 2003)</li> </ul>
Hunting	<ul style="list-style-type: none"> <li>• De Beers will continue to enforce its no hunting and no fishing policy for</li> </ul>

Component	Commitment
	employees and contractors at Snap Lake. Personal snow machines and ATVs will not be permitted (IR 2.2.2)
Monitoring	<ul style="list-style-type: none"> <li>• A follow-up program to the July, 2001 blast monitoring program will be undertaken to allow for refinement of the equations used to calculate peak particle velocity and overpressure once mine production begins to ensure that predicted blast overpressure and ground vibrations estimates are correct (IR 3.9.12b)</li> </ul>
Protected Areas	<ul style="list-style-type: none"> <li>• De Beers committed to work through the Northwest Territories and the Nunavut Chamber of Mines for establishing a protected area in the Coppermine River Uplands Ecoregion (IR 2.5.1a cross referencing Table 14.2-2 on p. 14-7 of the EAR)</li> </ul>
Archaeology	<ul style="list-style-type: none"> <li>• De Beers will avoid locations identified as having archaeological potential. Site personnel will be trained on what to do when a historical artifact is discovered (EAR p. IV.1-12)*</li> </ul>
Esker	<ul style="list-style-type: none"> <li>• De Beers committed to carrying out a geophysical program including ground penetrating radar to delineate ice before any future work is done on the esker (s) (Technical Sessions, Day 8, 4 December 2002)*</li> </ul>
Winter Road	<ul style="list-style-type: none"> <li>• De Beers will continue to follow any operating parameters set out by the Tibbitt-Contwoyto Winter Road Joint Venture (IR 2.2.4b)</li> <li>• De Beers plans to monitor the winter access road and will set up a review of the monitoring and management plans for the road. De Beers is committed to revising procedures if through the review it is determined that improvement is needed (IR 2.2.4b)</li> <li>• During construction and operation, contractors will be expected to follow all procedures and policies incorporated under the Environmental Management System as a condition of their contract. This will include specific policies and procedures about road rules and spills, and De Beers will monitor traffic to ensure that the rules are being observed. De Beers will enforce the winter access road traffic rules as well as on-site road traffic rules (IR 2.2.4d)</li> </ul>
<b><i>Air Quality</i></b>	
Monitoring – Air Quality	<ul style="list-style-type: none"> <li>• Copies of the electronic input and output files for CALPUFF air quality monitoring will be forwarded separately to Environment Canada personnel and are available to other interested parties on request (IR 2.3.6)</li> <li>• De Beers will provide Environment Canada with copies of an annual report summarizing the ongoing results of the TSP monitoring completed at the Snap Lake Diamond Project. De Beers is open to discussions with Environment Canada and other interested parties on the details of the proposed TSP reporting (timelines, frequency, format) (IR 2.3.4b)</li> <li>• De Beers plans to continue to monitor TSP and plans to involve communities and government in the final design of the dust monitoring plan (IR 2.3.2)</li> <li>• Both Environment Canada and the Government of the Northwest Territories requested that De Beers make a commitment to specifically include monitoring of fine particles known as PM10 and PM2.5 in air quality monitoring. De Beers has committed to doing this monitoring and will finalize the air quality monitoring program in consultation with these organizations and communities (Public Hearing Transcripts, Day 1, 28 April 2003, p. 55)*</li> </ul>

Component	Commitment
<i>Aquatic Resources</i>	
Monitoring – Water Quality/Quantity	<ul style="list-style-type: none"> <li>• De Beers intends to refine information on the water quality of paste backfill porewater and to investigate potential amendments to the paste backfill (North Lakes Report, April 2002, p. 65-66).</li> <li>• De Beers will undertake a site water quality and flow monitoring program and a water quality and primary productivity (chlorophyll a) monitoring program in Snap Lake (Algal Modeling Technical Memo, 28 February 2003)</li> <li>• Apply new data and revise the groundwater flow model as the project moves forward (Technical Sessions, 25 November – 06 December 2002)</li> <li>• Consider incorporating localized eutrophication effects of Snap Lake into future monitoring decisions (Technical Sessions, 25 November – 06 December 2002)</li> <li>• As part of operational monitoring, De Beers will assess North Pile seepage quality and quantity and update or adjust water quality predictions, treatment, and mitigation strategies on an on-going basis as required (IR 3.8.12, 3.10.18a)</li> <li>• Work is currently underway to collect baseline data from the north lakes area to refine the impact predictions of the EA. Once data collection and analysis is complete, information will be made available and monitoring plans based on the revised predictions will be finalized (IR 3.10.18a)</li> </ul>
No Net Loss	<ul style="list-style-type: none"> <li>• Achieve appropriate consultation, in concert with DFO, to ensure the losses and gains of fish habitat, as well as the objectives of “No Net Loss” in relation to this project are communicated.</li> <li>• Complete any regulatory requirements associated with the Snap Lake Diamond Project relating to “No Net Loss” and DFO’s Policy for the Management of Fish Habitat (1986). (Fish Habitat Information and Loss Accounting for Waterbodies Situated on the Northwest Peninsula of Snap Lake, 10 February 2003)</li> </ul>
Water Treatment Plant	<ul style="list-style-type: none"> <li>• De Beers will be installing a water treatment plant capable of treating 35 000 m<sup>3</sup>/day of water. (Letter to Environment Canada re: Overcapacity, 4 February 2003)</li> <li>• The water treatment plant will also include the contingency of using ferric sulfate to precipitate phosphorus (Algal Modeling Technical Memo, 28 February 2003)</li> <li>• The water treatment plant will effectively reduce particulate phosphorus to very low concentrations because the basis of treatment is a high level of total suspended solids removal (to a TSS of less than 5 mg/L) (Algal Modeling Technical Memo, 28 February 2003)</li> <li>• Site drinking water will be treated through chlorination and filtration.</li> <li>• Should storage capacity be exceeded within the water treatment plant and water management pond, will flood the mine before releasing untreated water to Snap Lake (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
<i>Terrestrial</i>	
Migratory Bird Act	<ul style="list-style-type: none"> <li>• De Beers will incorporate Section 6 of the Migratory Birds Act into construction and production plans. (Technical Sessions, 25 November – 06 December 2002)</li> </ul>

Component	Commitment
	<ul style="list-style-type: none"> <li>• To show due diligence in relation to the Migratory Bird Act, De Beers will:               <ol style="list-style-type: none"> <li>1) When clearing vegetation where there are nests, time this activity during either the pre- or post-nesting season, or if clearing must be done during nesting season, search the area for nests, mark any active ones and allow a buffer zone around them until the hatchlings have fledged. Return and clear once the nests have been abandoned.</li> <li>2) If migratory birds are found nesting on the mine footprint, mark the nest, alert staff of its location and initiate a buffer zone around it until the hatchlings are fledged.</li> </ol> <ul style="list-style-type: none"> <li>⇒ De Beers to look at developing an operating procedure in the Environmental Management System for employees who discover an active bird nest.</li> <li>⇒ De Beers also to develop a standard incident reporting procedure with CWS (annual or incident-specific).</li> <li>⇒ De Beers to develop mitigation measures and possible methods to deter birds from nesting within the mine footprint.</li> <li>⇒ De Beers to re-examine existing construction schedule to determine consistency with breeding season, as buffer zones for these activities may not be feasible in some circumstances, e.g. quarry development. (CWS Meeting Notes, 12 February 2003)</li> </ul> </li> </ul>
Monitoring – Ecological Land Classification (ELC) Units	<ul style="list-style-type: none"> <li>• Throughout the construction and operation phases, De Beers will monitor whether the actual impacts to ELC units exceed or differ (i.e., area or type) from those predicted in the EAR. The losses or alteration of ELC units due to the development of the Snap Lake Diamond Mine will be mapped annually and the aerial extent of change compared to predicted impacts (IR 1.8)</li> </ul>
Monitoring / Management - Wildlife	<ul style="list-style-type: none"> <li>• A monitoring report summarizing wildlife data from 1999-2001 will be made available in summer 2002. This report will be given to the Canadian Wildlife Service and will be available to the any interested party upon request. The report will contain a map showing all plot locations (some of which were mistakenly covered by the project footprint in Figure 10.4-3 of the EAR) (IR 2.3.19)</li> <li>• It is De Beers' intent to monitor raptor breeding activity as part of annual wildlife monitoring. Occupancy and productivity may be measured by visiting raptor nest sites in May and July. Also, any raptor nests located incidentally in the future would be added to the database (IR 3.10.22b)</li> <li>• De Beers remains interested in practical alternate survey methods (wolverines) and will continue to follow the development of more sensitive and reliable survey methods with interest (IR 3.5.1)</li> <li>• Will use the same techniques employed by other mining companies for monitoring caribou behaviour (Technical Sessions, 25 November – 06 December 2002)</li> <li>• Ground Penetrating Radar will be used at the esker quarry sites prior to any future work (Technical Sessions, 25 November – 06 December 2002)</li> <li>• De Beers will record incidental wildlife observations, including rare species, until a need for monitoring specifically for that species is identified. (Technical Session Transcripts, Day 5, 29 November 2002, p. 47)*</li> </ul>



<b>Component</b>	<b>Commitment</b>
Mitigation Measures – Wildlife Attractants	<ul style="list-style-type: none"> <li>• De Beers will work with GNWT in the development of mitigation measures and thresholds for various species.</li> <li>• Food waste is not to go outside - an incinerator will be attached to the kitchen via an enclosed corridor.</li> <li>• De Beers will systematically assess individual potential attractants and determine mitigation measures for each factor. This information is to be provided to GNWT for review.</li> <li>• De Beers will ensure skirting on buildings extends all the way to the ground. (Technical Sessions, 25 November – 06 December 2002)</li> <li>• If a concern was noted that caribou were being attracted to the North Pile, then we would implement mitigation to prevent their access. (Public Hearing Transcripts, Day 4, 1 May 2003, p. 44)*</li> <li>• De Beers stated a commitment that if large numbers of caribou occur on site and management measures such as herding caribou from the air strip are overwhelmed, then flights to or from site will be postponed until such time that aircraft movement can be made with the safety of wildlife and people protected (Public Hearing Transcripts, Day 1, 28 April 2003, p. 50)*</li> </ul>
Road Design	<ul style="list-style-type: none"> <li>• Road [associated with the Snap Lake Diamond Project] will be designed so they do not interfere with wildlife movements (EAR p. IV.1-35) *</li> </ul>
Loss of Harvest Compensation	<ul style="list-style-type: none"> <li>• Compensation for demonstrable loss of harvest will be addressed in the IBAs (Technical Session Transcripts, Day 6, 2 December 2002, p. 38)*</li> </ul>
Mitigation Measures – Employee/Wildlife Interactions	<ul style="list-style-type: none"> <li>• Drivers will be warned if animals are known to be moving through the area. Temporary restrictions to road use will be considered if large numbers of animals are in the vicinity of the road, and the risk of collision with wildlife is high (IR 2.2.4c)</li> <li>• De Beers will put in place policies and regulations concerning employee-wildlife interactions. The implementation and training of staff about wildlife policies and regulations, as well as other policies and mitigation measures, will occur and be documented through the Environmental Management System for the Snap Lake Diamond Project. The policies and regulations concerning employee-wildlife interactions will include the following (IR 2.2.4c): <ul style="list-style-type: none"> <li>⇒ Education of people on the risk associated with feeding wildlife;</li> <li>⇒ employees, contractors and visitors will be prohibited from feeding and harassing wildlife; and</li> <li>⇒ employees, contractors and visitors will receive appropriate training on procedures on how to handle wildlife encounters. The level of training will be identified through a risk-based matrix that assesses the likelihood that a worker or visitor may encounter wildlife.</li> </ul> </li> </ul>
<b><i>Environmental Health</i></b>	
Dust Control	<ul style="list-style-type: none"> <li>• De Beers will use dust collection systems to control dust. For example, dust collection systems would be used on outdoor crushers at the quarry site. If additional dust control measures are required, the plan will be discussed with the regulators and follow the Government of the Northwest Territories guidelines for dust suppression (IR 4.12.18a&amp;b, 2.4.29, 2.5.32)</li> </ul>
<b><i>Cumulative Effects Assessment</i></b>	

Component	Commitment
Monitoring – Cumulative Effects	<ul style="list-style-type: none"> <li>De Beers restates its commitment that it will participate in regional initiatives to develop cumulative effects monitoring. In the meantime, De Beers will continue to collect data in a form and manner compatible with present monitoring activities in the Slave Geological Province (EAR Section 14.6; IR3.5.3a)</li> </ul>
Monitoring – Cumulative Effects	<ul style="list-style-type: none"> <li>De Beers is committed to involvement in cumulative effects programs through implementation of the environmental monitoring plans and management plans in the EAR (IR 3.9.1a,b)</li> </ul>
<b><i>Accidents</i></b>	
Spill Reporting	<ul style="list-style-type: none"> <li>De Beers undertakes to report all spills as per Environment Canada's request. (IR 3.3.4)</li> </ul>
<b><i>Abandonment &amp; Reclamation</i></b>	
Reclamation	<ul style="list-style-type: none"> <li>The Snap Lake Diamond Project will implement a decommissioning and reclamation monitoring program that will extend and evolve throughout the construction, operation, and decommissioning phases of the project (EAR, Section 10.3.2.2.5)</li> <li>Emerging technology and techniques will be implemented as they become available and the program will continue to evolve in consultation with government organizations and communities (EAR, Section 10.3.2.2.5)</li> <li>De Beers will develop an adaptive management approach to reclamation that will incorporate the results of the re-vegetation and experimental test plot program. Research and reclamation approaches that have been developed as part of other mine operations in the region (e.g., BHP Billiton's EKATI Diamond Mine™) will also be employed as appropriate. (IR 1.6, 1.8)</li> <li>De Beers is committed to a program of progressive reclamation at Snap Lake. Progressive reclamation has been built in as an integral part of the mine plan (IR1.8; Preliminary Mine Closure &amp; Reclamation Plan, 28 February 2003)</li> <li>De Beers is committed to reducing residual environmental effects at the site upon closure (Preliminary Mine Closure &amp; Reclamation Plan, 28 February 2003)</li> <li>De Beers is committed to providing suitable financial security and assurance to cover the cost of full reclamation of the Snap Lake Diamond Project (Preliminary Mine Closure &amp; Reclamation Plan, 28 February 2003)</li> <li>With respect to contaminant uptake by roots of plants that grow on the North Pile, De Beers committed to monitor to see if there is root penetration to the processed kimberlite [North Pile]. If so, and if the lead shape is showing to be acidic, then De Beers indicated it will monitor plant tissue for any kind of metal uptake (Public Hearing Transcripts, Day 4, 1 May 2003, p. 103)*</li> </ul>
Recycling	<ul style="list-style-type: none"> <li>De Beers is committed to maximizing recycling opportunities where suitable facilities exist within reasonable proximity (e.g. Alberta) at the time of closure, and where materials can be recycled at a reasonable cost. This includes some materials such as scrap metal, tires, conveyor belting, glass, etc. and may also include hazardous materials such as glycol, batteries and waste oil. (Buried Materials Technical Memo, 28 February 2003)</li> </ul>

<b>Component</b>	<b>Commitment</b>
<b><i>Monitoring Programs</i></b>	
Monitoring - General	<ul style="list-style-type: none"> <li>De Beers is committed to implementing and funding initiatives that monitor project-specific effects, however, unless data collection coincides with that goal, the funding of initiatives to fulfil other parties responsibilities would have to be reviewed on a case by case basis (IR 2.5.8c)</li> </ul>
Monitoring - General	<ul style="list-style-type: none"> <li>De Beers is committed to environmental monitoring and, as noted in the De Beers Environmental Policy De Beers is committed to good management practices that minimize environmental risks. (EAR, Table 14.2-1, Appendix III.8 and IR2.2.4)</li> </ul>
Monitoring - General	<ul style="list-style-type: none"> <li>De Beers is committed to implementing monitoring programs that meet the requirements of the results of the EA and regulatory review processes, and will be designed in collaboration with communities, Elders and governments. The design and details of these programs will be finalized during future consultations with communities and government (EAR, Table 14.2-1; IR2.2.13a, 2.3.18a, 3.5.2a&amp;b, 3.10.27; Technical Sessions, 25 November-06 December 2002)</li> <li>De Beers is committed to continuing these efforts throughout the life of the project as they represent sound business and environmental management practices (IR 3.5.2d)</li> </ul>
Monitoring – General	<ul style="list-style-type: none"> <li>De Beers will meet with regulatory agencies and Land and Environment Committees (or community-designated alternates) from each of the Aboriginal organizations and primary catchment communities identified in the EA for their input on all aspects of the monitoring programs, including the practical incorporation of TK (Overview of Project Milestones and Monitoring and Management Programs for the Snap Lake Diamond Project Technical Memo, 28 February 2003).</li> </ul>
Monitoring – General	<ul style="list-style-type: none"> <li>All environmental monitoring programs will be incorporated into an Environmental Agreement, as will opportunities for community involvement within these programs (Overview of Project Milestones and Monitoring and Management Programs for the Snap Lake Diamond Project Technical Memo, 28 February 2003)</li> </ul>
Monitoring - General	<ul style="list-style-type: none"> <li>Community-specific information will be incorporated into mitigation and monitoring plans (Technical Sessions, 25 November – 06 December 2002)</li> </ul>
<b><i>Environmental Management System (EMS)</i></b>	
EMS	<ul style="list-style-type: none"> <li>The effects that De Beers will incorporate into its EMS will include environmental effects for which a monitoring or management plan or program is presented in the EAR or is required by a permit or licence. This will include air, terrestrial, heritage resources, and water-related monitoring and management plans and programs (IR 3.5.15a)</li> <li>De Beers will prepare a separate EMS for construction and operation of the Snap Lake Diamond Project that will be founded on the EMS of the AEP but will be expanded to include all facets of mine construction and production (IR 3.5.15b)</li> <li>De Beers is committed to the use of adaptive management in all aspects of operations. ISO 14001 Environmental Management Systems are based on the use of adaptive management and it is through this that De Beers'</li> </ul>

Component	Commitment
	<p>commitment to “continual improvement” in environmental performance will be achieved. Adaptive management will be used to refine mitigation measures, including those that relate to wildlife (IR 4.11.18a, 4.9.2)</p> <ul style="list-style-type: none"> <li>• EMS audits will be made available to the public (Technical Sessions, 25 November – 06 December 2002)</li> <li>• De Beers commits to changing its mitigative measures when the effects are different than those predicted (i.e., beyond the range of results normally expected). This process would be captured by the environmental management system during annual management reviews, regular internal auditing or documented internal communication between environmental staff and management (IR 3.5.15c)</li> </ul>

\* *Additional commitments noted by the Review Board (also see note at above the table).*