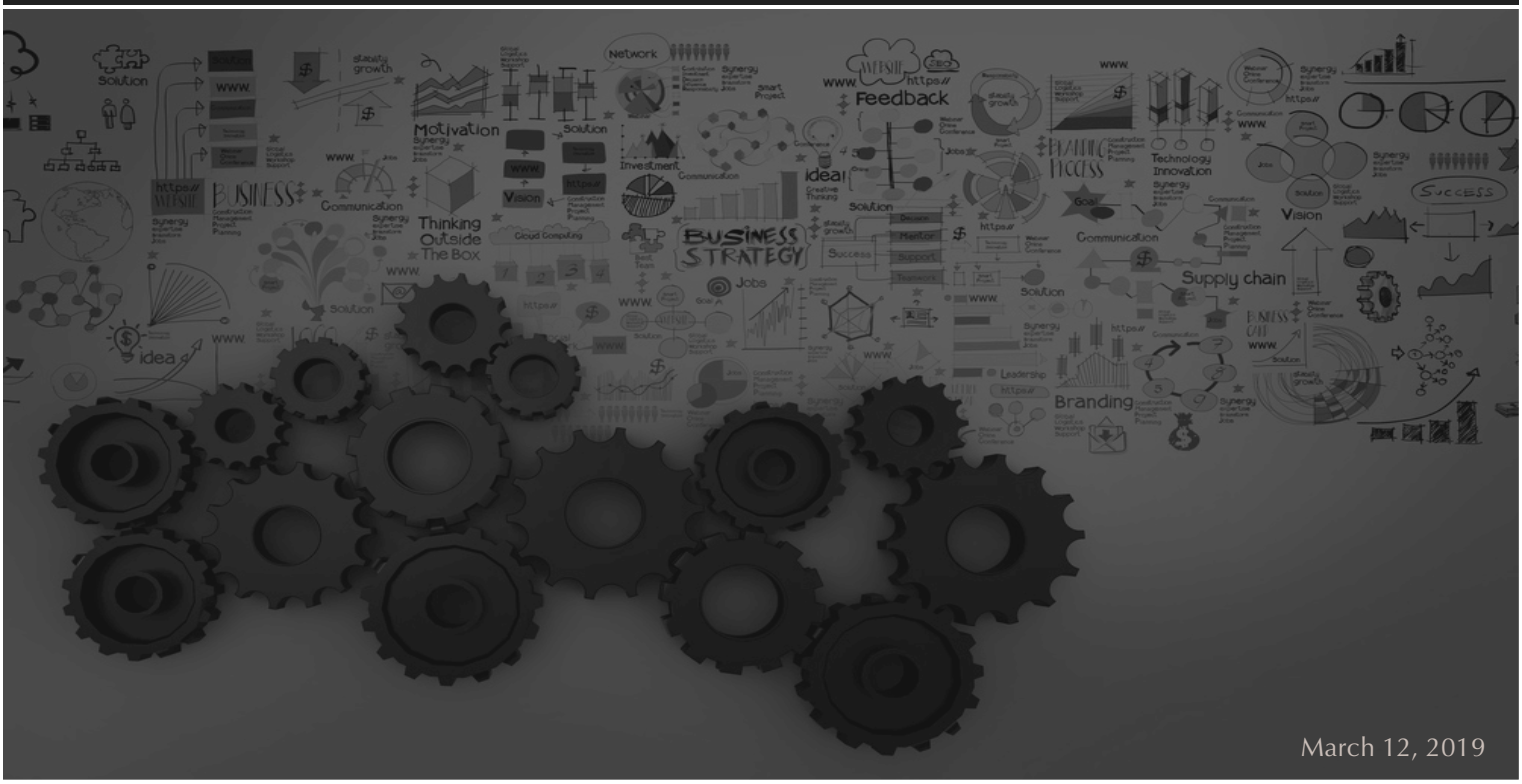
IMPACT ECONOMICS

Economic Study of the Slave Geological Province Road

For Department of Infrastructure (GNWT)



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Summary

The Government of the Northwest Territories (GNWT) has set the development of an all-season road into the Slave Geological Province as a priority for the long-term economic growth and sustainability of the territory. This road would replace the seasonal winter road that is built every year at a cost in excess of $20 million and operates for approximately 60 days each year. The GNWT's Department of Infrastructure is applying for federal government support through its National Trade Corridors Fund to complete the first phase of the road-building project. A cost benefit analysis and an economic effects assessment were completed in support of this application.

While there will be significant economic gains from the $1 billion investment in infrastructure, the real prize is opening a new, mineral-rich region of Canada to mineral exploration and development. Therefore, this economic assessment goes beyond the direct contribution of road construction and assesses the potential economic growth that is expected to follow.

Three mineral exploration and development scenarios were developed and tested—a low, medium, and high growth scenario.

- Low Scenario: a small increase in annual exploration activity (+$15 million) resulting in the development of four mineral deposits over the 30-year timeframe—three gold mines and one diamond mine.
- Medium Scenario: an increase in exploration spending ($30 million) and five new mine openings including one base metal mine.
- High Scenario: a large increase in mineral exploration activities ($45 million) that would result in the development of 7 new deposits over the 30-year timeframe.

These scenarios represent a reasonable view to what an all-season road into the Slave Geological Province would mean for mining activities based on prudent assumptions regarding the regions geological potential and based on historical evidence of mine developments in the NWT.

The results of the cost benefit analysis based on a 10% discount rate over a 30-year timeframe are provided in the table below. All scenarios had a positive net present value, with an internal rate of return ranging from 10.1% for the Low Growth Scenario to 12.5% for the High Growth Scenario.

Summary of Cost Benefit Analysis Results

	Present Value ($, millions, 10% discount rate)			IRR (%)	Benefit-Cost Ratio (%)
	Costs	Benefits	Net		
Low Growth Scenario	($1,224)	$1,229	$5	10.1%	100.4%
Medium Growth Scenario	($1,712)	$1,891	$179	11.7%	110.5%
High Growth Scenario	($2,246)	$2,610	$364	12.5%	117.6%

Positive results from a cost benefit analysis do not provide a complete picture of the project's value to the economies of the NWT or Canada. An economic effects assessment based on Statistics Canada's *Interprovincial Input-Output Model* was undertaken to learn of the project's direct, indirect, and induced effects from the investment in road infrastructure and that of the potential growth scenarios. Included in this assessment were the pre-construction activities such as engineering, regulatory, and permitting work, the road construction itself, and the mineral exploration and mine developments included in each of the three scenarios. The metrics used were gross output, GDP, and employment. A summary of the results is provided in the table below.

- The economic effect of the Low Growth Scenario on the NWT economy includes an estimated $19.8 billion increase in gross output, a $10.1 billion increase in GDP, and 29,000 jobs when considering all direct, indirect, and induced effects. The effects for the Canadian economy (that includes the NWT) include an estimated $32.1 billion increase in gross output, a $16.2 billion increase in GDP, and 80,000 jobs.
- The economic effect of the Medium Growth Scenario on the NWT economy includes an estimated $27.4 billion increase in gross output, a $14.3 billion increase in GDP, and 45,000 jobs. The effects for the Canadian economy include an estimated $44 billion increase in gross output, a $22.6 billion increase in GDP, and 114,000 jobs.
- The economic effect of the Low Growth Scenario on the NWT economy includes an estimated $39.2 billion increase in gross output, a $20.2 billion increase in GDP, and 63,000 jobs when considering. The effects for the Canadian economy include an estimated $61.5 billion increase in gross output, a $31.5 billion increase in GDP, and 157,000 jobs.

Economic Effects of the Project and Potential Growth Scenarios, $millions, number of jobs, and 30-year average

			Low Scenario		Medium Scenario		High Scenario	
	Effect	Metric	Total	Annual average	Total	Annual average	Total	Annual average
NWT	Direct	Gross Output	17,140	570	23,500	780	33,510	1,120
		GDP	8,620	290	12,070	400	16,930	560
		Employment	20,300	680	31,100	1,040	42,830	1,430
	Total Direct, Indirect, Induced	Gross Output	19,860	660	27,420	910	39,210	1,310
		GDP	10,140	340	14,320	480	20,190	670
		Employment	29,120	970	45,580	1,520	63,460	2,120
CANADA	Total Direct, Indirect, Induced	Gross Output	32,110	1,070	44,060	1,470	61,510	2,050
		GDP	16,220	540	22,620	750	31,520	1,050
		Employment	80,770	2,690	114,550	3,820	157,140	5,240

Introduction

The Government of the Northwest Territories has set the development of an all-season road into the Slave Geological Province as a priority for the long-term economic growth and sustainability of the territory. This road would replace the seasonal winter road that is built every year at a cost in excess of $20 million and operates for approximately 60 days each year. An all-season road would serve diamond mines currently operating in the region, providing a degree of security against climatic events that might jeopardise the safety of the winter road and affords those mines increased incentive for further exploration and development and potentially extensions to their operations. With that said, the long-term vision for this road to resources goes beyond the current mining activity, opening a vast track of mineral-rich land to exploration, development, and economic growth for decades to come.

The GNWT's Department of Infrastructure is applying for federal government support through its National Trade Corridors Fund to complete the first phase of the road-building project, which includes engineering and regulatory work. The application guidelines state that, if applicable, a funding proposal must provide a summary of a cost-benefit analysis, as well as a calculation of net present value, internal rate of return, and the net cost-benefit ratio, along with sensitivity analysis over a 30-year evaluation period using a discount rate of 10 percent.

The true value of the proposed road is not fully captured by a cost benefit analysis and therefore the Department of Infrastructure will also include an economic effects assessment of the project in its application. These calculations will demonstrate the direct, indirect, and induced effects on Gross Output, GDP, and employment of the construction project and the potential development scenarios that could arise as a result of the infrastructure investment.

The Department of Infrastructure contracted Impact Economics to complete the cost benefit analysis and economic effects assessment in support of its application.

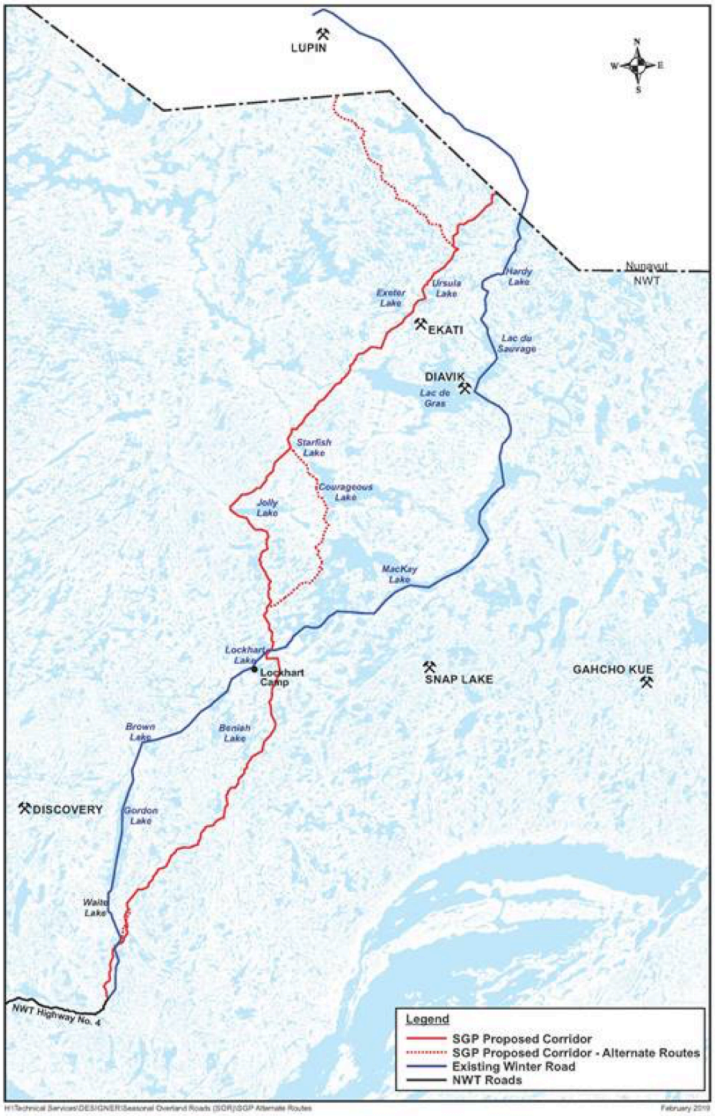
Slave Geological Province All-Season Road Overview

The Slave Geological Province all-season road (SGPASR) is a 413 kilometre road that will run from Tibbett Lake at the end of Highway #4 to the east of Contwoyto Lake adjacent to the NWT/Nunavut border. The route was selected after extensive financial and economic analysis of the geological potential of the region.[1] The all-season road will run generally east of the existing Tibbett to Contwoyto Winter Road (TCWR) in the southern portion and west of the TCWR in the northern portion.

In a best-case scenario, the road engineering, regulatory, and permitting work would be completed over a five-year period from 2019-20 to 2023-24, followed by a four-year construction period where the southern portion is completed by 2025-26 and the northern portion completed two years later in 2027-28.

The total construction costs are estimated at $450 million for the southern portion and $550 million for the northern portion, for a total project cost equal to $1 billion.[2]

Figure 1: Proposed SGP Route



Source: Government of the Northwest Territories, Department of Infrastructure

[1] The geological assessment and route selection was completed the Government of the Northwest Territories and by Aurora Geoscience Ltd.
[2] The Government of the Northwest Territories provided the project cost estimates.

Economic Scenario Development and Data Sources

This study of the SGPASR includes an assessment of the financial and economic contribution from the construction project. As a discrete project, it represents a $1 billion investment for the NWT economy that will create thousands of jobs and address growing concerns regarding the declining economy.

The real prize sought by this investment is not its direct contribution to the economy, but rather its contribution to the economic future of the territory through an expansion of the mining industry.[3] The effects of this potential are an essential component in this study, requiring a forecast of future users of the road. The Department of Infrastructure proposed a methodology that would assess this potential based on three scenarios depicting low, medium, and high levels of exploration and development. These scenarios as well as the baseline forecast were developed and quantified by the Department of Industry, Tourism, and Investment and were based, in part, on an assessment of the geological potential of the Slave Geological Province completed by Aurora Geoscience Ltd. in 2015.

The scenarios were developed outside the financial and economic evaluation process. The low, medium, and high scenarios portray reasonable projections based on prudent assumptions regarding mineral discoveries and the economic feasibility of those deposits. These assumptions are based on known geology of the region and historical evidence regarding the NWT's mineral potential. Extreme scenarios are not tested such as a No Growth Scenario or a Transformative or Very High Growth Scenario.

Economic Baseline

A baseline forecast is needed before establishing low, medium, and high development scenarios. A baseline establishes a growth path that will occur regardless of the presence of an all-season road and therefore cannot be included in the evaluation of the road's contribution to the economy. This does not mean that current operators would not use the road. An all-season road would lower the climatic and safety risks associated with the temporary ice road, and would improve the financial viability of mines in the latter stages of their operations. The added insurance and improved finances that the road offers could affect decisions regarding mine extensions, however, this possibility was not included in the baseline or in any of the growth scenarios.

The baseline (or current) scenario includes all operating mines based on existing mine plans. This includes the Ekati, Diavik, and Gahcho Kué Mines. Additionally, it is assumed that the Jay Deposit at the Ekati Mine will be developed. This is an influential assumption for the study because it is a large deposit and by including it in the baseline, its economic contribution cannot be attributed to the road if it were developed after the road is built. It must be emphasised that this technicality is important to the legitimacy of the assessment, but it does lower the road's return

[3] Any industrial use of the road would be considered an indirect effect of the road construction, however, we cannot presume a mathematical relationship exists between public infrastructure expenditures and private sector mining activities. As a result, the potential mining scenarios included in this research are treated as assumptions, while all other things remain unchanged.

on investment. If developed, the Jay Deposit would generate revenues that could (theoretically) pay for a significant portion, if not all, of the road construction costs.[4]

Included in the baseline are the following assumptions regarding mine operations:

- The Ekati Mine will operate until 2033-34. It includes development of the Jay Deposit, but nothing beyond that such as Fox Deep development.
- The Diavik Mine will operate until 2024-25.
- The Gahcho Kué Mine will operate until 2029 and will not include an expansion of the Tuzo Pit that would add two years to its mine life.
- Each mining project is followed by a reclamation and remediation project.
- Along with these developments, the baseline includes the continued construction of the TCWR until all mines are closed.

No further mining is assumed in the Slave Geological Province over the 30-year forecast period given the low levels of grass-roots exploration taking place.

Road Construction Cost and Timeline

The SGPASR construction is included in all growth scenarios. Information for this project was supplied by the Department of Infrastructure. It is assumed the total project cost will be $1 billion, where the southern road portion from Tibbett Lake to Lockhart Lake will cost $450 million and the northern portion from Lockhart Lake to the NWT/Nunavut border will cost $550 million. It is assumed that engineering work, environmental assessment, and permitting will span 5 years from 2019-20 to 2023-24. Construction will span 4 years, with work conducted on the southern and northern portions concurrently. The southern portion will open by 2026-27 while the northern portion will open two years later in 2028-29.

Slave Geological Province All-Season Road Cost and Timeline

	Cost (millions)	Timeline
Baseline Studies	$4.5	2019-20 to 2020-21
Engineering and Pre-Construction	$24	2019-20 to 2023-24
Project Description Report	$4.4	2019-20 to 2020-21
Environmental Assessment	$4.4	2021-22 to 2022-23
Permitting	$2.2	2023 to 2024
Consultation and Engagement	$0.5	2019-21 to 2023-24
Construction (Southern Portion)	$450	2024-25 to 2025-26
Construction (Northern Portion)	$550	2026-27 to 2027-28

Source: GNWT Department of Infrastructure

[4] In its *Developers' Assessment Report. Jay Project. Appendix 14A: Economic Impact Report. March 2015*, Dominion Diamond Corporation demonstrated the Jay Deposit would generate an estimated $1.2 billion in tax revenues through direct personal, payroll, direct corporate, mining (royalties) and other indirect taxes.

Scenario One: Low Growth

The Low Growth Scenario was developed by the GNWT Department of Industry, Tourism, and Investment and includes fewer developments than what Aurora Geoscience Ltd. described as its preferred estimate (which was the lowest of its three possible scenarios labelled high, optimistic, and preferred).[5] This scenario included the following key elements:

- 20-year outlook, from 2015 to 2035
- mineral occurrences were restricted to a 50km buffer zone (25 km either side of the road)
- the methodology generates conservative estimates of mineral potential because an average to large deposit would not be ignored if it were beyond the buffer zone[6]
- estimates for the Cameron and Beaulieu Greenstone Belt (CBGB)/Gordon Lake buffer zone accessible via the SGPASR included 329 mineral occurrences, two small to average sized gold mines, and two average sized base metal mines
- estimates for the northern SGP buffer zone included 86 mineral occurrences, one average sized gold mine, and one average sized base metal mine

Contrary to the assessment, this Economic Study covers a 30-year timeframe. However, there are no additional developments included in the scenarios to account for the 10 additional years of exploration.[7] And, in the case of the Low Growth Scenario, there are no base metal discoveries.[8] This scenario represents an outlook for mineral development that would be well below the historical trends in the industry despite the presence of a new all-season road.

The Low Growth Scenario includes

- Increased mineral exploration ($15m annually) beginning in 2024-25 when construction of the SGPASR begins
- Development of four mineral deposits over a 30-year time period
- A medium gold deposit developed (G1) in the CBGB/Gordon Lake area
- A small-to-medium gold deposit developed (G2) in the northern portion of the SGP
- A small gold deposit developed (G3) in the CBGB/Gordon Lake area
- A medium diamond deposit developed (D1) in the Lac de Gras/Contwoyto Lake area

[5] Aurora Geoscience reported on the mineral potential of several potential road routes. The current route was based on a comprehensive cost benefit analysis of each route. To aid this assessment, mineral occurrences had to be within of 25 kilometers of the either side of the road.
[6] This approach meant that some large, known deposits were not included in the assessment, such as the Courageous Lake gold deposit.
[7] All scenarios fall within the boundaries set by the preferred estimates in the Aurora Geoscience report with the exception of the development of diamond mines in the Medium and High Growth Scenarios.
[8] Aurora Geoscience Ltd. did not assess the potential for new diamond mines, but instead concentrated on gold and base metal mineral potential, citing challenges associated with identifying the economic feasibility of diamond-bearing kimberlite pipes.

Timing of these developments is important for the scenario development and will influence the results of the cost benefit analysis. Again, a prudent approach was taken in establishing a reasonable timetable for these projects. It was assumed that the average time from mineral discovery to mine development is 10 years for gold and diamond mines and 15 years for base metal mines. In the Low Growth Scenario, the first gold mine (G1) development will occur 10 years after the southern portion of the road opens. The second gold mine (G3) in the CBGB zone is developed 5 years after that. The single gold development in the northern zone (G2) is developed 10 years after that portion of the road opens in 2028-29. The diamond mine (D1) would also be developed 10 years after the northern portion of the road opens.

Low Growth Scenario

		Timing		Financial Data (millions)		
	Geological Zone	**Construction**	**Operation**	**CAPEX**	**OPEX**	**Revenue**
				(total)	(average annual)	(average annual)
Medium gold mine (G1)	CBGB/Gordon Lake	2035-36 to 2036-37	2037-38 to 2047-48	$248	$61	$272
Small-to-Medium gold mine (G2)	Northern SGP	2037-38 to 2038-39	2039-40 to 2049-50	$179	$78	$202
Medium diamond mine (D1)	Northern SGP	2037-38 to 2039-40	2040-41 to 2050+	$1,100	$207	$637
Small gold mine (G3)	CBGB/Gordon Lake	2040-41 to 2042-43	2043-44 to 2050+	$143	$55	$146

Source: GNWT Department of Industry, Tourism, and Investment. All figures are based on 2018-19 prices.

Scenario Two: Medium Growth

The Medium Growth Scenario makes only minor changes to the Low Growth Scenario and stays within the boundaries established by the preferred estimate scenario in the Aurora Geoscience report. It assumes exploration expenditures double what was spent in the Low Growth Scenario. It assumes that the first gold discovery occurs earlier leading to mine development (G1) in the CBGB/Gordon Lake area 5 years after the southern portion of the road opens. There are no changes to the size or timing of the second gold mine (G3) in the CBGB. There is no change in the timing of the northern gold mine (G2) included in the Low Growth Scenario, but its mine life is extended through additional discoveries that result in further development costs in the outer years of the original mine's life followed by four additional year of production. The diamond mine (D1) opens 2 years earlier than was predicted in the Low Growth Scenario and its life is extended by five years through new discoveries.[9]

The most significant addition in this scenario is the discovery and development of a base metal deposit (B1) in the CBGB/Gordon Lake area. Such a discovery was included in the preferred estimate scenario in the Aurora

[9] Note that the mine extension has virtually no effect on the assessment because the majority of the associated economic activity occurs outside the 30-year timeframe.

Geoscience report.[10] Development is assumed to occur 15 years after the road opens. The mine would be described as medium in size by most base metal mine standards and large enough to be sustainable given its remote location.

The Medium Growth Scenario includes

- Increased mineral exploration ($30m annually) beginning in 2024-25 when the construction project begins
- Development of five mineral deposits over a 30-year time period
- A medium gold deposit developed (G1) in the CBGB/Gordon Lake area
- A small-to-medium gold deposit developed (G2) in the northern SGP with an extended mine life
- A small gold deposit developed (G3) in the CBGB/Gordon Lake area
- A medium diamond deposit developed (D1) in the Lac de Gras/Contwoyto Lake area with an extended mine life
- A medium base metal deposit developed (B1) in the CBGB/Gordon Lake area

Medium Growth Scenario

		Timing		Financial Data (millions)		
	Geological Zone	**Construction**	**Operation**	**CAPEX**	**OPEX**	**Revenue**
				(total)	(average annual)	(average annual)
Medium gold mine (G1)	CBGB/Gordon Lake	2030-31 to 2031-32	2032-33 to 2042-43	$248	$61	$272
Medium diamond mine (D1)	Northern SGP	2035-36 to 2037-38	2038-39 to 2050+	$1,500	$195	$633
Small-to-Medium gold mine (G2)	Northern SGP	2037-38 to 2038-39	2039-40 to 2050+	$253	$56	$158
Small gold mine (G3)	CBGB/Gordon Lake	2040-41 to 2042-43	2043-44 to 2050+	$143	$55	$146
Medium base metal mine (B1)	CBGB/Gordon Lake	2040-41 to 2042-43	2043-44 to 2050+	$477	$222	$425

Source: GNWT Department of Industry, Tourism, and Investment. All figures are based on 2018-19 prices.

Scenario Three: High Growth

The High Growth Scenario assumes an increase in exploration activity over the Medium Growth Scenario that results in discoveries occurring sooner. It assumes two new discoveries that lead to the development of a second diamond mine (D2) and a small base metal mine (B2) in the outer years of the forecast period. The increased exploration also results in extended operations for the small gold mine (G3) developed in the CBGB/Gordon Lake area and for the first diamond mine (D1). An extended mine life also occurs at the first base metal mine, however, this expansion would not occur until after 2050 and therefore is not included in the analysis.

This High Growth Scenario is within the limits established in the best estimate scenario of the Aurora Geoscience report, with the exception of the diamond mines.

[10] In actuality, the best estimate scenario included two average-sized base metal discoveries large enough for development within the 20-year timeframe adopted in that study.

The High Growth Scenario includes

- Increased mineral exploration immediately following the conclusion of the Baseline Studies ($15m annually), ramping up to $45m annually when the road opens
- Development of seven mineral deposits over a 30-year time period
- A medium gold deposit developed (G1) in the CBGB/Gordon Lake area
- A small-to-medium gold deposit developed (G2) in the northern SGP with an extended mine life
- A small gold deposit developed (G3) in the CBGB/Gordon Lake area with an extended mine life
- A medium diamond deposit developed (D1) in the Lac de Gras/Contwoyto Lake area with an extended mine life
- A medium sized diamond deposit developed (D2) in the Lac de Gras/Contwoyto Lake area
- A medium base metal deposit developed (B1) in the CBGB/Gordon Lake area with an extended mine life occurring after 2050
- A small base metal deposit developed (B2) in the CBGB/Gordon Lake area

High Growth Scenario

		Timing		Financial Data (millions)		
	Geological Zone	**Construction**	**Operation**	**CAPEX**	**OPEX**	**Revenue**
				(total)	(average annual)	(average annual)
Medium gold mine (G1)	CBGB/Gordon Lake	2030-31 to 2031-32	2032-33 to 2042-43	$248	$61	$272
Small-to-Medium gold mine (G2)	Northern SGP	2032-33 to 2033-34	2034-35 to 2050+	$253	$56	$158
Small gold mine (G3)	CBGB/Gordon Lake	2035-36 to 2036-37	2037-38 to 2050+	$184	$50	$124
Medium diamond mine (D1)	Northern SGP	2035-36 to 2037-38	2038-39 to 2050+	$1,500	$195	$633
Medium diamond mine (D2)	Northern SGP	2040-41 to 2042-43	2043-44 to 2050+	$1,100	$207	$637
Medium base metal mine (B1)	CBGB/Gordon Lake	2040-41 to 2042-43	2043-44 to 2050+	$477	$222	$425
Small base metal mine (B2)	CBGB/Gordon Lake	2045-46 to 2043-44	2047-48 to 2050+	$388	$198	$329

Source: GNWT Department of Industry, Tourism, and Investment. All figures are based on 2018-19 prices.

Research Methodology

No one approach provides a complete picture of the true value of a $1 billion infrastructure investment. Two standard methodologies are used in this research to capture the financial results of the project and the economic effects. A description of these methodologies is provided in this chapter.

Cost Benefit Analysis

Cost benefit analysis is an approach used to study the risks and rewards of an investment. Put simply, it demonstrates whether benefits (typically benefits that will occur in the future) outweigh costs (typically upfront and ongoing costs) after accounting for the time value of money. In that sense, cost benefit analysis is used to determine the economic (financial) feasibility of new business ideas, research and development of new products, investments in new equipment or technology, or upgrading or building new infrastructure. Cost benefit analysis is often employed when comparing the net benefit of different investments over time.

Cost benefit analysis requires that all costs and benefits be quantified including any qualitative results, though in this study of the SGPASR, only monetary costs and benefits are considered.

When using cost benefit analysis to study a business decision, all costs and benefits are paid and received by the business. In the case of a public sector investment, benefits can flow back to government in the form of taxes or reduced spending in the future, but often times, benefits can flow to the private sector, either to individuals, communities, or industry. In these cases it is not uncommon that the costs and benefits are studied from a global or societal viewpoint; that is, all costs are viewed as being born by a community, region, or country as a whole, while all benefits are viewed as collective whether they flow to individuals or government.

There is added complexity associated with this SGPASR study because the proposed investment is meant to open up a new region of Canada to mineral exploration and development. Costs and benefits associated with the mining industry are international in scope, where mine development can be financed in part by foreign investors and mine profits are distributed to shareholders throughout the world. The GNWT is not in a position to speculate on the ownership profile of potential developers, and therefore, there is no benefit from studying the cost and benefits from the position of several different stakeholders.

In the case when the public sector is investing in infrastructure that will lower costs, improve safety, or increase productivity of industry, a cost benefit analysis records the marginal benefits experienced by those industries. For example, had the SGPASR been built in late 1990s in response to the emerging diamond industry, the cost savings associated with the road as well as any improvement in safety, efficiency, or other transportation-related factors would be included in the assessment. The purpose of this all-season road has now changed. It is now meant to open the SGP to exploration without knowing exactly how the mineral exploration industry will respond or what might be

discovered as a result. In this way, the methodology adopted in this cost benefit analysis differs from a more traditional approach and instead follows the methodology adopted by the Conference Board of Canada in its study of *Transportation and Economic Development in the Slave Geological Province*.[11]

Current users of the TCWR will clearly benefit from the investment; however, these benefits are ignored in this analysis. Instead, the benefits that are included flow exclusively from future mineral development that is itself based on the known geology of the region. Costs are associated with the road construction, assumed exploration activities (which are viewed as a cost in this analysis), and assumed mine development and operating costs (CAPEX and OPEX).

The National Trade Corridors Fund *Applicant's Guide* requires that the cost benefit analysis include the following:

- Description of methodology
- Statement of major benefits
- Net present value, internal rate of return, and net cost-benefit ratio
- A sensitivity analysis
- A 30-year evaluation period
- A 10% discount rate

All of these requirements are included in this report.

Economic Effects Assessment

As already discussed, the purpose of the proposed all-season road is not the road itself, but the economic opportunities that it is expected to generate. An assessment of economic effects of the construction project and the potential activity it generates are included as part of the economic effects evaluation.

There are a few different ways to study the economic effects of an investment such as the SGPASR. This research employs Input-Output models to determine the direct, indirect, and induced effects on gross output, GDP, and employment associated with the SGPASR construction project and with the potential effects associated with any mineral exploration and mining activities that occur through the use of the road.

Input-Output models are best suited when investigating the economic effects of a change in production, and especially in cases where that change can be thought to occur without significantly altering the structural make-up of an economy.

Input-output models utilise the expenditure patterns from an existing or potential producer to depict the effect those expenditures will have on an economy. Determining the value and location of the thousands of transactions that

[11] The conference Board of Canada, "Slave Geological Province. Transportation and Economic Development: Benefit-Cost Analysis." Produced for the Government of the Northwest Territories Department of Economic Development and Transportation. November, 2001.

occur as a result any of a project would be virtually impossible to do manually. Input-Output models perform the calculations through a complex system of resource allocation. In essence, they trace the flow of money through an economy, measuring the effects on gross output, GDP, and employment from each transaction along the supply chain.

In Canada, Statistics Canada builds and maintains the *Inter-provincial Input-Output Model*. In addition to representing the structure of the Canadian, provincial, and territorial economies, this model has the added complexity of tracing trade flows between Canada's provinces and territories as well as internationally.

One must be cautious when interpreting the results of Input-Output models. Like all models, Input-Output models are predicated on assumptions that alter or influence the results. Any results should be viewed as approximations and be combined with other knowledge of the industry or economy being studied. Some of the more influential assumptions associated with Input-Output models include:

- Input-Output models are linear, meaning they do not make adjustments for the size, scale, or direction of any change.
- Input-Output models do not reflect limitations of capital and labour; that is, there are no capacity constraints. This assumption does not hold in some industries in the NWT with respect to labour. This is addressed putting limits on the induced effect based on resident labour participation rates.
- Input-Output models are static, meaning they do not account for time; that is, they are based on the structure of an economy at a single point in time. The economic effect of a project is the same whether it occurs today or 10 years from today. The project is assumed to require the same labour force, the same amount of capital, the same inputs of goods and services, etc.
- The data used to develop the relationships between industrial sectors are the result of surveys. They must be treated as approximations of actual relationships because unknown variability is embedded in those survey results.

With the areas of caution noted, Input-Output models provide a useful starting point for understanding the direct, indirect, and induced effects of a major project such as the construction of a road or the development of a mine.

Direct effects are the value-added components of the production process. A firm will combine labour and capital with goods and services (inputs) to generate a product or service. After selling the product or service, whatever is left over is the firm's operating surplus. The labour and capital costs (sometimes referred to as "rent") and any operating surplus is the value that has been added to the inputs to create a new product or service—this is the value-added output, commonly referred to as gross domestic product. The sum of the inputs and the value-added components is called gross output. The labour utilised in the production process is the direct effect on employment.

The inputs (goods and services) purchased of as part of the production process generate the first round of *indirect effects*, sometimes referred to as direct endogenous effects in construction and mining industries because some of the expenditures are paying for goods and service providers that operate on site and contribute directly to production. Like the original producer, its suppliers must combine inputs with labour and capital to generate the product or service it sells. When the supplier does this as a result of its contract with the producer, the GDP and labour effects are referred to as indirect effects. This triggers additional purchases of goods and services from additional suppliers, each time generating further indirect effects. This trickle down effect continues along the supply chain until the effect is too small to measure. The sum of all these rounds of effects is the total indirect effect.

All businesses associated with the direct or indirect effects employ staff and pay wages. The economic activity generated when these income earners spend their wages is called *induced effects*. Assessing induced effects can be difficult when someone is working in one jurisdiction, but resides, spends, and pays taxes in another. This issue can be addressed by imposing restrictions on the model regarding the residency of employees.

In this study, the direct, indirect, and induced effects of the road construction, exploration activities, and mine developments are estimated.

Results from the Cost Benefit Analysis

The results from the cost benefit analysis for each scenario are presented in this chapter. Each time series is categorised as a cost or benefit, and is assembled according to the schedules assigned by each scenario. All expenditures associated with the SGPASR project as well as all exploration activity are designated as costs, as are the costs of constructing a mine. The only benefits included in this analysis are those associated with mineral production.

Highlights from Low Growth Scenario

- In all scenarios, the SGPASR project schedule is the same. The baseline, engineering, regulatory, and permitting work takes place over a five-year period, 2019-20 to 2023-24. The project's construction spans four years, from 2024-25 to 2027-28. This is followed by ongoing maintenance costs. The assumed cost of this work is $40 million for the preparatory work and $1 billion for the project's construction. Its net present value is $496 million.
- All scenarios are tested assuming a 10% discount rate.
- Exploration activities deviate from the baseline starting in 2024-25 by $15 million annually. Brought to present value, this expenditure stream is valued at $86 million.
- The four mines included in this scenario are developed according to the stated schedule. Construction timelines for gold mines are assumed to be two years. Diamond mines are assumed to require three years to build. Each mine incurs operating costs and revenues. The total cost of each mine includes its capital expenditures, operating expenditures, sustaining capital, and any further capital costs associated with future mine developments. The present value of the mines' cost and benefit streams are presented in the table below.
- The net present value of the Low Growth Scenario is almost zero (+$5 million), where the present values of the costs and benefits are approximately $1.2 billion over the 30-year evaluation period.
- The Internal Rate of Return (IRR) is 10.1% and the benefit cost ratio is 100.4%.

Low Growth Scenario

	Timing		Present Value (millions, 10% discount)			IRR (%)	Benefit Cost Ratio (%)
	Construction	Operation	Costs	Benefits	Net		
Road Engineering, Regulatory, Permitting, and Construction	2019-20 to 2027-28	2026-27 to 2050+	($496)	-	($496)		
Exploration Activity	2024-25 to 2050+		($86)		($86)		
Medium gold mine (G1)	2035-36 to 2036-37	2037-38 to 2047-48	($123)	$318	$194		
Small-to-Medium gold mine (G2)	2037-38 to 2038-39	2039-40 to 2049-50	($106)	$195	$89		
Medium diamond mine (D1)	2037-38 to 2039-40	2040-41 to 2050+	($361)	$623	$262		
Small gold mine (G3)	2040-41 to 2042-43	2043-44 to 2050+	($52)	$94	$42		
Total			($1,224)	$1,229	$5	10.1%	100.4%

Highlights from Medium Growth Scenario

- The present value of the SGPASR is unchanged in the Medium Growth Scenario at $496 million.
- The exploration activity doubles in this scenario to $30 million over the baseline. This doubles the present value of that time series to $172 million.
- This scenario alters the timing of the first gold mine (G1) development, bringing its costs and benefits closer to the current year, which raises its present values.
- The same is true for the diamond mine (D1), which adds a second construction phase in the outer years of the study's timeframe along with additional costs and revenues.
- The timeframe for the second gold mine (G2) does not change, but it does undergo a second development phase beginning 2048-49, followed by additional operating costs and revenues. Note that this schedule means that the majority of additional revenues occur after 2050 and are therefore not included in the cost benefit calculations. This effectively lowers that projects potential contributions because the full cost of the expansion is included.
- The scenario adds a base metal mine (B1) beginning 2040-41.
- It is worth noting that projects that get underway in 2040 or later contribute little to the net results of the study compared—such is the nature of this assessment approach. This is especially the case for mine extensions, that are very important to an economy but make little difference in a cost benefit analysis.
- The net present value of the Medium Growth Scenario is $179 million, where the present values of the costs and benefits are $1.712 billion and $1.891 billion, respectively.
- The IRR is 11.7% and the benefit cost ratio is 110.5%.

Medium Growth Scenario

	Timing		Present Value (millions, 10% discount)			IRR (%)	Benefit Cost Ratio (%)
	Construction	Operation	Costs	Benefits	Net		
Road Engineering, Regulatory, Permitting, and Construction	2019-20 to 2027-28	2026-27 to 2050+	($496)	-	($496)		
Exploration Activity	2024-25 to 2050+		($172)	-	($172)		
Medium gold mine (G1)	2030-31 to 2031-32	2032-33 to 2042-43	($199)	$511	$313		
Medium diamond mine (D1)	2035-36 to 2037-38	2038-39 to 2050+	($481)	$813	$332		
Small-to-Medium gold mine (G2)	2037-38 to 2038-39	2039-40 to 2050+	($111)	$200	$89		
Small gold mine (G3)	2040-41 to 2042-43	2043-44 to 2050+	($52)	$94	$42		
Medium base metal mine (B1)	2040-41 to 2042-43	2043-44 to 2050+	($201)	$273	$72		
Total			($1,712)	$1,891	$179	11.7%	110.5%

Highlights from High Growth Scenario

- The present value of the SGPASR is unchanged in the Medium Growth Scenario at $496 million.
- The increased exploration activity begins in 2021-22 in this scenario, first by $15 million and then to $45 million annually once the road opens. The present value of this time series to $257 million.
- This scenario moves the start date of the northern SGP gold mine (G2) to 2032-33. In addition to bringing the costs and benefits closer to the present day, this change also means that all but the final two years of operations occur within the Study's timeframe.
- The small gold mine (G3) is also developed earlier and undergoes a second development phase beginning 2046-47, followed by additional operating costs and revenues. The majority of revenues generated as a result of this extension occur after 2050.
- The scenario adds a second diamond mine (D2) beginning in 2040-41.
- The scenario also adds a second base metal mine (B2) beginning in 2045-46. This project begins generating so late in the forecast timeframe that it actually registers as a negative in the cost benefit analysis.
- The net present value of the High Growth Scenario is $364 million, where the present values of the costs and benefits are $2.246 billion and $2.610 billion, respectively.
- The Internal Rate of Return (IRR) is 12.5% and the benefit cost ratio is 117.6%.

High Growth Scenario							
	Timing		Present Value (millions, 10% discount rate)			IRR (%)	Benefit-Cost Ratio (%)
	Construction	Operation	Costs	Benefits	Net		
Road Engineering, Regulatory, Permitting, and Construction	2019-20 to 2027-28	2026-27 to 2050+	($496)	-	($496)		
Exploration Activity	2021-22 to 2050+		($257)	-	($257)		
Medium gold mine (G1)	2030-31 to 2031-32	2032-33 to 2042-43	($199)	$511	$313		
Small-to-Medium gold mine (G2)	2032-33 to 2033-34	2034-35 to 2050+	($187)	$349	$163		
Small gold mine (G3)	2035-36 to 2036-37	2037-38 to 2050+	($102)	$186	$83		
Medium diamond mine (D1)	2035-36 to 2037-38	2038-39 to 2050+	($481)	$813	$332		
Medium diamond mine (D2)	2040-41 to 2042-43	2043-44 to 2050+	($250)	$404	$154		
Medium base metal mine (B1)	2040-41 to 2042-43	2043-44 to 2050+	($201)	$273	$72		
Small base metal mine (B2)	2045-46 to 2043-44	2047-48 to 2050+	($73)	$72	($1)		
Total			($2,246)	$2,610	$364	12.5%	117.6%

Sensitivity Analysis

The three potential growth scenarios represent a means to test the sensitivity of the SGPASR project costs against different outcomes. Each presents variation in the mineral exploration industry to the new road, the number and timing of discoveries, and the number of developments.

The three scenarios were tested against discount rates of 5%, 8%, and 12% in addition to the base discount rate of 10%. The results are provided in the table below. A 5% discount rate assumes a very optimistic outlook on inflation and interest rates, while a 12% discount rate takes a very pessimistic view. The 8% discount rate is more moderate. It produces net benefits equal to $281 million, $540 million, and $872 million for the Low, Medium, and High Growth Scenarios, respectively.

Sensitivity Analysis of Scenarios with Discount Rates of 5%, 8%, 10%, and 12%

	Present Value ($, millions)			IRR (%)	Benefit-Cost Ratio (%)
	Costs	Benefits	Net		
Low Growth Scenario					
At 5% discount rate	($2,799)	$3,971	$1,171	10.1%	141.8%
At 8% discount rate	($1,666)	$1,947	$281	10.1%	116.9%
At 10% discount rate	($1,224)	$1,229	$5	10.1%	100.4%
At 12% discount rate	($925)	$785	($140)	10.1%	84.9%
Medium Growth Scenario					
At 5% discount rate	($4,056)	$5,700	$1,644	11.7%	140.5%
At 8% discount rate	($2,366)	$2,907	$540	11.7%	122.8%
At 10% discount rate	($1,712)	$1,891	$179	11.7%	110.5%
At 12% discount rate	($1,273)	$1,249	($24)	11.7%	98.1%
High Growth Scenario					
At 5% discount rate	($5,582)	$8,005	$2,423	12.5%	144.9%
At 8% discount rate	($3,165)	$4,037	$872	12.5%	129.0%
At 10% discount rate	($2,246)	$2,610	$364	12.5%	117.6%
At 12% discount rate	($1,637)	$1,713	$75	12.5%	106.0%

The Medium Growth Scenario was used to test additional sensitivities. Specifically, the sensitivity of the cost benefit analysis to escalating construction costs. The scenario was tested assuming +10% and +25% increase in construction costs and was then reverse engineered to find the escalation rate that would result in an IRR equal to the discount rate of 10%. All other things were held constant.

- The net present value of the Medium Growth Scenario with a project construction cost of $1.1 billion (10% increase) is $130 million, the IRR is 11.2% and the benefit cost ratio is 17.4%.
- The net present value of the Medium Growth Scenario with a project construction cost of $1.25 billion (25% increase) is $57 million, the IRR is 10.5% and the benefit cost ratio is 103.1%.

- The net present value of the Medium Growth Scenario with a project construction cost of $1.3675 billion is zero, the IRR is 10% and the benefit cost ratio is even.

Sensitivity Analysis of Road Construction Cost based on the Medium Growth Scenario						
		Present Value (millions, 10% discount rate)			IRR (%)	Benefit-Cost Ratio (%)
	Change in Cost	Costs	Benefits	Net		
Road Engineering, Regulatory, Permitting, and Construction	**Cost +10%**	($544.49)	-	($544.49)		
Total		($1,761)	$1,891	$130	11.2%	107.4%
Road Engineering, Regulatory, Permitting, and Construction	**Cost +25%**	($617.59)	-	($617.59)		
Total		($1,834)	$1,891	$57	10.5%	103.1%
Road Engineering, Regulatory, Permitting, and Construction	**Cost +37%**	($677.05)	-	($677.05)		
Total		($1,891)	$1,891	$0	10.0%	100.0%

Results from the Economic Effects Assessment

The results from the Economic Effects Assessment for each scenario are presented in this chapter. This includes estimates of the economic activity associated with the SGPASR road construction and potential mineral exploration and mining. The metrics are Gross Output, GDP, and employment.

Each change introduced to the economy is tested separately, including the pre-construction activities (engineering, regulatory, and permitting), SGPASR construction, road operations or maintenance, mineral exploration, mine construction, and mine operations. The results are presented individually and collectively for each scenario.[12]

As noted in the methodology, there are supply constraints in the NWT's labour market. The following limitations were imposed on the direct and indirect employment effects based on historical evidence.

- Engineering and professional services related to the road pre-construction work will import 66% of its labour.
- The SGPASR construction project will import 75% of its labour.
- Exploration activities will import 50% of its labour.
- Mine construction will import 80% of its labour.
- Mine operations will import 50% of its labour.

Note also that these assumptions do not alter the results for direct and indirect effects. The model measures effects on a domestic basis; that is, the effects on gross output, GDP, and employment that take place within a jurisdiction. Separating the results on a national basis (by residency of labour or supplier) must take place outside the model.

Input-Output models are built using the structure of an economy in the recent past. A challenge arises when an industry is not present in that economy. There are two instances where this is the case in this Economic Study—gold mining and base metal mining. In these cases, the Input-Output tables from a representative jurisdiction were employed. Below is a list of the economic activities associated with this study and the direct industries affected.

- *SGPASR Pre-Construction*: Engineering and related services; Management, Scientific, and Technical Consulting Services; Other Professional, Scientific, and Technical Services, NWT
- *SGPASR Construction*: Transportation Engineering Construction, NWT
- *Mineral Exploration*: Support Activities for Mining, NWT
- *Mine Construction:* Other Engineering Construction, NWT
- *Gold Mine*: Gold and Silver Mining, Nunavut
- *Diamond Mine*: Diamond Mining, NWT
- *Base Metal Mine*: Copper, Nickel, Zinc, Lead Mining, Yukon

[12] Note that the detailed results from this assessment are presented in an Appendix following this chapter.

Highlights from Low Growth Scenario

In all scenarios, the SGPASR project schedule is the same. The baseline, engineering, regulatory, and permitting work takes place over a five-year period, 2019-20 to 2023-24. The project's construction spans four years, from 2024-25 to 2027-28. This is followed by ongoing maintenance costs. The assumed cost of this work is $40 million for the preparatory work and $1 billion for the project's construction.

- The pre-construction work has a small but not insignificant effect on employment, averaging 59 full-time equivalent (FTE) jobs over the five-year period. [13]
- The model estimated the construction project would raise GDP in the NWT by $377 million, creating 3,313 new direct jobs.
- The total effect including direct, indirect, and induced effects would raise GDP in the NWT by $483 million, creating 4,100 jobs.
- Average employment during the four-year construction project is estimated to equal 1,025 jobs.
- Across Canada, the effect is double the size, with Gross Output exceeding $2 billion and total jobs exceeding 8,000.[14]

Economic Effects of SGPASR Pre-Construction and Construction, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
		Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Pre-Construction	2019-20 to 2023-24	5	40	22	241	51	28	293	10	6	59
SGPASR Construction	2024-25 to 2027-28	4	1,000	377	3,313	1,198	483	4,100	299	121	1,025

Mineral exploration will proceed throughout the study period beginning in 2024-25. Expenditures were assumed to total $15 million annually. This activity will create, on average, 78 direct jobs annually and 90 jobs annually once factoring in the indirect and induced effects. Mineral exploration has a relatively small effect on the Canadian economy, raising GDP and employment by approximately 50% over the effects in the NWT.

Economic Effects of Mineral Exploration, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Exploration Activity	2024-25 to 2050+	27	405	229	2,077	483	276	2,437	18	10	90

[13] All employment estimates are shown as full-time equivalencies.
[14] The full results of the economic effects assessment are provided in the Appendix following this chapter.

The Low Growth Scenario includes the discovery and development of four mineral deposits 10 to 15 years after the road opens. The construction of these mines contributes to the economic activity of the territory. In calculating these effects, it was assumed that 10% of a mine's total capital cost goes to the purchase of foreign imports and therefore has no economic effect on the territorial or national economies apart from any associated transportation. The results for each development are presented separately.

- The gold mines vary in size, but are all small- to medium-sized operations and as a result require a relatively small CAPEX and workforce. The direct effect on jobs ranges from 210 to 364.
- The diamond mine is larger, with a CAPEX of $1.1 billion, creating 1,616 direct jobs (approximately 540 annually, on average).
- Mine construction requires a lot of inputs, which creates a large indirect effect raising the GDP multiplier to approximately 1.6 and the employment multiplier to almost 1.8 in the NWT. The result is average employment for gold mine construction ranges from 187 to 325 per year, while the diamond mine construction will create 962 jobs annually.

Economic Effects of Mine Construction, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2035-36 to 2036-37	2	223	54	364	281	87	651	140	43	325
Small-to-Medium gold mine (G2)	2037-38 to 2038-39	2	161	39	262	202	62	469	101	31	234
Medium diamond mine (D1)	2037-38 to 2039-40	3	990	242	1,616	1,244	384	2,887	415	128	962
Small gold mine (G3)	2040-41 to 2042-43	2	128	31	210	161	50	375	81	25	187

The Low Growth Scenario has a schedule for new mine openings between 2037-38 and 2043-44. In the case of the diamond mine (D1) and the last gold mine (G3), the late start date means that the full effect of production does not occur within the Study's timeframe. This effects the total economic effect, but has very little influence on the average annual effect.

- The gold mines range in size, producing a gross output equal to $1.31 billion in the case of the small gold mine (G3) and up to $2.99 billion in the case of the medium gold mine (G1).
- The diamond mine's output is valued at $7.4 billion.
- The GDP to Gross Output ratio for the gold mines was estimated to be approximately 60%, while the same ratio for diamond mines is just under 50%.
- The workforce requirements at the gold mines is small relative to the diamond mine, averaging 134 direct jobs at the smallest gold mine (G3), up to 250 direct jobs at the largest gold mine (G1). The diamond mine (D1) was estimated to require 494 direct employees.

- The territory's GDP will rise by $98 million annually in the base of the small gold mine (G3), $184 million annually in the case of the medium gold mine (G1), and by $389 million for the diamond mine (D1).
- The territory's employment will rise by 190 jobs annually in the base of the small gold mine (G3), 355 jobs annually in the case of the medium gold mine (G1), and by 763 jobs for the diamond mine (D1).

Economic Effects of Mine Production, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2037-38 to 2047-48	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355
Small-to-Medium gold mine (G2)	2039-40 to 2049-50	11	2,221	1,347	2,044	2,481	1,490	2,905	226	135	264
Medium diamond mine (D1)	2040-41 to 2050+	11	7,396	3,572	5,429	8,635	4,275	8,397	785	389	763
Small gold mine (G3)	2043-44 to 2050+	9	1,311	795	1,206	1,464	879	1,714	163	98	190

The total economic effect of the Low Growth Scenario on the NWT economy includes an estimated $19.8 billion increase in gross output and a $10.1 billion increase in GDP. This economic activity will create more than 29,000 jobs in total.

The figures are substantially higher for Canada as a whole (which included the NWT). The total economic effect on the Canadian economy includes an estimated $32.1 billion increase in gross output and a $16.2 billion increase in GDP. This economic activity will create more than 80,000 jobs in total.

Total Economic Effect of the Low Growth Scenario

			All Economic Activities	
	Effect	Metric	($ millions, # of jobs)	(average annual)
NWT	**Direct**	**Gross Output**	17,136	571
		GDP	8,618	287
		Employment	20,303	677
	Total Direct, Indirect, Induced	**Gross Output**	19,861	662
		GDP	10,143	338
		Employment	29,118	971
CANADA	**Total Direct, Indirect, Induced**	**Gross Output**	32,111	1,070
		GDP	16,221	541
		Employment	80,770	2,692

Highlights from Medium Growth Scenario

Mineral exploration doubles in this scenario to $30 million, meaning the economic effects will also double. This activity will create over 4,000 direct person-years worth of work. Including all direct, indirect, and induced effects, this level of mineral exploration will contribute $552 million to NWT's GDP and create 4,874 jobs.

Economic Effects of Mineral Exploration, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Exploration Activity	2024-25 to 2050+	27	810	457	4,154	967	552	4,874	36	20	181

The Medium Growth Scenario includes the discovery and development of five mineral deposits 5 to 15 years after the road opens. As with the Low Growth Scenario, it was assumed that 10% of a mine's total capital cost goes to the purchase of foreign imports. Also, as noted in the Methodology, Input-Output models do not account for the passage of time. Therefore, the economic effect of a project is not affected by a change in its start date.

The key changes in this scenario related to mine construction are the extensions to the diamond mine (D1) and the gold mine (G2) and the addition of a base metal mine (B1) starting in 2040-41.

- With the increased capital expenditures at the diamond mine (D1), its contribution to direct GDP rises from $242 million in the Low Growth Scenario to $329 million in this scenario. The number of direct jobs rises from 1,616 to 2,204.
- The expansion at the gold mine (G2) also contributes to more employment and more value-added production over the Study's timeframe. Total direct jobs are estimated to equal 372, while the new estimate for GDP is $56 million.
- The new base metal mine has a CAPEX of $477 million, adding to the NWT's gross output by $429 million, its GDP by $105 million, and its employment by 700 jobs through the direct effects of these expenditures.

Economic Effects of Mine Construction, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2030-31 to 2031-32	2	223	54	364	281	87	651	140	43	325
Medium diamond mine (D1)	2035-36 to 2037-38	5	1,350	329	2,204	1,697	524	3,936	339	105	787
Small-to-Medium gold mine (G2)	2037-38 to 2038-39	4	228	56	372	286	88	664	72	22	166
Small gold mine (G3)	2040-41 to 2041-42	2	128	31	210	161	50	375	81	25	187
Small base metal mine (B1)	2040-41 to 2041-42	2	429	105	700	539	167	1,251	270	83	625

The Medium Growth Scenario has a schedule for new mine openings between 2032-33 and 2043-44. The change in dates does has no bearing on the estimated effects except where the earlier start date means more of the mine's productive life occurs within the Study's timeframe.

- With the diamond mine (D1) starting two years earlier, its total gross output increases to $8.5 billion. However, there are only minor changes to the average annual contributions to GDP or employment at the territorial or national levels.
- The gold mines range in size, producing a gross output equal to $1.31 billion in the case of the small gold mine (G3) and up to $2.99 billion in the case of the medium gold mine (G1).
- Similarly, the gold mine (G2) includes an extension in this scenario, however, this development occurs in the outer years of the study period and therefore has little effect on its economic contributions. The value of its gross output increases from $2.2 billion to $2.3 billion.
- The addition of a base metal mine to the NWT economy beginning with its construction in 2040-41 enters production in 2042-43. Its nine years of production within the study period is valued at $3.8 billion, giving rise to $2.3 billion in direct GDP and 6,371 direct jobs.
- The model shows a high employment multiplier in this industry equal to 1.58, resulting in a total employment effect equal to more than 10,000 jobs, which translates to an average employment effect of 1,119 in the NWT.
- Nationally, the annual employment effect exceeds 2,000.

Economic Effects of Mine Production, NWT

			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2032-33 to 2042-43	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355
Medium diamond mine (D1)	2038-39 to 2050+	13	8,572	4,140	6,292	10,007	4,955	9,732	770	381	749
Small-to-Medium gold mine (G2)	2039-40 to 2050+	12	2,318	1,406	2,133	2,589	1,555	3,032	216	130	253
Small gold mine (G3)	2042-43 to 2050+	9	1,311	795	1,206	1,464	879	1,714	163	98	190
Small base metal mine (B1)	2042-43 to 2050+	9	3,826	2,386	6,371	4,515	2,821	10,069	502	313	1,119

The total economic effect of the Medium Growth Scenario on the NWT economy includes an estimated $27.4 billion increase in gross output and a $14.3 billion increase in GDP. This economic activity will create more than 45,000 jobs in total.

The figures are substantially higher for Canada as a whole. The total economic effect on the Canadian economy includes an estimated $44 billion increase in gross output and a $22.6 billion increase in GDP. This economic activity will create more than 114,000 jobs in total.

Total Economic Effect of the Medium Growth Scenario				
			All Economic Activities	
	Effect	Metric	($ millions, # of jobs)	(average annual)
NWT	Direct	Gross Output	23,497	783
		GDP	12,068	402
		Employment	31,101	1,037
	Total Direct, Indirect, Induced	Gross Output	27,417	914
		GDP	14,317	477
		Employment	45,581	1,519
CANADA	Total Direct, Indirect, Induced	Gross Output	44,057	1,469
		GDP	22,622	754
		Employment	114,551	3,818

Highlights from High Growth Scenario

The increase in mineral exploration activity starts earlier and rises to $45 million by the time the SGPASR opens in the High Growth Scenario. Total expenditures reach $1.2 billion over the 30 years of exploration, creating over 6,100 direct jobs and contributing $678 million to the territory's GDP.

Economic Effects of Mineral Exploration, NWT											
			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Exploration Activity	2021-22 to 2050+	30	1,200	678	6,155	1,432	818	7,220	48	27	241

The High Growth Scenario includes the discovery and development of seven mineral deposits after the road opens. As with the previous scenarios, it was assumed that 10% of a mine's capital cost goes to the purchase of foreign imports.

The key changes in this scenario related to mine construction are the addition of a medium diamond mine (D2) in 2040-41, a small base metal mine (B2) in 2045-46, and an extension to the gold mine (G3) in 2046-47.

- The second diamond mine is assumed to have a CAPEX of $1.1 billion and was estimated to add $384 million to the NWT's GDP and create 2,887 jobs when factoring in all direct, indirect, and induced effects.
- The new base metal mine has a CAPEX of $388 million, adding to the NWT's gross output by $349 million, its GDP by $85 million, and its employment by 570 jobs through the direct effects of these expenditures.
- The expansion at the small gold mine (G3) will cost $41 million, bringing its total CAPEX of that project to $184 million.

Economic Effects of Mine Construction, NWT											
			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2030-31 to 2031-32	2	223	54	364	281	87	651	140	43	325
Small-to-Medium gold mine (G2)	2032-33 to 2033-34	4	228	56	372	286	88	664	72	22	166
Small gold mine (G3)	2035-36 to 2036-37	4	166	40	270	208	64	483	52	16	121
Medium diamond mine (D1)	2035-36 to 2037-38	5	1,350	329	2,204	1,697	524	3,936	339	105	787
Medium diamond mine (D2)	2040-41 to 2042-43	3	990	242	1,616	1,244	384	2,887	415	128	962
Medium base metal mine (B1)	2040-41 to 2042-43	2	429	105	700	539	167	1,251	270	83	625
Small base metal mine (B2)	2045-46 to 2046-47	2	349	85	570	439	136	1,018	219	68	509

The High Growth Scenario has a schedule for new mine openings beginning in 2032-33. This scenario brings the start dates of the two gold mines (G2 and G3) forward, which allows for a larger portion of their total mine life to occur within the timeframe of this study. There are no changes to the first diamond mine (D1), but the second diamond mine (D2) opens in 2043-44. The second base metal mine (B2) opens in 2047-48 and therefore only 4 years of production are evaluated in this study.

- The gross output of the two gold mines (G2 and G3) equal $2.8 billion and $1.9 billion in this scenario. The total employment effect is 3,666 and 2,481, respectively, equal to 216 and 177 annually over the life of each project.
- The second diamond mine production is valued at $5.8 billion. Its annual contribution to GDP and employment in the territory is estimated at $424 million and 832 jobs.
- The base metal mine (B2) has a production value worth $1.3 billion in its first four years of operations, and is estimated to create 547 direct jobs and raise GDP by $205 million annually.

Economic Effects of Mine Production, NWT											
			Direct			Total (Direct, Indirect, Induced)			Average Annual		
	Production	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Medium gold mine (G1)	2032-33 to 2042-43	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355
Small-to-Medium gold mine (G2)	2034-35 to 2050+	17	2,804	1,701	2,580	3,131	1,881	3,666	184	111	216
Small gold mine (G3)	2037-38 to 2050+	14	1,897	1,151	1,745	2,119	1,273	2,481	151	91	177
Medium diamond mine (D1)	2038-39 to 2050+	13	8,572	4,140	6,292	10,007	4,955	9,732	770	381	749
Medium diamond mine (D2)	2043-44 to 2050+	8	5,864	2,832	4,304	6,846	3,390	6,658	856	424	832
Medium base metal mine (B1)	2042-43 to 2050+	9	3,826	2,386	6,371	4,515	2,821	10,069	502	313	1,119
Small base metal mine (B2)	2047-48 to 2050+	4	1,314	820	2,188	1,551	969	3,458	388	242	865

The total economic effect of the High Growth Scenario on the NWT economy includes an estimated $39.2 billion increase in gross output and a $20.2 billion increase in GDP. This economic activity will create more than 63,000 jobs in total.

The figures are substantially higher for Canada as a whole. The total economic effect on the Canadian economy includes an estimated $61.5 billion increase in gross output and a $31.5 billion increase in GDP. This economic activity will create more than 157,000 jobs in total.

Total Economic Effect of the High Growth Scenario

			All Economic Activities	
	Effect	**Metric**	($ millions, # of jobs)	(average annual)
NWT	**Direct**	**Gross Output**	33,513	1,117
		GDP	16,926	564
		Employment	42,827	1,428
	Total Direct, Indirect, Induced	**Gross Output**	39,206	1,307
		GDP	20,195	673
		Employment	63,458	2,115
CANADA	**Total Direct, Indirect, Induced**	**Gross Output**	61,513	2,050
		GDP	31,521	1,051
		Employment	157,139	5,238

Appendix A: Detailed Results from the Economic Effects Assessment

Economic Effects of the Low Growth Scenario: Detailed Results

			NWT									CANADA					
			Direct			Total (Direct, Indirect, Induced)			Average Annual			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Pre-Construction	2019-20 to 2023-24	5	40	22	241	51	28	293	10	6	59	84	46	470	17	9	94
SGPASR	2024-25 to 2027-28	4	1,000	377	3,313	1,198	483	4,100	299	121	1,025	2,099	965	8,215	525	241	2,054
Medium gold mine (G1)	2035-36 to 2036-37	2	223	54	364	281	87	651	140	43	325	511	213	1,788	256	107	894
Small-to-Medium gold mine (G2)	2037-38 to 2038-39	2	161	39	262	202	62	469	101	31	234	368	154	1,287	184	77	644
Medium diamond mine (D1)	2037-38 to 2039-40	3	990	242	1,616	1,244	384	2,887	415	128	962	2,268	946	7,930	756	315	2,643
Small gold mine (G3)	2040-41 to 2042-43	2	128	31	210	161	50	375	81	25	187	294	123	1,029	147	61	515
Sub-Total		30	2,502	744	5,766	3,086	1,066	8,480	103	36	283	5,541	2,401	20,249	185	80	675
	Operation																
SGPASR	2026-27 to 2050+	25	311	117	1,030	373	150	1,275	15	6	51	653	300	2,555	26	12	102
Exploration Activity	2024-25 to 2050+	27	405	229	2,077	483	276	2,437	18	10	90	746	418	3,662	28	15	136
Medium gold mine (G1)	2037-38 to 2047-48	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355	5,058	2,789	10,934	460	254	994
Small-to-Medium gold mine (G2)	2039-40 to 2049-50	11	2,221	1,347	2,044	2,481	1,490	2,905	226	135	264	3,757	2,072	8,122	342	188	738
Medium diamond mine (D1)	2040-41 to 2050+	11	7,396	3,572	5,429	8,635	4,275	8,397	785	389	763	14,138	7,019	30,456	1,285	638	2,769
Small gold mine (G3)	2043-44 to 2050+	9	1,311	795	1,206	1,464	879	1,714	163	98	190	2,217	1,222	4,793	246	136	533
Sub-Total		30	14,634	7,874	14,537	16,774	9,076	20,637	559	303	688	26,570	13,820	60,521	886	461	2,017
Total		**30**	**17,136**	**8,618**	**20,303**	**19,861**	**10,143**	**29,118**	**662**	**338**	**971**	**32,111**	**16,221**	**80,770**	**1,070**	**541**	**2,692**

Notes: Gross Output and GDP are shown in $ millions. Employment is number of full-time equivalent jobs. Average Annual is calculated from the number of active construction or operations years, and for the sub-total and total, over the 30-year time period.

Economic Effects of the Medium Growth Scenario: Detailed Results

			NWT									CANADA					
			Direct			Total (Direct, Indirect, Induced)			Average Annual			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Pre-Construction	2019-20 to 2023-24	5	40	22	241	51	28	293	10	6	59	84	46	470	17	9	94
SGPASR construction	2024-25 to 2027-28	4	1,000	377	3,313	1,198	483	4,100	299	121	1,025	2,099	965	8,215	525	241	2,054
Medium gold mine (G1)	2030-31 to 2031-32	2	223	54	364	281	87	651	140	43	325	511	213	1,788	256	107	894
Medium diamond mine (D1)	2035-36 to 2037-38*	5	1,350	329	2,204	1,697	524	3,936	339	105	787	3,093	1,290	10,814	619	258	2,163
Small-to-Medium gold mine (G2)	2037-38 to 2038-39*	4	228	56	372	286	88	664	72	22	166	522	218	1,824	130	54	456
Small gold mine (G3)	2040-41 to 2042-43	2	128	31	210	161	50	375	81	25	187	294	123	1,029	147	61	515
Medium base metal mine (B1)	2040-41 to 2042-43	2	429	105	700	539	167	1,251	270	83	625	983	410	3,436	491	205	1,718
Sub-Total		30	3,358	953	7,163	4,162	1,398	10,976	139	47	366	7,502	3,219	27,106	250	107	904
	Production																
SGPASR maintenance	2026-27 to 2050+	25	311	117	1,030	373	150	1,275	15	6	51	653	300	2,555	26	12	102
Exploration Activity	2024-25 to 2050+	27	810	457	4,154	967	552	4,874	36	20	181	1,493	836	7,323	55	31	271
Medium gold mine (G1)	2032-33 to 2042-43	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355	5,058	2,789	10,934	460	254	994
Medium diamond mine (D1)	2038-39 to 2050+	13	8,572	4,140	6,292	10,007	4,955	9,732	770	381	749	16,386	8,136	35,299	1,260	626	2,715
Small-to-Medium gold mine (G2)	2039-40 to 2050+	12	2,318	1,406	2,133	2,589	1,555	3,032	216	130	253	3,922	2,162	8,477	327	180	706
Small gold mine (G3)	2043-44 to 2050+	9	1,311	795	1,206	1,464	879	1,714	163	98	190	2,217	1,222	4,793	246	136	533
Medium base metal mine (B1)	2043-44 to 2050+	9	3,826	2,386	6,371	4,515	2,821	10,069	502	313	1,119	6,826	3,958	18,064	758	440	2,007
Sub-Total		30	20,138	11,116	23,938	23,255	12,919	34,605	775	431	1,153	36,555	19,403	87,444	1,218	647	2,915
Total		**30**	**23,497**	**12,068**	**31,101**	**27,417**	**14,317**	**45,581**	**914**	**477**	**1,519**	**44,057**	**22,622**	**114,551**	**1,469**	**754**	**3,818**

Notes: Gross Output and GDP are shown in $ millions. Employment is number of full-time equivalent jobs. Average Annual is calculated from the number of active construction or operations years, and for the sub-total and total, over the 30-year time period. * denotes multiple construction time periods—in all cases, development that takes place after the initial construction period is assumed to occur over a two-year period at the end of the original mine life.

Economic Effects of the High Growth Scenario: Detailed Results

			NWT									CANADA					
			Direct			Total (Direct, Indirect, Induced)			Average Annual			Total (Direct, Indirect, Induced)			Average Annual		
	Construction	Years	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment	Gross Output	GDP	Employment
Pre-Construction	2019-20 to 2023-24	5	40	22	241	51	28	293	10	6	59	84	46	470	17	9	94
SGPASR	2024-25 to 2027-28	4	1,000	377	3,313	1,198	483	4,100	299	121	1,025	2,099	965	8,215	525	241	2,054
Medium gold mine (G1)	2030-31 to 2031-32	2	223	54	364	281	87	651	140	43	325	511	213	1,788	256	107	894
Small-to-Medium gold mine (G2)	2032-33 to 2033-34*	4	228	56	372	286	88	664	72	22	166	522	218	1,824	130	54	456
Small gold mine (G3)	2035-36 to 2036-37*	4	166	40	270	208	64	483	52	16	121	379	158	1,327	95	40	332
Medium diamond mine (D1)	2035-36 to 2037-38*	5	1,350	329	2,204	1,697	524	3,936	339	105	787	3,093	1,290	10,814	619	258	2,163
Medium diamond mine (D2)	2040-41 to 2042-43	3	990	242	1,616	1,244	384	2,887	415	128	962	2,268	946	7,930	756	315	2,643
Medium base metal mine (B1)	2040-41 to 2041-42	2	429	105	700	539	167	1,251	270	83	625	983	410	3,436	491	205	1,718
Small base metal mine (B2)	2045-46 to 2046-47	2	349	85	570	439	136	1,018	219	68	509	800	334	2,797	400	167	1,399
Sub-Total		30	4,735	1,289	9,410	5,892	1,933	14,989	196	64	500	8,873	3,791	31,898	296	126	1,063
	Production																
SGPASR	2026-27 to 2050+	25	311	117	1,030	373	150	1,275	15	6	51	653	300	2,555	26	12	102
Exploration Activity	2021-22 to 2050+	30	1,200	678	6,155	1,432	818	7,220	48	27	241	2,211	1,239	10,849	74	41	362
Medium gold mine (G1)	2032-33 to 2042-43	11	2,990	1,814	2,751	3,339	2,006	3,910	304	182	355	5,058	2,789	10,934	460	254	994
Small-to-Medium gold mine (G2)	2034-35 to 2050+	17	2,804	1,701	2,580	3,131	1,881	3,666	184	111	216	4,743	2,615	10,252	279	154	603
Small gold mine (G3)	2037-38 to 2050+	14	1,897	1,151	1,745	2,119	1,273	2,481	151	91	177	3,209	1,769	6,937	229	126	495
Medium diamond mine (D1)	2038-39 to 2050+	13	8,572	4,140	6,292	10,007	4,955	9,732	770	381	749	16,386	8,136	35,299	1,260	626	2,715
Medium diamond mine (D2)	2043-44 to 2050+	8	5,864	2,832	4,304	6,846	3,390	6,658	856	424	832	11,209	5,565	24,147	1,401	696	3,018
Medium base metal mine (B1)	2042-43 to 2050+	9	3,826	2,386	6,371	4,515	2,821	10,069	502	313	1,119	6,826	3,958	18,064	758	440	2,007
Small base metal mine (B2)	2047-48 to 2050+	4	1,314	820	2,188	1,551	969	3,458	388	242	865	2,344	1,359	6,204	586	340	1,551
Sub-Total		30	28,778	15,638	33,417	33,314	18,262	48,469	1,110	609	1,616	52,640	27,730	125,241	1,755	924	4,175
Total		**30**	**33,513**	**16,926**	**42,827**	**39,206**	**20,195**	**63,458**	**1,307**	**673**	**2,115**	**61,513**	**31,521**	**157,139**	**2,050**	**1,051**	**5,238**

Notes: Gross Output and GDP are shown in $ millions. Employment is number of full-time equivalent jobs. Average Annual is calculated from the number of active construction or operations years, and for the sub-total and total, over the 30-year time period. * denotes multiple construction time periods—in all cases, development that takes place after the initial construction period is assumed to occur over a two-year period at the end of the original mine life.