*Bathurst Caribou Range Plan: Draft Range Assessment and Technical Methods Report (March 2017)*

**APPENDIX E:**

# Land Use Economic Evaluation Methods

## 1 Introduction

This document summarizes methods used to estimate the economic outputs of potential future mineral sector and transportation projects within the Bathurst range planning area. At this time, only future potential mineral development and transportation projects have been considered[1]. Potential economic outputs of projects included in the BCRP Future Development Scenarios (see **Appendix B**) have been estimated based on known or estimated project parameters.

The goal of economic evaluation within the BCRP range planning exercise is not to make precise predictions about future economic outputs resulting from potential mineral development and transportation projects. Instead, its purpose is to understand the relative changes that may occur as a means to explore the potential economic consequences of different caribou habitat management strategies that could alter, defer or limit future levels of future land use activity.

The methods and results of this evaluation should be interpreted in the following context:

- The methods and results should be interpreted as relative economic outputs or contributions; the methods used are not suitable to forecast detailed absolute values; and
- The methods used result in economic outputs specific to the Bathurst range planning area. They are not intended to provide a detailed economic model for the entire NWT or Nunavut economy, nor do they consider contributions to the national or global economy.

## 2 Methods

### 2.1 General Approach

Different economic models and modeling approaches are available to estimate the economic contributions of potential future economic development. Potential economic models include *Statistics Canada's Interprovincial Input-Output Model* and the *Northwest Territories Economic Impact Model*. However, using such detailed economic models can be time intensive and require high levels of expertise. The role of economic modeling within the BCRP is not to make precise estimates of economic contributions resulting from potential future development to the territorial or national economy, but to understand the relative changes that may occur while exploring different caribou habitat management strategies.

Recognizing this situation, the BCRP Working Group aimed to estimate the approximate and relative economic outputs associated with a range of potential mineral development and transportation

[1] In the future, economic outputs associated with mineral development may be considered.

scenarios in the 2016 to 2040 time period. For each mineral development or transportation project included in the BCRP Development Scenarios (see **Appendix B**), published economic multipliers from the NWT Bureau of Statistics (2012) and expert opinion were used to estimate the future economic output of individual projects, based on known or estimated parameters for construction, operations and reclamation costs for each project. Detailed methods are described below.

## 2.2 Economic Multipliers

The NWT Bureau of Statistics (2012) has published tables of economic multipliers that relate a given amount of economic output within a sector to three different economic indicators: **Gross Domestic Product (GDP), Labour Income,** and **Employment**. As stated by the NWT Bureau of Statistics (2012), such economic multipliers are considered to be intensity ratios, and are intended to be used as follows:

- The intensity ratios are appropriate for very general assessments of economic impacts.
- When estimating economic impacts, it is preferable to use multipliers to make relative, rather than absolute, comparisons. Where multipliers are used to estimate the impacts of a single activity, the results should be treated only as a general estimates, indicating the order of magnitude of the impacts rather than exact levels.

Economic multipliers are therefore well suited as a means to consider the relative changes in economic output that may occur while exploring different caribou habitat management strategies. The following example from NWT Bureau of Statistics (2012) illustrates how economic multipliers can be used to estimate economic output associated with a specified level of spending in the construction industry.

**Example:** Construction Industry Expansion

Intensity ratios are often used when all that is known about a project is the gross change in economic activity. For example, if there were a $50 million increase expected in the output of the territorial construction industry, then using the construction industry intensity ratios from Table 1, the total direct and indirect economic effects would be as follows:

GDP at Basic Prices ($): [GDP intensity ratio for Const.] x [Gross output]
[0.46] x [$50 million] = $23 million

Labour Income ($): [Labour income intensity ratio for Const.] x [Gross output]
[0.33] x [$50 million] = $16.5 million

Employment (PYs): ([Gross output] / [1 million]) x [Employment intensity ratio for Const.]
[$50 million/1 million] x [3.5] = 175

Therefore, a $50 million expected increase in the output of the construction industry has a potential GDP impact of $23.0 million; labour income impact of $16.5 million; and the potential creation of 175 person-years of employment.

## 2.3 Applying Economic Multipliers to Mineral Sector Activity

The two main parts of the mining life cycle (**Figure 1**), exploration and development, provide a useful framework to understand activities considered by the BCRP economic evaluation.

### Mineral Exploration

Mineral Exploration may include all activities prior to mine development (the Exploration and Discovery phases of the mining life cycle, as shown in **Figure 1**). Specific activities may include mineral claim staking and early investigations, exploration associated with land use permits, and advanced exploration and deposit appraisal.

### Mineral Development

Mineral Development refers to the life cycle phases of mine Development (i.e., construction), Production (operations) and Reclamation (**Figure 1**). Mine development results in the construction of long-term industrial facilities as well as air or ground transportation infrastructure.

At this time, only the mineral development part of the mining life cycle has been considered in the BCRP economic evaluation.

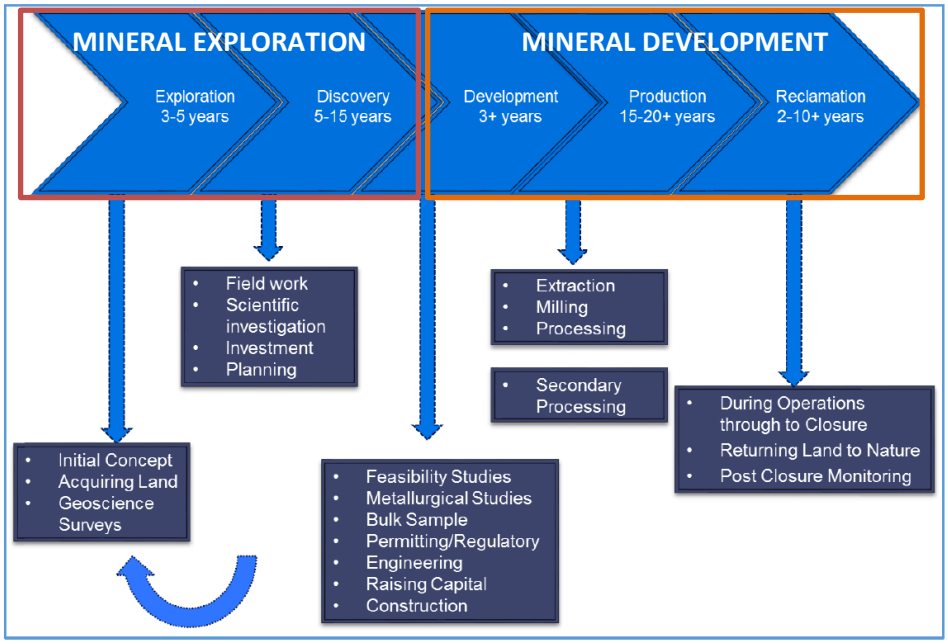


**Figure 1.** The mineral exploration and development life-cycle (Source: Government of Northwest Territories, Department of Industry, Tourism and Investment).

The BCRP Working Group has used published NWT economic multipliers to estimate economic output associated with mineral development and transportation projects included in the BCRP Future Development Scenarios (see Appendix C). Published economic multipliers relevant to the NWT mineral exploration and development sectors are listed in **Table 1**[2]. A similar approach was used in a recent socio-economic assessment for the Łue Túé Sųlái Candidate Protected Area in southern NWT (Stantec 2015).

**Table 1.** NWT economic indicators and multipliers, organized by mineral sector exploration and development activities. Source: NWT Bureau of Statistics (2012).

| Mineral Sector Activities | NWT Economic Indicators and Economic Multipliers | | |
|---|---|---|---|
| | GDP per dollar of expenditure | Labour Income per dollar of expenditure | Jobs per million dollars of expenditure (PYs) |
| **MINERAL EXPLORATION *** | | | |
| Support Activities for Mining and Oil and Gas Extraction | 0.79 | 0.57 | 5.5 |
| **MINERAL DEVELOPMENT** | | | |
| Construction | 0.46 | 0.33 | 3.5 |
| Diamond Mining | 0.71 | 0.13 | 1.1 |
| Truck Transportation | 0.55 | 0.44 | 5.7 |
| Waste Management and Remediation Services | 0.82 | 0.47 | 6.7 |

** Note: At this time the BCRP economic evaluation focuses on potential future mineral development and transportation projects.*

### 2.3.1 Estimating Economic Outputs of Mineral Development and Transportation Projects Considered in the BCRP Development Scenarios

Estimating the potential future economic outputs of mineral development is dependent on the size of the mine, operating costs, and potentially the level of production and/or mineral commodity. BCRP Working Group members held meetings with Government of Northwest Territories and NWT and Nunavut Chamber of Mines representatives between October 2015 and March 2016. During these meetings, and through subsequent research, known or estimated costs were identified for the construction, operations and reclamation phases of mineral development projects considered within the BCRP development scenarios.

**Table 2** provides a summary of the known or estimated project costs and calculated economic outputs for three indicators—GDP, labour income and employment—based on NWT published economic multipliers. Results are shown for the construction and operations phases of each mineral development project.

[2] The published NWT economic multipliers are assumed to also be relevant for similar activities in the Nunavut portion of the Bathurst range planning area.

**Table 2.** Calculated economic outputs (GDP, labour income and employment) resulting from mineral development and transportation projects considered in the Bathurst development scenarios. Economic outputs are based on published NWT economic multipliers (NWT Bureau of Statistics 2012).

| SCENARIO | PROJECT | PHASE | CONSTRUCTION | | | | | | | | OPERATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Cost ($M) | Duration (years) | GDP ($M) | | Labour Income ($M) | | Jobs (PY) | | Annual Costs ($M) | Duration (years) | GDP ($M) | | Labour Income ($M) | | Jobs (PY) | |
| | | | | | Annual | Total | Annual | Total | Annual | Total | | | Annual | Total | Annual | Total | Annual | Total |
| CASE 1 | Ekati | | 520 | 4 | 60 | 239 | 43 | 172 | 455 | 1,820 | 600 | 14 | 426 | 5,964 | 78 | 1,092 | 660 | 9,240 |
| | Diavik | | 386 | 3 | 59 | 178 | 42 | 127 | 450 | 1,351 | 423 | 7 | 300 | 2,102 | 55 | 385 | 465 | 3,257 |
| | Gahcho Kué | | 1,019 | 2 | 234 | 469 | 168 | 336 | 1,783 | 3,567 | 212 | 12 | 151 | 1,806 | 28 | 331 | 233 | 2,798 |
| CASE 2 | Whati Road | | 190 | 4 | 22 | 87 | 16 | 63 | 166 | 665 | 1 | 18 | 1 | 10 | 0 | 8 | 6 | 103 |
| | Snap Lake | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 10 | 142 | 1,420 | 26 | 260 | 220 | 2,200 |
| | Back River (Goose) | | 415 | 2 | 95 | 191 | 68 | 137 | 726 | 1,453 | 121 | 12 | 86 | 1,031 | 16 | 189 | 133 | 1,597 |
| | Kennady North | | 1,019 | 2 | 234 | 469 | 168 | 336 | 1,783 | 3,567 | 212 | 12 | 151 | 1,806 | 28 | 331 | 233 | 2,798 |
| | NICO | | 357 | 2 | 82 | 164 | 59 | 118 | 625 | 1,250 | 59 | 16 | 42 | 670 | 8 | 123 | 65 | 1,038 |
| | Tibbit-Lockhart Rd | | 230 | 3 | 35 | 106 | 25 | 76 | 268 | 805 | 2 | 14 | 1 | 15 | 1 | 12 | 11 | 160 |
| | Lupin and Ulu | | 470 | 4 | 54 | 216 | 39 | 155 | 411 | 1,645 | 150 | 10 | 107 | 1,065 | 20 | 195 | 165 | 1,650 |
| | Courageous Lake | | 1,520 | 2 | 350 | 699 | 251 | 502 | 2,660 | 5,320 | 300 | 10 | 213 | 2,130 | 39 | 390 | 330 | 3,300 |
| CASE 3 | Nechalacho | | 1,580 | 2 | 363 | 727 | 261 | 521 | 2,765 | 5,530 | 300 | 15 | 213 | 3,195 | 39 | 585 | 330 | 4,950 |
| | Indin Lake | | 250 | 2 | 58 | 115 | 41 | 83 | 438 | 875 | 150 | 13 | 107 | 1,385 | 20 | 254 | 165 | 2,145 |
| | Tyhee Gold | | 250 | 2 | 58 | 115 | 41 | 83 | 438 | 875 | 150 | 10 | 107 | 1,065 | 20 | 195 | 165 | 1,650 |
| | Izok Road | | 400 | 4 | 46 | 184 | 33 | 132 | 350 | 1,400 | 4 | 8 | 2 | 18 | 2 | 14 | 23 | 182 |
| | Izok Lake | | 2,000 | 2 | 460 | 920 | 330 | 660 | 3,500 | 7,000 | 600 | 6 | 426 | 2,556 | 78 | 468 | 660 | 3,960 |
| | High Lake | | 1,000 | 2 | 230 | 460 | 165 | 330 | 1,750 | 3,500 | 400 | 6 | 284 | 1,704 | 52 | 312 | 440 | 2,640 |
| | BIPAR Road | | 170 | 3 | 26 | 78 | 19 | 56 | 198 | 595 | 1 | 3 | 1 | 2 | 0 | 1 | 6 | 17 |
| | Hackett River | | 1,500 | 2 | 345 | 690 | 248 | 495 | 2,625 | 5,250 | 600 | 2 | 426 | 852 | 78 | 156 | 660 | 1,320 |
| | TOTALS | | 12,756 | 43 | 2,752 | 5,868 | 1,974 | 4,209 | 20,937 | 44,646 | 3,885 | 184 | 2,757 | 22,832 | 508 | 4,208 | 4,310 | 35,766 |

**ECONOMIC MULTIPLIERS**

| Sector | GDP | Labour Income | Jobs (PY) |
|---|---|---|---|
| Construction | 0.46 | 0.33 | 3.5 |
| Mining | 0.71 | 0.13 | 1.1 |
| Transportation | 0.55 | 0.44 | 5.7 |
| | | | |

**TRANSPORTATION CONSTRUCTION COSTS**

| ($ million/km) |
|---|
| 2.0 |

**NOTES**

1. **Duration of Operations phase is only showing the number of years prior to end of scenario (2040).**
2. **Values in red indicate estimated costs based on similar-sized projects.**

### 2.3.2 Estimating Economic Outputs of Transportation Projects Considered in the BCRP Development Scenarios

An average of $2 million/km was used to represent construction costs associated with a typical northern all-season road. This value was used based on estimates created for the proposed Whatì all-season road (NWT Department of Transportation estimates a construction cost of approximately $1.6 million/km).

**Table 2** shows calculated economic outputs for potential future transportation projects based on average construction costs of $2 million/km and published Transportation economic multipliers.

### 2.3.3 Estimating Economic Outputs Associated with Mine Reclamation

Information regarding the reclamation costs for existing mines is available (Diavik and Gacho Kué). A coarse level assumption was made to estimate reclamation costs for mines without this type of information (future conceptual projects). Both Diavik and Gacho Kué's reclamation costs are in the range of 20%-35% of annual operating costs. This estimation method assumes that annual operating costs will be proportional to reclamation costs at a level indicated by available information on the Diavik and Gacho Kué mine. So as not to overestimate economic outputs associated with reclamation, a value of 25% annual operating costs was used to estimate reclamation costs for all projects. While this method has a high level of uncertainty, reclamation costs associated with specific mine sites was found to be a relatively minor contribution to the total economic outputs associated with the scenarios, relative to Construction and Operations.

### 2.3.4 Tracking Economic Contributions of BCRP Development Scenario Projects

A custom-developed spreadsheet was designed to track the economic parameters associated with each mineral development and transportation project included in the BCRP Development Scenarios, for a period 24-years into the future (2016 to 2040). Appendix B of the *Interim Discussion Document (2016)* contains results of the economic assessment by Range Assessment Area.

## 3 References

NWT Bureau of Statistics. 2012. NWT Economic Multipliers—Overview and Results. Government of Northwest Territories. July 2012. Available online: http://www.statsnwt.ca/economy/multipliers/.

Stantec. 2015. Łue Túé Sųlái Candidate Protected Area Socio-economic Assessment. Final Report. September 30, 2015.