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July 3, 2022

Please accept Northwest Institute's submission to the British Columbia Environmental Assessment Office regarding Telkwa Coal Limited's proposed Tenas Project. Attached are two socio-economic reports. The first prepared by John Thompson of Watrecon Consulting is a critical review of the socio-economic assessment provided by the proponent in its application. The second report prepared by Dr. Chris Joseph of Swift Creek Consulting is a cost benefit analysis of the project.

As previously agreed, the third report we have commissioned will be submitted on July 4th. This report is a technical review of the mine plan and handling of waste rock and waste water.

Your sincerely,

P. Moss

Patricia (Pat) Moss
Executive Director

Proposed Tenas Coal Project: Critical Review of the Socio-Economic Assessment

1.0 Introduction

In June of 2022, the Northwest Institute and What Matters in Our Valley, both based in Smithers BC, asked Watrecon Consulting[1] to undertake a critical review of the socio-economic components of the environmental impact assessment prepared for the proposed Tenas coal project, which would be located seven kilometres southwest of Telkwa. The Telkwa Coal Company (TCL) is applying for approval to construct a mine and processing facility that would produce between 775,000 and 825,000 metric tonnes of metallurgical coal per year over a 26.5-year life of mine. TCL submitted a comprehensive environmental assessment of the project to the BC Environmental Assessment Office and the BCEAO has asked for comments on the application to be submitted by early July of 2022. For this analysis, Watrecon agreed to:

- Review the sections of the application dealing with project need and benefits (Part A and K of the Overview)
- Review the sections of the application dealing with economic issues (Section 5.1 and 5.2)
- Review selected sections of the application dealing with demographic and infrastructure issues (Sections 6.1 and 6.3)
- Identify any data gaps and any problems with the analyses and associated conclusions
- Identify a limited number of "major" issues that the group may want to submit to BCEAO
- Help the group prepare documentation for submission to BCEAO

This report was prepared by Watrecon following the review of the above-noted documents.

It should be noted that there is a very specific flow to doing socio-economic analysis. The analysis typically starts with an analysis of labour demand and supply, with the understanding that labour will come from three sources:

- The local area, which means local residents who are unemployed or underemployed and will need training in order to take advantage of the jobs being offered, but whose employment on the project may create job vacancies elsewhere in the local area that would be filled by others.

- People living outside the areas who will commute to the project area and will need temporary accommodation, such as a work camp or commercial accommodation, while they are employed and will thereby put some pressure on local infrastructure.

[1] Watrecon Consulting is an Edmonton-based company that has 45 years of experience assessing the economic and social dimensions of economic development in western and northern Canada. An overview of company experience is provided in Appendix A.

- People who choose to permanently relocate to the local areas, often bringing family with them, thereby causing population growth and an associated increase in demand for housing, infrastructure or services.

Thus, it is necessary to understand the assumptions about labour sourcing in order to understand the anticipated effects on demography, infrastructure and services.

2.0 Assessment

2.1 PROJECT NEED AND BENEFITS

2.1.1 Project Need

The assessment of project need is addressed in Section 7.0 of the Overview, which is titled "Alternatives to the Project". Project need is only discussed in terms of how the project would help address global demands for seaborne metallurgical coal (defined as hard coking coal, semi-soft coking coal (SSCC) and PCI coal). It is argued that coal from the project would allow Asian steel mills to diversify their supply away from Australian coal mines and Canadian mines are seen as a more reliable source of supply. At the time the application was written, project need was based on the observation that no other mines were producing medium volatile SSCC in Canada and that there was growing global demand for seaborne metallurgical coal in the near future, especially in China and India. It should be noted, however, that the demand projections for metallurgical coal were based on 2018 data and market conditions have changed substantially since then.

KEY OBSERVATION: The discussion of Project need is based on 2018 coal market projections and this needs to be revisited in the context of current global demands.

2.1.2 Project Benefits

Section 3.0 of the Overview contains a description of Project Benefits which is described in terms of employment and labour income during all four phases of the project: construction, operation, decommissioning and reclamation, and closure. The analysis looks at direct project employment as well as indirect and induced effects. The analysis also describes benefits in terms of cumulative government revenues over the life of the project (Section 3.8).

The analysis of project need is couched in terms of the ability to produce coal from the proposed Tenas project at a very low cost. Figure 7.2-4 shows a production cost per tonne for the Tenas Project ranging between $50 and $100 US per tonne over the life of the project and Section 3.0 shows the annual construction and operating costs over the proposed life of mine. It should be noted that the analysis is based on 2019 estimates (with some inclusion of 2020 cost information although this is not specified). With global financial conditions having changed over the last two years, it must be questioned whether the project cost estimates can still be considered reliable. For example, Table 3.10-1 notes that the financial analysis assumed an average price of $0.80

per litre of diesel fuel, while the current prices of diesel in BC is currently more than $2 per litre (a 250% increase). And with direct purchases of diesel fuel and lubes accounting for 8% of annual operating costs, the much higher cost of diesel could have a huge effect on the projects' financial viability and revenue requirements. To ensure the validity of the discussion of project benefits, it is essential that a revised cost estimate be provided that factors in current (not 2019) prices.

> **KEY OBSERVATION**: The discussion of Project benefits is based on 2019 input prices, some of which have changed significantly in recent years, so a revised assessment based on current costs is required to ensure the discussion of relevant project benefits is still valid, as this will affect a public interest decision.

What is missing from the application, however, is a discussion of the expected revenues and coal prices that would be needed to make the mine profitable. The government revenue estimates are derived from a financial feasibility study, which is not publicly available, but without knowing the coal price assumptions used in the model it is not possible to determine, with any certainty, whether these revenue estimates are in any way reliable. If BCEAO is expected to make a public interest determination that compares the project's adverse environmental and socio-economic effects to its public benefits, then knowledge of the coal prices required to make the project economically viable are essential.

> **KEY OBSERVATION**: It is not possible to test the validity of the estimates of project benefits without knowing what coal prices were assumed in assessing financial feasibility. This is a significant deficiency in the application and the Applicant must provide these coal price assumptions in order to be able to truthfully and transparently understand the economic merits of then proposed project.

2.1.3 Project Expansion

In a 2021 presentation by Allegiance Coal Limited, the production plan for the Tenas mine was described as being 750,000 clean metric tonnes per annum (ctpa) ramping up to 1.35 million ctpa by year 5. While the application by TCL is for an annual production rate of between 750,000 and 825,000 metric tonnes per year, a production rate of 1.35 million metric tonnes is clearly beyond the scope of the existing application. Furthermore, Section 7.4 of overview specifically states:

> As part of the alternative review process, various production rates were reviewed and as per 6.4.3, the final selected rate for the Project was 775,00 to 825,000 metric tonnes of processed coal produced per annum which was based on a consideration of:
>
> - cost effectiveness;
> - community effects and input including human health; and.
> - minimize or avoiding effects on the natural environment.
>
> The production rate alternatives were not expected to have effects on the following performance objectives:
>
> - be technically applicable, with system integrity, and reliability.

> In summary a production rate of approximately 800,000 metric tonnes of processed coal per annum, was selected as the preferred option.

Thus, ant TCL plans to expand production to 1.35 million tonnes per year directly contravenes the conclusions of the application with respect to an 800,00 tonne per year operation having the preferred levels of socio-economic and environmental impacts.

> **KEY OBSERVATION**: Expanding production to 1.35 million tonnes per year directly contradicts the Company's conclusions about the preferred option in terms of environmental and socio-economic effects.

2.2 METHODOLOGICAL ISSUES

There are two fundamental methodological issues associated with the assessment of the project's economic and social effects. These relate to the boundaries of the LSA and RSA and related analysis, and the outdated socio-economic baseline data upon which the application was based.

2.2.1 LSA Boundaries

For both the analysis of both the economic (Section 5) and social/infrastructure (Section 6) parts of the application, the Local Study Area (LSA) was defined as:

> The LSA comprises the Village of Telkwa, Town of Smithers, the District of Houston, and the community of Witset (formerly Moricetown).

These communities are shown in Figure 1 and were considered to be part of the LSA because of their relatively close proximity to the project such that commuting to the project would involve a one-way travel time of half an hour or less. As described in Table 4.25 of Section 6.1 of the Application, these communities had a combined population of 10,352 people in 2016.

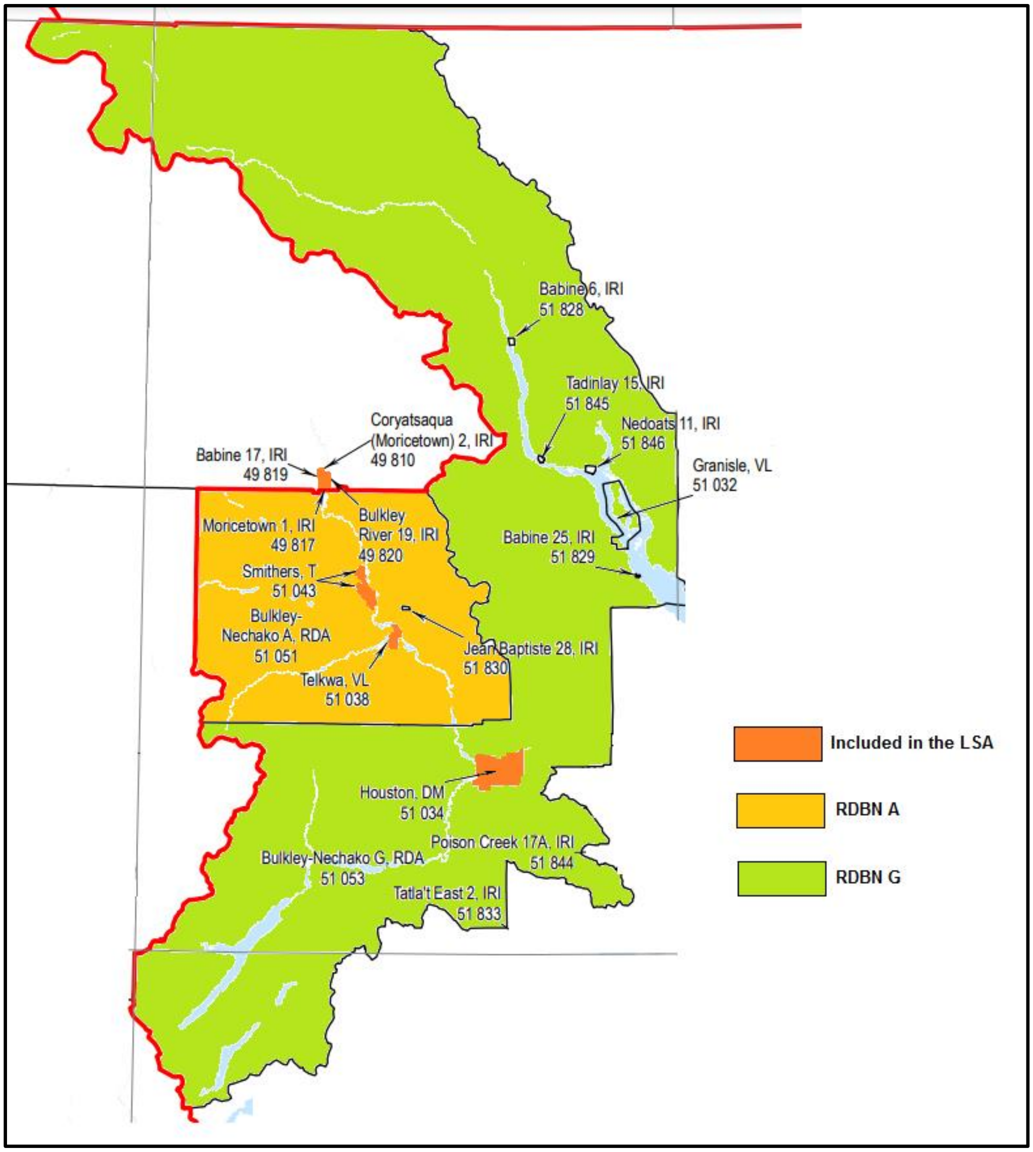
There are two problems with the LSA boundaries. The more important problem is that the communities included in the LSA definition are only the urban communities, such that residents of the rural population of the area (people living in the Bulkley-Nechako A Regional District [RDBN A] outside the listed communities and also shown in Figure 1) appear to have been precluded from most of the analysis. Based on the LSA definition, this means that someone who could live adjacent to the mine site, but outside the Village of Telkwa, was omitted from the LSA and subsequent analysis of project impacts,

However, as per page 34 of Section 5.1 (Labour Market Valued Component), it is noted that 90% of operational workers would be sourced from the LSA (including RDBN A <u>and RDBN G</u>, which is also shown in Figure 1). This is very inconsistent and confusing. The labour force analysis includes the assumption that some rural residents (RDBN A and RDBN G) would be

> **KEY OBSERVATION**: The choice of LSA is significantly flawed because it excludes people who live in rural areas in the vicinity of the proposed mine site and only includes residents of the four nearby urban communities, yet those people were included in the assessment of labour effects but excluded from the analysis of other socio-economic VCs.

hired for operations but those people are not included in the assessment of impacts on demography or infrastructure because they are not part of the LSA definition used in the analysis.

Figure 1: LSA Boundaries and Rural Areas Precluded from the LSA Definition



A second problem with the LSA definition is the statement that the LSA includes boundaries that are within a half hour commute from the mine site. A Google maps analysis indicates that people living in Witset (Moricetown) face a 38-minute commute to Telkwa while Houston residents face a 32-minute commute to Telkwa. This does not include travel time from Telkwa to the mine site. Thus, according to their definition, Smithers and Telkwa are the only two urban communities that should fall within the LSA.

The failure to properly define the LSA is not a fatal flaw in the assessment because drawing available human and other resources from a larger baseline population could reduce the magnitude of the effect in relative terms. The problem is that the assessment paints an incorrect picture of the region and cannot be relied as the basis for the analysis.

2.2.2 Out of Date Socio-Economic Information

The analysis of project effects was undertaken using a socio-economic baseline that was based largely on the 2016 census. This information is very out of date and, although the full results of the 2021 census have not yet been released, the 2021population counts that have been released show some important trends that need to be factored into a revised assessment of socio-economic effects.

Table 1 shows the population counts for 2021 as well as 2011 and 2016 for the communities in the LSA and the corrected LSA (with RDBN A) as well as the rate of population change. It shows that the population of Smithers and Witset declined between 2016 and 2021 while there were small population increases in Telkwa and Houston. The overall effect was a slight population increase (146 people) in the LSA, with most of this increase occurring in Telkwa. When the LSA boundaries are amended to include the rural population in RDBN A, there was a net population increase of 477 people between 2016 and 2021with population change in RDBN A accounting for nearly 755 of the increase. Overall, the population of the LSA did not change much between 2016 and the data in Table 1 by themselves are not expected to have a significant impact on the conclusions of the socio-economic assessment of the Project.

Table 1: LSA Population 2011 to 2021

	Population			Population Change		
Community	**2011**	**2016**	**2021**	**2011-2016**	**2016-2021**	**2011-2021**
Telkwa	1,350	1,327	1,474	-1.7%	11.1%	9.2%
Smithers	5,404	5,401	5,378	-0.1%	-0.4%	-0.5%
Houston	3,147	2,993	3,052	-4.9%	2.0%	-3.0%
Witset	560	631	594	12.7%	-5.9%	6.1%
LSA	**10,461**	**10,352**	**10,498**	**-1.0%**	**1.4%**	**0.4%**
RDBN A	5,391	5,256	5,587	-2.5%	6.3%	3.6%
Revised LSA	**15,852**	**15,608**	**16,085**	**-1.5%**	**3.1%**	**1.5%**

However, the important question to ask is: in what way is the population changing? Part of the answer can be found in Table 2. It shows that, based on the limited 2021 census data available at the present time, much of the observed small increase in the LSA population is due to a growing aging population that more than offset a decline in the number of people of normal working age (aged 15 to 64 years). Between 2016 and 2021 there was a net loss of 270 people in that age group in the LSA, with much of the decline occurring in Smithers. For the corrected LSA, which includes the rural population in RDBN A, the net decline in people of normal working age was lower (185 people) because there was an increase in the number of people of working age in RDBN A.

Table 2: Changes in the Age of the LSA Population 2016 to 2021

Community	Number of People Aged 15 to 64			Percent of the Population			
				Ages 15 to 64		Ages 65 and Older	
	2016	2021	Change	2016	2021	2016	2021
Telkwa	965	935	-30	67.3%	63.4%	10.2%	12.9%
Smithers	3,595	3,415	-180	66.0%	63.5%	15.8%	18.3%
Houston	1,930	1,945	15	65.1%	63.7%	14.0%	16.0%
Witset	450	375	-75	67.7%	63.6%	9.4%	14.4%
LSA	**6,940**	**6,670**	**-270**	**66.1%**	**63.5%**	**14.2%**	**16.7%**
RDBN A	3,440	3,515	75	62.9%	62.9%	13.8%	16.5%
Revised LSA	**10,380**	**10,185**	**-195**	**66.2%**	**63.3%**	**13.8%**	**16.6%**

Table 2 also shows that the percentage of people in the LSA and revised LSA aged 65 and older increased from about 14% of the population in 2016 to about 16.5% in 2021.

All of the predictions of project impacts on employment, population and infrastructure in the LSA are predicated on the assumption that there is sufficient capacity in the local labour force to account for 61% of direct construction labour (83.4 FTEs) and up to 131 of the 145 total operational jobs. While it is not clear how the capacity determination was made based on available 2016 information, it is important that this assumption be tested to account for changes in the age and composition of the local labour force as of 2021. It should be noted that the release date for the 2021 census related to employment and labour force is November 30, 2022.

It is essential that a re-evaluation of the assumptions related to the labour force be undertaken when the 2021 census results are released. While federal and provincial governments have continued to provide labour force and unemployment data since 2016, the data are reported for the North Coast and Nechako Region which is a very large area such that the results may not be applicable to the communities in the LSA. The only source of employment data for an area the size of the LSA is the census.

KEY OBSERVATION: The conclusions about the impacts of the project on socio-economic conditions in the LSA were based on conditions at the time of the 2016 census and there have since been important changes in the overall size and age structure of the LSA population. The validity of the conclusions about project effects need to be re-examined using the results of the 2021 census.

2.2.3 Failure to Address Job Losses as a Result of Mine Closure

A very significant omission from the assessment of labour market impacts is that there is no mention of the potential adverse effects of mine closure. The discussion of the effects of the decommissioning and reclamation phase of the project (Section 5.2.1.4 of Section 5.1 of the Application) describes the positive effects in terms of labour (30.6 FTEs in year 22) for decommissioning and 18.2 FTEs during years 23 to 25 for reclamation. No where in the assessment is there a discussion of what the loss of 145 operational jobs would have on the local or regional labour market, nor is there a discussion of potential options that the company would be prepared to take to mitigate for these losses.

It is ironic that the application promotes the project on the basis of the new, long-term operating employment at the mine but fails to address the question of what happens to that employment when the mine ceases operation. It is the very nature of the mining industry that mine closure is inevitable. While it may not possible to establish a list of specific mitigative actions in the application that will ultimately prove to be effective when the mine closes some 22 years in the future, the mining industry and various governments around the world have accepted the concept of "planning for closure"[2]. Various objectives and principles have been developed to guide this process. One of the key principles is communication and consultation with stakeholders to ensure that the interests of all potentially-affected parties are considered in mine closure plans. Another key principle is the establishment of a set of indicators that can be used to assess the successful completion of the closure process. A third principle is that closure planning requires regular and critical review to ensure that the plan reflects changing circumstances.

The failure to discuss the adverse effects of mine closure and an associated mine closure mitigation strategy is a major deficiency in the application and needs to be addressed before the application can be deemed complete. The Applicant should be required to amend its application to properly address mine closure before the regulatory process can continue.

KEY OBSERVATION: The application fails to address the adverse effects of mine closure on the labour market VC or the demography and infrastructure VCs, nor does it provide a strategy or show a commitment for mitigating these effects. The application should be deemed incomplete until this omission is adequately addressed.

2.3 ECONOMIC ISSUES

2.3.1 Cost of Labour

The project economics and benefits were developed using various assumptions about the average cost of labour for all four phases of the project. As shown in Table 3.4-1 of the Overview, an average cost of $94,613 (average all-in salary) was assumed for the operations phase. Additional information on operational labour costs is provided in Table 3.4-6 of the Overview which shows the number of direct FTE jobs created in the RDBN and the associated wages and salaries. Analysis of this information shows an average of 138.4 FTEs per year over the 22 years of operation with average wages and salaries of $94,400. It is assumed that labour costs are expressed in 2019 Canadian dollars.

There are some questions about these numbers, however. The numbers show the average wages and salaries per FTE as being $94,400 while the average all-in salary, which typically includes benefits, was only slightly higher ($94,613), which suggests average benefits per FTE of only $213 per FTE or 0.2% of wages and salaries. For comparison, Statistics Canada produced

2 Australian and New Zealand Minerals and Energy Council. 2000. Strategic Framework for Mine Closure. Access April 10, 2008 at http://www.doir.wa.gov.au/documents/environment/Shed_env_guide_closure.pdf.

economic multipliers for 2018 which showed that, for the BC coal mining industry, for every $1.0 million in revenues, wages and salaries accounted for $121,000, with employers' social contributions being another $21,000 (equivalent to 17% of wages and salaries) and this would result in 0.915 FTE jobs. Thus, the average remuneration for workers in the BC coal industry in 2018 was $132,240 without benefits and $155,191 with benefits.

The difference between the numbers in the analysis is quite striking, with average wages and salaries to be paid at the Tenas mine being 71% of the provincial average for people employed in the coal mining industry. This drops to 61% when the employer's social contributions (benefits) are included. The reasons for these differences are unknown. Part of the difference may be due to how the labour costs were calculated. If the BCIOM was used to estimate labour, wages and salaries per unit of output (sales revenues) based on projected revenues, this should not result in large differences because the BCIOM and the Statistics Canada models use the same data sets. The other approach to calculating labour income and employment is to override the models and input project-specific data, in which case Telkwa Coal Limited is claiming that it can operate its mine by paying wages that are only 60% to 70% of the provincial average. It may be that regional workers are willing to mine coal at wage rates that are well below the provincial average; this issue has not been discussed in the socio-economic assessment. However, if workers demand wages and benefits that are closer to the provincial average, this will have a significant effect on the project's financial viability because, as calculated, direct labour costs will account for 29% of total operating costs.

KEY OBSERVATION: Project operating labour costs are projected to be about 60% to 70% of average labour for coal mines in BC. There is no indication that regional workers will work at these rates. If the company has to pay labour costs that are more in line with the provincial average, this will adversely affect its financial feasibility.

2.3.2 Sourcing of Labour

2.3.2.1 Construction Phase

There is conflicting information about construction phase employment. Both Section 3.4.1 of the Overview Section and Section 5.2.1.2 of Section 5.1 talk about 127.9 FTEs of construction labour during the first two years of construction, consisting of 118.3 FTEs of contractor labour and 9.6 FTEs of TCL employees) with another 9.0 FTEs of construction labour during Year 1 of operation. However, the direct employment impact in BC during construction, based on the BC input/output model (BCIOM) as per Table 5.2-1 of Section 5.1 shows 295.8 FTEs, consisting of 160 FTEs in the Regional District of Bulkley Nechako (the RSA) and 135.8 FTEs in the rest of BC. Both numbers cannot be correct. The problem may lie in the interpretation of direct effects, with the definition (page 31 of Section 5.1) including "the direct TCL employees and direct Project contractors, as well as other direct positions that the BC IOM estimated for direct supplier industries". Based on this, it would appear that BCIOM is estimating 167.9 FTEs of other direct employment to arrive at a total of 295.8 FTEs. This problem carries over into the estimates of labour income during employment with Section 5.2.1.2 reporting a total of

$13.6 million ($12.4 million for contractors and $1.2 million for TCL employees) while the BCIOM results (Table 5.2-1) shows a total of $25.4 million, a difference of $11.8 million.

The information contained in the assessment raises serious doubts about the validity of the construction labour and labour income estimates. The observed differences may be an attempt to reconcile actual direct employment and labour costs estimates provided by the company with an estimate generated by the BCIOM which is for an "average" construction project for the base year of the model. If the BCIOM model results are being used as the basis for describing project benefits, then all of the benefits numbers may be suspect because of how the project was modelled. Consequently, the contents of Table 5.2-1 be ignored completely.

KEY OBSERVATION: There is a major inconsistency between the direct construction labour and labour income reported by the company and the results of the BCIOM that raises serious questions about how the construction phase of the project was actually modelled. The proponent must be asked to explain those differences or alternatively the results of the BCIOM need to be ignored.

According to Section 5.2.2.1 of Section 5.1 of the Application (the Labour Market analysis), during construction "Close to 60% of these positions are expected to be filled by local workers (from the LSA, RDBN A, and RDBN G)". After a review of the educational and employment characteristics of LSA residents, using 2016 data (which is now out of date), the analysis concludes that there is "a sufficient pool of unemployed workers in the LSA, RDBN A and RDBN G to fill Project construction jobs designated for the local workforce" (page 43). However, there is no discussion of how the 60% "**designation**" for residents of the LSA (plus RDBN A and RDBN G) was actually determined.

Section 6.1 further elaborates on the percentage of the local residents that would be hired during construction. It examines three scenarios, including a base assumption of 60% local, but also considers options of 30% or 90% local. This is problematic because the analysis concludes in Section 5.1 that there would be no potential for wage inflation with 60% local hiring but does not contain any observations about potential impacts for the 30% and 90% local hiring scenarios assumed in Section 6.1. Consequently, the analysis of labour effects in Section 5.1 is incomplete and inconsistent with the analysis contained in Section 6.1

KEY OBSERVATION: The assessment of impacts on the labour market VC (Section 5.1) only examines the effects of 60% local hiring during construction but the assessment of impacts on the demographic VC (Section 6.1) considers the effects of 30%, 60% and 90% local hiring. This is inconsistent such that Section 5.1 needs to be redone to examine all three scenarios used in Section 6.1.

There is another problem with the analysis, however. The analysis correctly observes that the number of people to be directly working on the project (jobs) will be higher than the actual amount of labour required to complete construction (FTEs). However, the analysis of what that will mean in terms of changes in number of local residents to be hired (including the associated effects on demographics and infrastructure) is focused on FTEs when it should be based on the number of people actually employed in construction. The assumptions about residency are based on 137 FTEs whereas, as shown in Figure 5.2-1, the number of workers could be as low as 40 during the first quarter of Year 0 and between 160 and 186 during the third quarter, with the typical number of workers being 70 (Section 5.2.2.1 of Section 6.1).

Overall, the analysis of the number of LSA residents to be employed during construction is very confusing. The application says 60%, and, based on the FTEs (over the entire construction period), this would be 82 residents of the LSA (and RDBN A and RDBN G). However, using the two additional scenarios in Section 6.1, this could actually range from 41 to 140 FTEs (see Table 3). But, in terms of jobs at any one time, the number could range from 21 to 63 under typical conditions to 56 to 167 people under peak conditions.

Table 3: Possible Number of LSA Residents Employed during Project Construction

	FTEs		Jobs	
Scenario	**Low**	**High**	**Typical**	**Peak**
60% Local	82	n.a.	42	112
30% Local	41	60	21	56
90% Local	123	140	63	167

So, as shown in Table 3, the number of construction workers to be hired from the local area could range from 21 to 167 at any point in time, depending on the monthly construction schedule, and the analysis of impacts on labour markers needs to be revised to consider this range.

KEY OBSERVATION: The analysis of potential project requirements for labour during construction needs to be recalculated in terms of numbers of jobs, rather than in terms of FTEs, in order to gain a clearer understanding of requirements for local labour and the associated impacts on labour markets and wage inflation and to provide a better understanding of potential effects on demography and infrastructure.

2.3.2.2 Operation Phase

Section 5.2.1.3 of Section 5.1 of the application notes that an average of 145 people will be employed at the mine during operations with 60 people working on site during any one shift. It also notes that 90% of operational workers (131 of 145) are expected to be hired from the LSA, including RDBN A and RDBN G. It then speculates that, over time, all workers will be expected to relocate to the LSA in order to reside closer to the project. It also notes that an additional 17 contractors could be employed for coal haul and load out/

There is no rationale for how the 90% estimate was selected. Given the absence of anyone in the RDBN having been employed in the coal mining industry in 2016 (see Table 4.2-5), this assumption appears optimistic. And, while some of the operational jobs do not require specialized skills, such as trucking (see Figure 5.2-3 in Section 5.1 of the Application for the mix of operational employment), other jobs, such as mine support, technical and supervisory and plant operations, are quite specialized. Given that one of the labour market VCs selected for analysis is the potential for increased competition for skilled local and regional workforce, it is reasonable to assume a worst-case scenario (a high percentage of local hires) for the analysis. However, for the basis of the rest of the analysis, a more in-depth assessment of the potential for local hiring should have been presented.

Again, the analysis of demographic effects (Section 6.1 of the Application) uses different assumptions about local hiring during operations. According to Section 5.2.2.2 of Section 6.1, 75% of the workforce will be withdrawn from the LSA, not 90%, and there is no mention of workers being drawn from RDBN A or RDBN G. Curiously, the number of local hires (130) is the same in both Sections 5.1 and 6.1 of the Application, suggesting that, according to Section 6.1, there will be 173 operational workers, about 30 more than stated in Section 5.1, but perhaps this includes indirect and induced employment in the LSA. This inconsistency in numbers is confusing, especially since TCL will have no control over where indirect and induced employment is sourced. Furthermore, the demographic analysis uses local employment scenarios that are not found in the labour market analysis. It assumes a conservative estimate of 60% local hires (or 102 workers) as well as a 90% option (153 workers). So, according to Section 6.1, the number of local residents hired for operations could range from 102 to 153, but Section 5.1 uses 130 workers. Thus, in assessing the potential for increased competition for skilled local and regional workforce as part of the labour force VC, the worst-case scenario should have been 153 not 130.

Clearly, there are inconsistencies between Sections 5.1 and 6.1 of the Application in terms of assumptions about the number of workers to be hired locally and it could be concluded that using a more modest assumption about local hires in the labour force analysis could have specifically been done to ensure that there would be no significant adverse effects. Given that baseline labour markets in the region have changed since the 2016 census, is recommended that both Sections 5.1 and 6.1 be redone to use consistent assumptions and to confirm that there would be sufficient local residents interested in mine-related employment to support those assumptions.

KEY OBSERVATION: Sections 5.1 and 6.1 of the Application use different assumptions about the percentage and number of local residents to be hired during operations. The analysis needs to be redone to eliminate this inconsistency and in the context of current labour market conditions to ensure that the assumptions about local hiring are realistic.

2.3.2.3 Decommissioning and Reclamation Phase

As noted previously, the analysis focuses on the number of people and labour income that would be hired to undertake decommissioning and reclamation but does not address the loss of 145 to 173 operational jobs when the mine closes.

2.3.2.4 Cumulative Effects

Section 6.0 of Section 5.1 of the Application identifies numerous proposed projects that could, if underway at the same time as this project, result in cumulative effects. This list is likely out of date, but also contains no information whatsoever on the potential labour demands associated with any of these projects. This makes it impossible to conclude as to whether the employment demands of the Tenas project could lead to adverse cumulative effects on local or regional labour market conditions. This is a major deficiency that could be addressed by using the current BC Major Projects Inventory to update the list of projects and to undertake investigations as to the labour (construction and operational) associated with each one, especially for those projects that would be targeting the same portions of the labour force (mining and construction projects).

KEY OBSERVATION: The assessment of cumulative effects arising from competing demands for local and regional labour is out of date and incomplete and needs to be revisited to ensure that there will be no adverse cumulative effects on the local or regional labour force.

2.4 DEMOGRAPHIC AND INFRASTRUCTURE ISSUES

Many of the problems inherent in the assessment of project effects on demography and infrastructure have already been identified. These include the definition of the LSA excluding the rural population and baseline socio-economic conditions having changed substantially since 2016. However, there are additional problems.

2.4.1 Construction Phase

The biggest issue for the construction phase is that workers brought in from outside the LSA will require accommodation. According to Section 5.2.2.1 of Section 6.1, "The Project plans to contract a block of up to 70 short-term accommodation rooms available in the LSA communities of Smithers and Houston during the 1.5 year Construction Phase, thereby eliminating the need for a Project work camp or Fly-In-Fly-Out (FIFO) arrangements." And, according to Section 6.3 of the Application, TCL has confirmed that there are 13 establishments with 197 rooms in Houston and Smithers such that their workers would require 33% of available rooms.

There are two problems with the analysis. First, the analysis in Section 5.2.2.1 of Section 6.1 of Application is misleading because it describes effects in terms of FTEs over the entire construction period whereas demographic effects need to be assessed in terms of numbers of people. Table 4 describes the number of non-resident workers during a typical month of construction as well as during peak periods, for each of the three scenarios used to assess demographic effects. Based on this information, it would appear that 70 rooms would be adequate to support non-resident workers under the 60% and 90% local workforce scenarios. But, under the 30% scenario, as many as 130 rooms would be required, and this would represent 66% of the available supply. It is noteworthy that the assessment of significance of effects only considered the 60% scenario.

Table 4: Possible Number of Non-Residents Employed during Project Construction

	LSA Residents		Non-Residents	
Scenario	**Typical**	**Peak**	**Typical**	**Peak**
60% Local	42	42	28	74
30% Local	21	21	49	130
90% Local	63	63	7	19

The second problem relates to project timing. Figure 5.2-1 of Section 5.1 of the Application shows the month by month demand for construction workers, with the peak demands occurring in the summer months of Year 0. This means that TCL would be requiring between 33% and 66% of total available rooms during peak tourist season. This is not insignificant, because commercial accommodation typically relies heavily on summer bookings for revenues so any limitations on availability of that accommodation to tourists in one year could result in adverse effects on regional tourism that could last for years. This effect could be mitigated by shifting the peak season of construction to the winter months if possible. But more discussions with owners of commercial properties about the seasonality of the project's accommodation demands are required if the true effects on temporary accommodation are to be fully understood.

If those discussions reveal that providers of commercial accommodation are unlikely or unable to provide the 70 to 130 rooms during the peak summers season of construction, TCL will have to develop an alternative strategy for accommodating its non-resident workforce. This may require the provision of a camp, and the potential implications of this, in terms of possible effects on the community and on the financial feasibility of the project, are not addressed in the current application.

KEY OBSERVATION: The assessment of demands for commercial accommodation during construction needs to be revised since project demands could require as much as 66% of the available supply during the peak tourism season.

2.4.2 Operation Phase

For the operations phase, the most important consideration is the number of workers who will choose to move into the LSA from outside the region, potentially bringing family members, and their demands for housing, infrastructure and services. As stated in Table 5.2-2 of Section 6.1, the population of the LSA could increase by between approximately 50 to 200 people. According to Section 6.3 of the Application, this could result in demands for up to 68 residential units in a housing market that, at the time of the assessment, was considered "limited". Furthermore, the anticipated arrival of up to 30 children under the age of 15 could stress school capacity in Telkwa (but not Smithers or Houston) and could stress the provision of child care services. There is presumed to adequate capacity in the water and sewage infrastructure to accommodate such a population increase and there was also believed to sufficient health care capacity in Smithers. The Application also notes that taxes paid to various levels of government should assist in paying the costs of additional demands for services.

In general, the picture painted in the Application for the operations phase seems reasonable based on the baseline conditions at the time the application was prepared. However, much of the housing information was based on the 2016 census and could be considerably out of date by now. However, the biggest question, and it is impossible to answer, is where incoming workers and their families will choose to live. If they distribute themselves throughout the LSA, then the description of project effects may be correct. On the other hand, if the workers choose to locate in one specific community, their demands could exceed the capacity of that community. There can also be concerns that, if the demand for new housing results in the creation of a new subdivision that consists almost entirely of project workers and their families, this can lead to polarization of the community (old houses versus new, mine workers versus non-mine workers, younger population versus older population) which has happened in other communities and is not healthy. This problem can be addressed by including a provision in the mitigation section for housing (Section 5.3.3 of Section 6.3) that commits the proponent to work with developers and local governments to ensure that new workers and their families are distributed throughout the LSA and not concentrated in a single subdivision in single community.

> **KEY OBSERVATION**: While the assessment of effects during operation on demographics and infrastructure may be reasonable if the incoming workers and their families choose to locate throughout the LSA, issues could arise if all the demands are placed on one or two of the urban communities. TCL needs to work with local governments and developed to ensure this doesn't happen.

The comments that taxes paid to governments by TCL will held address the extra costs that incoming workers and their families of will impose on communities in the LSA is not entirely true. According to Table 3.8-1 of Section 1.0 Overview, TCL expects to pay a total of $13.7 million in property taxes to the Regional District of Bulkley Nechako. While this may offset some of the increased costs faced by the Regional District, TCL will not be paying any form of taxes to the individual urban communities in the LSA which typically are saddled with the costs of providing services to both urban and rural residents. This situation has caused major issues related to oil development in Alberta where rural communities get the money and the urban communities bear the costs.

2.4.3 Decommissioning and Reclamation Phase

Section 5.2.2.3 correctly observes that mine closure could result in a small population loss with this would be small in the context of population forecasts for the RSA. There is no mention of the effect of a population decline on conditions in the LSA. In addition, there is no discussion of how mine closure and an associated population decline might affect on housing or housing prices in the LSA or RSA.

> **KEY OBSERVATION**: The assessment fails to consider how mine closure could result in out-migration from the LSA and the resulting changes in housing availability or demands on infrastructure.

3.0 Overall Observations

Overall, the socio-economic assessment of the proposed Tenas Project provides a reasonable, but sloppy and dated picture of how the project could affect the community. It is sloppy in that:

- Although the LSA boundary precludes the rural portion of the regional population (residents of RDBN A), the analysis often includes the rural populations of both RDBN A and RDBN G.

- The scenarios used in the assessment of demographics and infrastructure are not the same as was used in the assessment of effects on labour force. The assessment looks at labour effects in terms of FTEs when it should be assessing impacts in terms of jobs and number of workers.

It is dated because the baseline assessment for the project and for the cumulative effects assessment is based on old information. The baseline relies primarily on the results of the 2016 census and what little 2021 census information that has been released shows that there have been some important changes in the demographic make up of the LSA and surrounding rural population. Furthermore, the list of reasonably foreseeable projects upon which the cumulative effects assessment was based is also out of date and incomplete. Consequently, it is questionable as to whether all the conclusions in the socio-economic components of the assessment can still be considered accurate and a reinvestigation should be undertaken to see if anything has significantly changed. This does not mean that the assessment needs redoing, it just means that some of the key baseline data and related assessment conclusions need to be double checked once the full census results are released at the end of November.

The biggest problem with the entire socio-economic assessment is that there is almost no mention of the adverse effects of mine closure on labour, demography or any of the other socio-economic VCs. It has been standard practice in all of the mine-related EIAs that I have done to discuss the adverse effects of closure and to commit to working with the local community to build a mine closure plan to address foreseeable circumstances. This is "best practice" in the mining industry and the omission of a discussion of the adverse effects of closure is a major deficiency of the application. If mine employment is touted as a major benefit of the project then mine closure would represent a significant adverse effect of the project and it needs to be addressed in the overall mitigation plan.

However, the greatest overall problem with the entire application is that no proof has been offered that shows the project is financially viable. While there is considerable information on costs, there is no information on markets, expected prices or revenues. And, with recent increases in world oil prices and fuel costs and the shift away from coal, the conditions that made this project seem viable back in 2019 may no longer exist. It makes no sense for regulators to be deciding on the conditions under which a project should proceed without them knowing that the proposed project was and remains financially viable given changing world economic conditions.

SUMMARY OF KEY OBERVATIONS

PROJECT NEED AND BENEFITS

- The discussion of Project need is based on 2018 coal market projections and this needs to be revisited in the context of current global demands.
- The discussion of Project benefits is based on 2019 input prices, some of which have changed significantly in recent years, so a revised assessment based on current costs is required to ensure the discussion of relevant project benefits is still valid, as this will affect a public interest decision.
- It is not possible to test the validity of the estimates of project benefits without knowing what coal prices were assumed in assessing financial feasibility. This is a significant deficiency in the application and the Applicant must provide these coal price assumptions in order to be able to truthfully understand the economic merits of then proposed project.
- Expanding production to 1.35 million tonnes per year directly contradicts the Company's conclusions about the preferred option in terms of environmental and socio-economic effects.

METHODOLOGICAL ISSUES

- The choice of LSA is significantly flawed because it excludes people who live in rural areas in the vicinity of the proposed mine site and only includes residents of the four nearby urban communities, yet those people were included in the assessment of labour effects but excluded from the analysis of other socio-economic VCs.
- The conclusions about the impacts of the project on socio-economic conditions in the LSA were based on conditions at the time of the 2016 census and there have since been important changes in the overall size and age structure of the LSA population. The validity of the conclusions about project effects need to be re-examined using the results of the 2021 census.
- The application fails to address the adverse effects of mine closure on the labour market VC or the demography and infrastructure VCs, nor does it provide a strategy or show a commitment for mitigating these effects. The application should be deemed incomplete until this omission is adequately addressed.

ECONOMIC ISSUES

- Project operating labour costs are projected to be about 60% to 70% of average labour for coal mines in BC. There is no indication that regional workers will work at these rates. If the company has to pay labour costs that are more in line with the provincial average, this will adversely affect its financial feasibility.
- There is a major inconsistency between the direct construction labour and labour income reported by the company and the results of the BCIOM that raises serious questions about how the construction phase of the project was actually modelled. The proponent must be asked to explain those differences or alternatively the results of the BCIOM need to be ignored.
- The assessment of impacts on the labour market VC (Section 5.1) only examines the effects of 60% local hiring during construction but the assessment of impacts on the

demographic VC (Section 6.1) considers the effects of 30%, 60% and 90% local hiring. This is inconsistent such that Section 5.1 needs to be redone to examine all three scenarios used in Section 6.1.

- The analysis of potential project requirements for labour during construction needs to be recalculated in terms of numbers of jobs, rather than in terms of FTEs, in order to gain a clearer understanding of requirements for local labour and the associated impacts on labour markets and wage inflation and to provide a better understanding of potential effects on demography and infrastructure.
- Sections 5.1 and 6.1 of the Application use different assumptions about the percentage and number of local residents to be hired during operations. The analysis needs to be redone to eliminate this inconsistency and in the context of current labour market conditions to ensure that the assumptions about local hiring are realistic.
- The assessment of cumulative effects arising from competing demands for local and regional labour is out of date and incomplete and needs to be revisited to ensure that there will be no adverse cumulative effects on the local or regional labour force.

DEMOGRAPHIC AND INFRASTRUCTURE ISSUES

- The assessment of demands for commercial accommodation during construction needs to be revised since project demands could require as much as 66% of the available supply during the peak tourism season.
- While the assessment of effects during operation on demographics and infrastructure may be reasonable if the incoming workers and their families choose to locate throughout the LSA, issues could arise if all the demands are placed on one or two of the urban communities. TCL needs to work with local governments and developed to ensure this doesn’t happen.
- The assessment fails to consider how mine closure could result in out-migration from the LSA and the resulting changes in housing availability or demands on infrastructure.

JOHN P. THOMPSON, B.A., M.E.S.

Mr. Thompson has 45 years of experience assessing and evaluating the economic and social effects of natural resource management projects, programs and policies in western and northern Canada. Most of this time has been spent as a consultant but he also spent 14 years working for the Government of Alberta as Senior Economist for Alberta Environment and as Senior Economist/Social Scientist for an Alberta environmental regulatory agency (the Natural Resources Conservation Board).

For the last 20 years John has focused on three main areas of practice:

- socio-economic impact assessment;
- ecological economics in support of land use and river basin planning; and
- water management.

During his career, John has completed social and economic impact assessments for a wide variety of projects across Canada, including mines, pipelines, oil sands plants and LNG facilities. These projects include:

Mines:	British Columbia: Blackwater gold mine, Mount Milligan copper mine, Kitsault molybdenum project, Raven coal project, Sukunka coal project Alberta: Teck's Cardinal River Operations Saskatchewan: Star Diamond project Ontario: Marathon PGM-Cu Project, Barrick-Hemlo's open pit expansion, Rainy River Gold Project.
Pipelines:	Northern Gateway Pipeline; Prince Rupert Gas Transmission Project
LNG Projects:	Pacific NorthWest LNG Project; LNG Canada (Kitimat)
Heavy Oil:	Carmon Creek Project (Shell Canada); EnCana Borealis In-Situ Oil Sands Mining Project
Natural gas	Suffield In-Fill Natural Gas Drilling Program
Petrochemicals	Methanex, Pembina Pipeline Corporation and Field Upgrading Limited applications under Alberta royalty reduction programs
Other:	Various assessments for hydroelectric, water, highway and casino projects.

These assessments have been undertaken to meet the requirements set out in provincial legislation (BC, Alberta, Saskatchewan and Ontario) , the Canadian Environmental Assessment Act, and/or the National Energy Board. In some cases, John has used input/output analysis and/or economic multipliers to estimate the provincial and national impacts of many of these projects to demonstrate potential project benefits.

He has participated in hearings before numerous regulatory boards, and has been recognized as an expert socio-economic witness by the NEB (Northern Gateway Project). It should be noted that John has also participated in project reviews as an employee of the Alberta Natural Resources Conservation Board (including being seconded to the Alberta Energy and Utilities Board) on various projects, including the Dunvegan Hydroelectric Project, the Little Bow Project/Highwood Diversion Plan, and the Rossdale power project.

His recent experience in ecological economics involved completing five studies in the NWT for Aboriginal Affairs and Northern Development and Parks Canada related to the potential creation of protected areas. All of the studies involved assessing the benefits of creating protected areas (environmental and economic) against the costs (lost opportunities for non-renewable resource development), to help identify appropriate protected area boundaries. This has entailed working with Aboriginal communities to identify and classify areas of cultural, historical, social and economic importance. John has also undertaken ecological economic studies related to the value of fish and wildlife resources, wetlands, recreational resources, ecological goods and services, and national and provincial parks and protected areas.

John has undertaken various consulting projects related to Alberta's Water for Life policy, including assessments of current and future water in all of Alberta's major river basins and for sub-basins in the North Saskatchewan watershed, an inter-jurisdictional review of policies related to inter- and intra-basin transfers, and several cost accounting assessments for government-funded water management infrastructure. As senior economist for Alberta Environment, he was involved in river basin planning and water conservation and helped draft the Alberta Water Act. He has also prepared socio-economic assessments of the Special Areas Water Supply Project on three separate occasions and has undertaken peer reviews of economic studies of other proposed water management projects, including the Meridian Dam.

Education

B.A. (Economics), University of British Columbia, 1973.

M.E.S. (Natural Resource Management/Welfare Economics), York University, 1977.

Professional History

Principal, Watrecon Consulting	2003 to date
Senior Resource Economist, Stantec	2013 to 2017
Senior Resource Economist, AMEC Earth & Environmental	2005 to 2013
Director, Board Reviews; Senior Economist/Social Scientist, Natural Resources Conservation Board	1997 to 2003
Senior Manager, Strategic Management Division, Alberta Environmental Protection	1994 to 1997
Head, Economics and Water Use Section, Planning Division, Alberta Environment, Edmonton, Alberta, Acting Head Water Conservation Section, Planning Division, Alberta Environment, Edmonton, Alberta	1990 to 1994
Principal, Thompson Economic Consulting Services, Calgary, Alberta	1986 to 1990
Resource Economist, Reid Crowther & Partners Ltd., Calgary, Alberta.	1983 to 1986
Senior Resource Economist, Canadian Resourcecon Ltd., Vancouver, B.C.	1977 to 1983
Environmental Planner, Environmental Assessment Team, Land-Use Coordination Branch, Ontario Ministry of Natural Resources.	1976
Researcher, Inquiry Appraisal Team, Berger Commission on the Mackenzie Valley Pipeline, Ottawa.	1975

Review of Net Economic Benefits of Telkwa Coal Limited's Tenas Project

July 1, 2022

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Executive Summary

Telkwa Coal Limited (TCL) proposes to develop the Tenas project (the Project) near the town of Telkwa in northwest BC and in the traditional territory of the Wet'suwet'en Nation. The Project is currently being reviewed under the BC environmental assessment process of the 2002 *Environmental Assessment Act* overseen by the BC Environmental Assessment Office. The act is concerned with avoiding what are termed 'significant adverse effects' but also with furthering the public interest. The 45-day comment period on TCL's application under the act will end on July 3rd, 2022.

As part of its application, TCL has undertaken an assessment of the Project's economic and other benefits, an assessment of adverse economic impacts, and other studies. The Northwest Institute is concerned about the economic benefits and impacts of the Project in light of environmental and other impacts of the Project and in the context of the public interest case for the Project. Accordingly, the Northwest Institute commissioned Swift Creek Consulting to prepare an assessment of the Project's net economic benefits and comment on the Project's public interest case. Economic benefits play an out-sized role in public interest evaluations, and therefore it is crucial to closely examine economic net benefits so that the BC government is properly informed.

The objective of the Project is to produce metallurgical coal for export to Asia. The Project would take advantage of existing infrastructure but entail the construction and development of various mine components. TCL proposes an annual production rate of about 800,000 metric tonnes of processed metallurgical coal annually over 21 years of operations after 1.5 years of construction and followed by at least 29 years of decommissioning, reclamation, and post-closure activities.

TCL argues that the Project will have a variety of economic and other benefits, and the application reviews a wide range of environmental and other impacts. Stated economic benefits include employment, tax revenue, and impacts on gross domestic product. TCL concluded that the Project would have only one significant adverse effect in terms of visual quality.

TCL applied the method of economic impact analysis, including the technique of input-output modeling, to estimate the Project's economic benefits, but this method is inconsistent with modern practice and provides results that provide limited useful information on the Project's economic benefits and impacts. TCL's method is incapable of providing a comprehensive assessment of net economic benefits, was never meant to be a method for assessing project benefits, and therefore TCL's assessment of Project benefits has little value in informing the BC government's decision regarding the Project's public interest case.

A proper assessment of Project benefits must assess <u>net</u> benefits, which is the difference between benefits and costs. The best method available for such an assessment is cost-benefit analysis (CBA), which is modern economics' standard method for assessing a project's value to society. CBA and its variants have a long history of use in BC and Canada, and the method's usefulness to major project evaluation was recently recognized by the Joint Review Panel for the proposed Grassy Mountain Coal mine and is recognized also by the Impact Assessment Agency of Canada for its potential in federal environmental assessment.

To support the BC government's decision-making, a CBA was performed on the proposed Tenas project. The CBA examined Project costs, Project revenues, employment, government revenue and costs, impacts on other financial interests, and environmental and other benefits and costs including social costs of carbon associated with the Project's greenhouse gas emissions. Uncertainties in these parameters were considered by examining 24 different sensitivity analysis scenarios, and all impacts were considered in terms of their time-value. Input parameters were based upon TCL data, government information, or information in the academic and professional literature.

The results of the CBA suggest that the Project is not in the public interest. Fourteen (58%) of the scenarios resulted in a negative net present value, suggesting that that Project will not be a net benefit to society. The private investment case is also weak: only under an assumption of an atypically-high coal price is an internal rate of return above typical investor expectations found. The break-even price for the Project is also high relative to historical and expected future coal prices. No incremental employment benefits are expected due to current and anticipated labour market conditions, and the many environmental and other impacts and risks pose further reasons to be skeptical about the Project's public interest case.

Overall, it is hard to see a positive public interest case for the Tenas project. TCL's application provides insufficient information on the Project's economic benefits and public interest case, and the information gathered in the course of the CBA helps fill these gaps, indicating that the future coal market, costs of development, the social cost of carbon, and the risks posed by coal mining to the environment and taxpayers all conspire against the Project's public interest case.

Statement of Limitations

This document was prepared by Swift Creek Consulting for the exclusive use and benefit of the Northwest Institute ("Client"). This document represents the best professional judgment of Swift Creek Consulting based on the information available at the time of its completion and as appropriate for the scope of work. Services were performed according to normal professional standards in a similar context and for a similar scope of work.

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Acknowledgements

- Dr. Thomas I. Gunton (Professor and Director of Resource and Environmental Planning at Simon Fraser University) provided peer review of this report including methodological suggestions

Contents

Acronyms

2002 EAA	BC *Environmental Assessment Act 2002*
BC EAO	BC Environmental Assessment Office
CBA	cost-benefit analysis
EconIA	economic impact analysis
EA	environmental assessment
GHG	greenhouse gas
IRR	internal rate of return
mtpa	million tonnes per year
NPV	net present value
VC	valued component

1. Introduction

1.1 Project and Context for this Report

Telkwa Coal Limited (TCL), a joint venture of Australian mining company Allegiance Coal and Itochu Corporation of Japan, proposes to develop the Tenas project (the Project) near Telkwa, BC. The Project is currently being reviewed under the BC environmental assessment (EA) process of the 2002 *Environmental Assessment Act* (*2002 EAA*) overseen by the BC Environmental Assessment Office (BC EAO). The *2002 EAA* is concerned with avoiding what are termed 'significant adverse effects', but also with furthering the public interest (see sections (ss.) 6, 17, and 31 of the *2002 EAA*). The 45-day comment period on TCL's application for an EA certificate will end on July 3rd, 2022.

As part of its EA application, as directed by the final Application Information Requirements for the EA (BC EAO 2022), TCL has undertaken an assessment of the Project's economic and other benefits, an assessment of adverse economic impacts, and other studies. The Northwest Institute is concerned about the economic benefits and impacts of the Project in light of environmental and other impacts of the Project and in the context of the public interest case for the Project. Accordingly, the Northwest Institute commissioned me – Dr. Chris Joseph of Swift Creek Consulting – to prepare an assessment of the Project's net economic benefits and comment on the Project's public interest case to the extent possible based upon the analysis I undertook. While the *2002 EAA* does not define the term 'public interest', economic benefits play an out-sized role in public interest evaluations (Goodday et al. 2020) and therefore it is crucial to closely examine economic net benefits so that the BC government is properly informed.

1.2 Project Overview

The Project is a proposed surface coal mine near the town of Telkwa in northwest BC and in the traditional territory of the Wet'suwet'en Nation. The objective of the Project is to produce metallurgical coal, a type of coal used in steelmaking, for export to the Asian market. There is a history of coal mining at the site, though mostly for thermal coal.

The Project would take advantage of existing road, rail, and electrical infrastructure but entail the construction and/or development of: an open pit for mining coal, a coal processing plant, conveyors and other components of coal handling systems, administration and other buildings, surface water management infrastructure including sedimentation ponds, diversion berms, water storage pond, new roads and powerline, new rail infrastructure to enable coal loading, and a bridge (Telkwa Coal Limited Tenas Project Application (hereafter Application), Section (s.)0.0/s.1.2.2.2).[1]

TCL proposes an annual production rate of about 800,000 metric tonnes of processed metallurgical coal annually over 21 years of operations. TCL proposes 1.5 years of construction, 21 years of operations, 4 years of decommissioning and reclamation, followed by 10 years of active and then 15 years of passive post-closure activities (Application s0.0/s.1.2.2.3), summing to 51.5 years.[2] However, in its reclamation plan (Application s.13/s.15, page (p)83) TCL discusses post-closure activities to year 75 and beyond.

TCL argues that the Project will have a variety of economic and other benefits, and the application reviews a wide range of environmental and other impacts. TCL estimates economic benefits will include 125 person-years of direct employment during construction and between 55 and 145 full-time equivalent employees during operations, the majority of which are anticipated by TCL to come from the local region (Application s.0.0/s.1.2.5; s.1/s.3). TCL also estimates a variety of indirect and induced economic benefits as well as benefits under other value pillars (Application s.0.0/s.1.2.5; s.1/s.3).

TCL examined the potential for the Project to have effects on nine environmental valued components (VCs), two economic VCs, five social VCs, one heritage VC, and one health VC, and considered the potential for accidents and malfunctions, as well as effects of the environment on the Project (Application ss.3-10). TCL concluded (Application s.0.0/s.7, p87) that the Project

> *is likely to result in no significant adverse effects on all VCs except one of the VCs [Visual Quality] with the application of proven, accepted mitigation measures.*

1.3 Scope of Swift Creek Consulting's Analysis

I was hired to conduct a third-party, independent assessment of the Project's net economic benefits, i.e., benefits (positive impacts) minus costs (negative impacts, also known as adverse effects). To do so, I employed the methodology of cost-benefit analysis (CBA). The objective of my report is to provide insight – to the BC EAO, other government entities, and the public – into the Project's net economic benefits and the

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[1] TCL's EA application is structured into the Application Summary (s.0.0), front matter (ss.0.1-0.7), Part A Introduction (ss.1 and 2), Part B Assessment of Environmental, Economic, Social, Heritage and Health Effects (ss.3-10), Part C Wet'suwet'en Rights and Interests (s.11), Part D Public Consultation (s.12), Part E Management Plans and Management Strategies (ss.13-14), Part F Conclusions (ss.15-16), and Appendices, but within these sections are sections and chapters. For example, s.1.2.2.1 Existing Infrastructure and Information is in s.0.0 Application Summary, and I refer to it as "s.0.0/s.1.2.2.1".

[2] TCL refers to the initial 26.5 years as the 'life-of-mine' or LOM (Application s0.0/s.1).

Project's public interest case, for use in the BC government's decision-making regarding the EA application.

1.4 Qualifications

My qualifications are as follows:

- I have undergraduate, masters, and doctorate degrees in resource and environmental management;
- my doctorate was focused on the environmental assessment process, including an examination of appropriate methods of economic impact assessment for evaluating major energy projects, and a CBA of the Kearl bitumen mine;
- I have written and co-written articles for peer-reviewed academic journals on aspects of the environmental assessment process, economic impact assessment, cumulative effects assessment, greenhouse gas impact assessment, and other aspects to environmental and natural resource management, and I have provided peer review for a variety of academic journals;
- I have 18 years of experience consulting on the impacts of major projects, including coal mines, oil and gas pipelines, bitumen extraction projects, LNG projects, refineries, and port and shipping projects;
- I work as a private consultant, though from 2016 through 2018 I was also the socio-economic impact assessment lead at SNC Lavalin for the BC and Yukon region;
- I have provided expert testimony to:
    - the BC Utilities Commission for the Fortis Okanagan Upgrade Project;
    - the Joint Review Panel for the Grassy Mountain Coal Mine;
    - the Alberta Energy Regulator for the Syncrude Mildred Lake Extension project;
    - the Joint Review Panel for the Teck Frontier Oil Sands Mine;
    - the Supreme Court of British Columbia for the Site C Clean Energy Project;
    - the Minnesota Public Utilities Commission for the Enbridge Line 3 Replacement;
    - the National Energy Board for the Kinder Morgan Trans Mountain Expansion Project;
    - the National Energy Board for the Enbridge Northern Gateway Project; and
    - the Stk'emlupsemc te Secwepemc First Nation's Review Panel for the proposed Ajax copper/gold mine;
- I have written guidance and advised the BC, Alberta, and federal governments on aspects of economic impact assessment and cumulative effects assessment; and
- I have instructed university-level and professional courses in economics, resource and environmental management, and environmental assessment.

A current copy of my CV is available at www.swiftcreekconsulting.com.

2. Methodological Alternatives for Assessing Project Economic Impacts

TCL applied an economic impact assessment methodology inconsistent with modern practice, with results that unsurprisingly provide limited useful information on the Project's economic benefits and impacts. TCL used the method of economic impact analysis, including the technique of input-output modeling, to estimate what TCL refers to as the Project's economic benefits, namely: capital and operating expenditures, direct construction and operations employment and labour income, indirect and induced employment and labour income, gross domestic product impacts, and government tax and royalty revenue. As detailed in articles I and colleagues have authored in the international journal *Impact Assessment and Project Appraisal* (Joseph et al. 2020a; Joseph et al. 2020b), consistent with decades of literature and research on the subject, EconIA presents only a <u>limited</u> assessment of a project's <u>gross</u> economic impacts. EconIA is incapable of providing a comprehensive assessment of net economic benefits, was never meant to be a method for assessing project benefits, and therefore TCL's assessment of Project benefits has little value in informing the BC EAO's decision regarding the Project's public interest case. As well, standard practice in EA is to present the limitations of any methodology used, but TCL did not do this – no information was provided in the application regarding the limitations of EconIA – leading readers to potentially misunderstand the information provided. Lastly, TCL assessed various potential adverse economic effects in s.5 and assessed various non-economic adverse effects in ss.4, 6, 7, 8, and 9, but did not bring this information all together as is possible with available methodology to assess net benefits.

A proper assessment of Project benefits must assess <u>net</u> benefits, which is the difference between benefits and costs. Consistent with standard Canadian and international methodology, EA is concerned with the *incremental* effects of projects, defined as the difference between two futures: one with, and one without, a project. The best method available for such an assessment is CBA.

CBA is the standard method in modern economics for assessing a project's value to society. CBA entails identifying a project's benefits and costs, and then summing these impacts to arrive at an estimate of a project's net benefits (Boardman et al. 2018). While the method of CBA is not required under the Project's final Application Information Requirements, CBA can be used and is a standard method for project evaluation in many jurisdictions around the world, including Canada (see below), Australia and New Zealand, EU countries, the US, by international development banks, as well as for economic analysis of proposed regulatory change in Canada, the US, and other countries.

CBA can be used narrowly or broadly in an EA. The narrow approach is to use CBA to assess financial impacts of the Project (e.g., project costs, revenues, employment) as well as those economic impacts that are commonly thought of in economic and/or financial terms and can thus be labelled 'market impacts', such as impacts on other employers who must compete for labour by paying higher wages. The broader approach is to use CBA to assess the whole array of a project's impacts – both market and 'non-market' impacts – thereby quantifying and monetizing all of a project's impacts to arrive at a statement of the project's so-called 'total economic value' associated with a project (Pearce et al. 2006). Due to technical but also philosophical obstacles to implementing the latter, analysts often apply a modified form of CBA, such as multiple account CBA, to assess a project's net benefits (Gunton et al. 2020; Shaffer 2010).

CBA and its variants have a long history in BC and Canada. CBA has often been employed both in and outside of government (BC MAL 2007; BC MoTI 2014; Boardman et al. 2006; Crown Corporations Secretariat 1993), and in the EA context, CBA is increasingly being used to inform EA application decisions while EconIA is increasingly being recognized for its substantial limitations. For example, in 2020 I employed CBA as part of my assessment of a proposed coal mine in Alberta (Joseph 2020), and the Joint Review Panel for EA acknowledged the limitations of EconIA and the usefulness of CBA (JRP Grassy Mountain Coal Project 2021), stating:

> *[p]roponents should be required by the terms of reference to provide both an economic impact analysis and a cost-benefit analysis that allows decision makers to make informed decisions based on both types of economic information. We also suggest that governments develop guidelines on the methodologies and assumptions that should be followed by proponents in producing these future analyses (588).*

The Impact Assessment Agency of Canada (IAAC) now recognizes CBA for its potential in federal EAs (see IAAC Undated).

For this report, I relied upon CBA methodology to help inform the BC EAO, the Northwest Institute, and other interested parties of the net economic benefits of the proposed Tenas project. I conducted this analysis by building a spreadsheet-based model of costs and benefits.

3. Net Economic Benefits of Tenas Project

3.1 Overview of Swift Creek Consulting Analysis

Consistent with standard CBA methodology applied to assessment of major projects, in the sub-sections below I examine the following costs and benefits of the proposed Tenas project, including relevant key uncertainties:

- project costs;
- project revenue, including coal production and coal price;
- employment;
- government revenue and costs;
- other financial interests; and
- environmental and other benefits and costs.

Some of the impacts are examined in quantitative and monetary terms, while others only in qualitative terms. I conduct my analysis in 2021 CAD, though I at times present monetary figures in other currencies and dollar-years (I convert currencies and dollar-years using Bank of Canada data and calculators). I follow my discussion of impacts with a discussion of the time-value of impacts (i.e., discounting), and then I provide interpretation of the results.

3.2 Project Costs

Coal mines have a variety of costs, including: exploration, study costs (to do EAs, for example), construction, operating, and reclamation. TCL (s.1/s.3; s.13.15/s.8) says that the Project will have the following costs:

- initial and sustaining capital costs over the Project's lifespan of $242 million (2019CAD);
- operational costs over the Project's operational phase of $983 million (2019CAD);
- reclamation costs by end of year 21 of the Project of $44 million; and
- post-closure monitoring costs of a total of $4.1 million.[3]

I accept the proponent's statement (Allegiance Coal 2016) that there is little in the way of new exploration costs because of the history of past exploration and activity at the site and little need for further work of this nature.

There are three important issues with TCL's project cost information from a CBA perspective.

First, TCL presents these materials in the 'project benefits' section of their application. This presentation of costs as benefits is erroneous. These costs are costs, or in technical

[3] Application is unclear on dollar year for reclamation and post-closure costs, and so I assumed these figures were 2019 CAD.

terms, these costs are *opportunity costs*, which means that spending this money prevents it from being spent on other things. In my analysis these costs are appropriately categorized as costs instead of benefits.

Second, it is important to compare TCL's estimate with other coal mine cost estimates to ensure that the estimates are reasonable. A comparison with the recent Grassy Mountain mine proposal (Riversdale Resources 2019) suggests that TCL may be underestimating their costs. On a cost/tonne of production basis, it appears that TCL's estimates are low (Table 1), though site-specific, scale, or other factors may be at play. I do note that TCL investment materials argue that the coal is relatively low in cost to extract, in part because the resource is already well-defined (Allegiance Coal 2016).

Table 1. Cost comparison: Tenas Project vs. Grassy Mountain

	Tenas	Grassy Mountain	Difference
Average annual production (mtpa)	0.8	4.25	431%
Construction costs (million $2019CAD)	123.5	738	498%
Construction costs / tonne of production ($2019CAD)	154	174	12%

Sources: Application s.0.0/s.1.2.2, s.1, Executive Summary, s.1/s.3; Riversdale Resources (2019).

Comparing projects requires 'apples-to-apples' comparisons, but major projects do have a longstanding history of cost escalation (e.g., Deloitte 2017; Flyvbjerg et al. 2003; Gunton 2017; Hendricks et al. 2017; Lewis and Fife 2018; Olaniran et al. 2015). Regardless of the TCL project's characteristics, common practice in project cost forecasting is to conduct sensitivity analysis and consider cost escalation of 25% or more, thus bringing the Tenas project's capital costs and operational costs to $302 million and $1.1 billion under an assumption of 25% escalation, respectively.

It is also important to consider cost escalation with mine site reclamation. Reclamation of polluted industrial sites, such as mines, is notoriously challenging, and TCL's plan to address its potentially acid generating materials, tailings pond, and other physical and ecological disturbances associated with the Project may or may not be adequate. The experience in Alberta with bitumen mine reclamation is demonstrative of the costly challenges of reclamation (De Souza et al. 2018), and the potential for cost escalation in coal mine reclamation was noted by the Alberta-Canada Joint Review Panel for the proposed Grassy Mountain mine (JRP Grassy Mountain Coal Project 2021).

Reclamation, but also operational and even capital costs, may escalate due to the environmental impacts and risks posed by coal mining. In BC's Elk Valley, much money has been spent to date trying to address legacy and ongoing selenium and other pollution (Teck 2022), yet the problem remains. The Grassy Mountain review panel noted substantial uncertainty with respect to managing coal mine water pollution, and how it poses a risk to taxpayers, water users, and ecosystems (JRP Grassy Mountain Coal Project 2021). In reference to disconnects between the costs of complete reclamation and the financial security held by government to enforce reclamation, the Alberta Auditor General has expressed serious concern about coal mine reclamation liability (AGA 2019). The BC government recently introduced an interim policy (BC MEMLCI 2022) to address potential taxpayer liability of coal mine reclamation by requiring higher financial security from developers, but it is not clear if TCL's application is consistent with this new policy.

As well, near-term costs – particular construction – may escalate more than typical in the current, post-COVID-19 inflationary and supply-constrained economic environment. Statistics Canada (2022a), for example, recently noted supply chain-related cost inflation in things such as structural metal, electrical and telecommunications equipment, fuel, and labour – all things that would be necessary to build a coal mine. Therefore, depending on when construction starts, the Project may face much higher costs beyond the factors that commonly cause cost escalation.

For the purposes of my CBA, I used the proponent's estimated capital, operational, and reclamation costs but in alternative sensitivity analysis scenarios I escalated each 25% (I see no reason to test scenarios with lower costs). For reclamation, I note that TCL plans progressive reclamation, and lacking any further information I averaged TCL's reclamation costs over the construction and operations phases to get annual averages.

3.3 Project Revenue

The main benefit of a resource extraction project is its revenue from the sale of the commodity extracted, and this revenue is a function of production volume and commodity price.

3.3.1 Production Volume

TCL says that the Project will produce between 775,000 and 825,000 metric tonnes of processed coal per year (Application s.0.0/s.1), or an average of 0.8 million tonnes per year (mtpa). This number could vary upwards or downwards, due to uncertainty in such things as the quantity and quality of the realized coal resource and final mine configuration and efficiency. However, for the purposes of my analysis, I did not vary production rates and instead assumed 0.8 mtpa of production.

3.3.2 Price of Tenas Coal

A critical parameter in estimating the Project's net economic benefits is the future coal price, and not just a global price, but the specific price that this project will obtain. The price obtained by TCL determines its revenue but is also important in forecasting the Project's benefit stream to government (as mineral and corporate income taxes are a function of a project's profitability) as well as the Project's abilities to finance mitigation measures and final reclamation. TCL explains in its Application that the Project's purpose is to sell steelmaking coal to the Asian market, and TCL provides estimates of government royalties and taxes in s.1/s.3.8, but nowhere does TCL disclose its assumed coal price over the life of the Project. Therefore, it is not possible to verify and validate TCL's estimates of government benefits. In order to undertake my own assessment of the Project's benefits, I have reviewed information on current and future coal markets, as well as information available on the physical and chemical characteristics of Tenas coal and information on any location differential that may affect the price that TCL will obtain.

At present, post-pandemic and while Russia continues to invade Ukraine, steelmaking coal commands a high price, though there is uncertainty with respect to the effect of inflation, other global economic and geopolitical factors, and potential recession on demand (Kolijn 2020; World Steel Association 2022). Prices for steelmaking coal, like thermal coal of which its price is well-correlated, have risen markedly over the last year, but for a project like Tenas what matters is the market over its operational lifespan, which would be roughly 2025 to 2045.

Over the Project's lifespan, the demand – and thus price – for steelmaking coal is expected to decline; the question is how much and how fast. International energy giant BP produces an annual energy outlook, and its 2022 outlook (BP 2022) notes in stark terms that the global carbon budget is "running out" and that

> *government ambitions globally [with respect to reducing GHG [greenhouse gas] emissions have grown markedly… increased momentum in tackling climate change… movement to a lower carbon energy system leads to a fundamental restructuring of global energy markets (6).*

BP examined three scenarios in its 2022 outlook, and all of them anticipate a substantial reduction in use of coal for industrial processes including steelmaking, and increased uptake of alternative technologies including use of low-carbon hydrogen. BP states that

> *within hydrocarbons, the largest falls occur in the share of coal as the world increasingly shifts towards lower-carbon fuels in industry and buildings (39).*

BP anticipates a 1.4% to 6.9% reduction in coal as a primary energy source per year between 2019 and 2050.

Another international energy authority is the International Energy Agency – Canada is a member – and its most recent global energy outlook (IEA 2021) is also pessimistic with respect to the long-term outlook for coal in steelmaking. The IEA anticipates modest growth in demand for steelmaking coal in two scenarios to 2030, under assumptions of continued growth in economic activity in China and emerging and developing nations with little to no climate policy, in contrast to a third scenario of decline straight away from today. Beyond 2030, though, the IEA anticipates decline in industrial coal demand across scenarios, the rapidity of which is a function of climate policy. Speaking more pointedly towards the world's climate and renewable energy goals, the IEA's executive director Fatih Birol stated that "we do not need any more investments in new oil, gas and coal projects" (Chestney 2021).

These two international energy authorities' forecasts suggest that there may be a shorter-term market for TCL's coal but a diminishing market over the longer-term. The consequent effects on the price of coal will translate to diminished benefits over the Project's lifespan (e.g., in terms of operational employment, mineral and corporate income tax revenue) but also potential risk to the funding of mitigation programs and mine reclamation. I discuss potential liabilities from diminished Project revenues and benefits further in s.3.5 below.

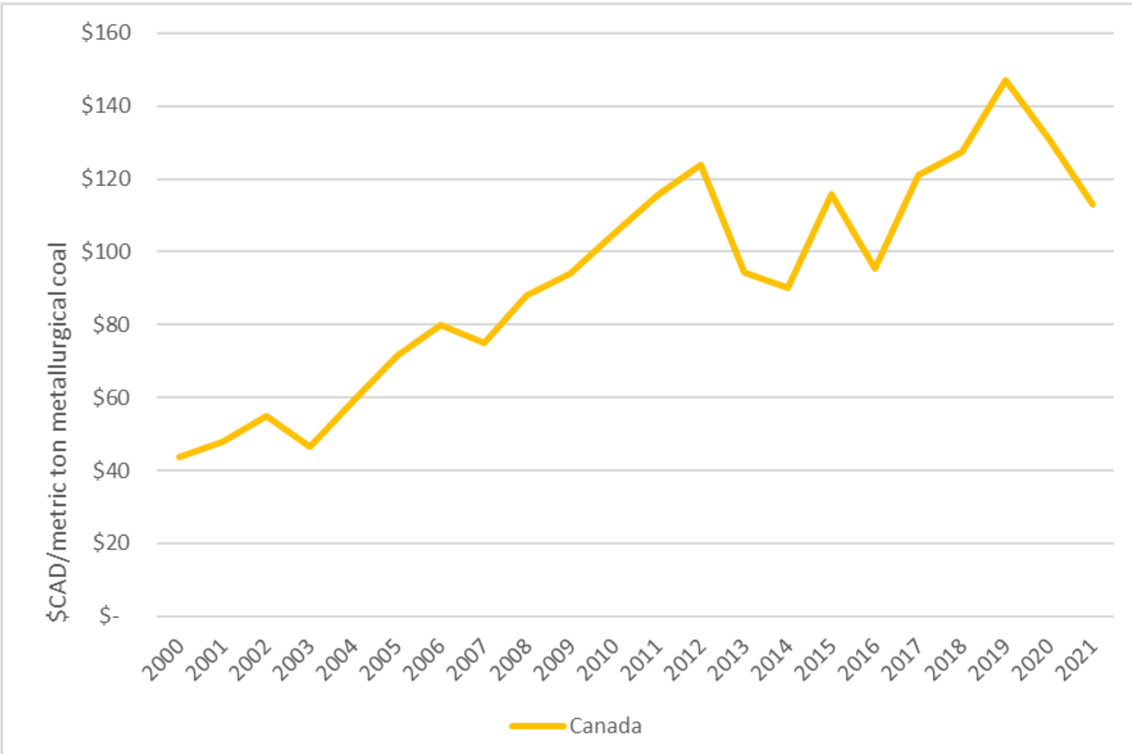
A key parameter in coal price is the quality, or rank, of the coal that would come from the Tenas project. A presentation of different coal ranks is provided by ScienceDirect (Undated). TCL states that the coal is suitable for use as a semi-soft coking coal and/or a pulverized coal injection (PCI) coal (Application s.1/s.1.8.2.4), but I note that the Tenas property has a history of thermal coal extraction due to its predominantly bituminous coal consistency (BC Undated) and the proponent itself has characterized the coal resource as a mix of PCI and thermal coal (Allegiance Coal 2016). It would therefore seem that the Tenas coal is not of the highest quality, and the price that the Tenas coal will command in the marketplace will reflect this.

On the other hand, as pointed out by TCL, the Project is located adjacent to the CN rail line and is very close to the Prince Rupert coal export terminal, which translates into a relatively lower cost to ship to market compared to product from coal mines further east in Canada. The low cost to market translates to a higher minehead price for Tenas coal, all else equal.

One source of data for BC coal export prices is from the BC government (BC MEMLCI 2021). Over 2020, BC PCI prices averaged "between $75 and $80" (2020USD), or about $108 (2021CAD), respectively.

Another source of price data is the US Energy Information Administration (US EIA Undated). According to this source, Canada's export price for metallurgical coal was $113 (CAD) in 2021 and averaged $93 (CAD) over the 2000 to 2021 time period (Figure 1).

Figure 1. Prices for metallurgical coal exports from US and Canada, 2000 to 2021



Source: US EIA (Undated). Original data in USD and short tons; converted to metric tons and CAD using Bank of Canada historical exchange rate data (Bank of Canada 2017; Undated).

Considering all of the above, for the purposes of my CBA I assume a base case long-term average price of $100 (2021CAD) per metric ton consistent with BC government and US EIA data, reflective of the BP and IEA long-term forecasts which anticipate a decline in the market for steelmaking coal, and reflective of the location benefit of the TCL project. In sensitivity analysis, I examine two alternative price scenarios: a high price case with a long-term average price 25% higher, or $125 (2021CAD), and a low price case 25% lower, or $75 (2021CAD).

3.4 Employment

TCL states that the Project will "generate" 125 person-years of direct employment during construction, and will "require" 55 to 145 full-time equivalents for operations, or approximately 3,125 person-years over the life of the Project excluding construction and post-closure activities (s.0/s.1.2.5). Elsewhere in the application (s.1/s.3.4) TCL provides slightly different numbers for Project direct employment, and argues in another section

(Application s.1/s.3.5) that the Project will also provide indirect and induced employment, i.e., employment at firms supplying goods and services to the Project and at firms supplying goods and services to Project direct employees spending their wages. TCL also provides quantitative figures indicating the proportion of workers who will be sourced from the local region, elsewhere in the province, and other geographic locales. For example, in s.0/s.1.2.5 TCL contends that it expects that approximately 58% of direct construction jobs, 90% of operations workers, and 50% of decommissioning workers will be from the local region. Lastly, TCL also provides information on the wages and salaries associated with this employment.

It is critical to observe the fact that labour is a cost of the Project, and that there is only an incremental benefit of the Project's employment if workers would not otherwise be paid as much or would not be working. In other words, if the workers on the Tenas project would otherwise be working for the same wages and salaries there is no net employment benefit of the Project. This is standard economic logic. To address this question, one needs to examine the current and anticipated labour market.

Mine construction requires construction skillsets, and the most recent BC construction labour market data indicates that the unemployment rate for the construction labour force was about 4.6% in 2021 and is expected to average 5.6% for the 2022 to 2027 period (BuildForce Canada 2022). Unemployment rates between 5% and 7% generally indicate a balanced labour market – the 5% to 7% range reflects the fact that there are always people in between jobs or unwilling to work at the time – with rates above 7% indicating an excess of labour relative to job opportunities, and rates below 5% indicating a shortage of labour. As such, there is little if any excess in the BC construction labour force, meaning that little if any Project employment will be incremental. In other words, the direct employment impacts – numbers of jobs, as well as labour income – are costs of the Project and there is no benefit to employing these workers on the Project because they would be employed elsewhere if the Project was not built.

The current state of the Canadian labour market is in a similar state, strongly suggesting that TCL's estimates of indirect and induced employment do not represent incremental gains in Canadian employment. The most recent data, from April of this year (2022), indicate a 5.2% unemployment rate, which in historical terms is very low (Statistics Canada 2022b). Therefore, it can reasonably be assumed that employment at firms supplying goods and services to the Project and its workers will also not be incremental, and thus the information provided by TCL in s.1/s.3.5 of their application on indirect and induced employment 'benefits' should be ignored.

3.5 Government Revenues and Costs

TCL presents estimates of the revenues that governments will receive from the Project in s.1/s.3.8 of its application. TCL estimates that over the first 50 years of the Project all governments combined will receive about $368 million in revenues.[4] TCL's information on government revenue benefits has several important shortcomings.

First, TCL provides no information explaining how they arrived at their estimates. Considering that, in practical terms, the Project's public interest case rests substantially on its economic benefits, this lack of transparency impeding one's ability to verify and validate TCL's estimates is a major shortcoming of TCL's application. Revenues to government, but also other benefit streams (e.g., employment), will be affected by coal prices and any escalation in costs. As explained in KPMG's guide to mining taxation (2016), the '2% net current proceeds tax' and '13% net revenue tax' that BC charges coal mine operators are based upon mine revenues and costs. If revenues are lower and/or if costs are higher, government revenues will be lower. Such a situation was recognized by the Alberta-Canada Joint Review Panel for the proposed Grassy Mountain coal mine in its 2021 decision statement and contributed to the review panel's conclusion that the proponent had likely overstated the positive economic impacts of the project (JRP Grassy Mountain Coal Project 2021, s.23).

The second problem with TCL's presentation of government revenue benefits is that it is an incomplete accounting of economic impacts on government. TCL does not present any information on incremental government <u>costs</u> of the Project. New major projects can create incremental costs for government due to such things as:

- an increase in road use and increased needs for road maintenance;
- increased need for policing and other emergency services associated with road accidents, industrial accidents, worker interactions in host communities (e.g., Ruddell 2011);
- increased use of health care services and facilities (Aalhus 2018); and
- environmental impacts to water, air, and land.

TCL recognizes some of these adverse effects in the Application, such as potential effects on roadways in their Infrastructure and Services VC, but TCL did not connect the dots between government revenue benefits and these adverse effects, leaving the impression that the revenue benefit estimates were accurate. In reality, the net benefit stream flowing to government is lower than what TCL presents. Certainly, tax revenue is intended in part to help address costs of development and activity on government, but BC's mineral taxes also exist to compensate the owners of the natural resource – BC

[4] TCL's reclamation plan at s.13 Chapter 15 notes that the post-reclamation activities are expected to continue at least 75 years into the future.

citizens – for its extraction and consumption. There will be revenues to government with the Project, but also costs, and sound analysis demands clarity on the net effect.

Compounding these analytical gaps is the real possibility that there are additional and sizeable costs to government stemming from mitigation and/or reclamation failure due to technical and scientific gaps but also threats to the Project's financial viability, as discussed in ss.3.2 and 3.3. Technical and scientific gaps to coal mine reclamation were recognized by the Alberta-Canada Joint Review Panel for the proposed Grassy Mountain coal mine and contributed substantially to the review panel's rejection of that project (JRP Grassy Mountain Coal Project 2021). Beyond this, it is important to recognize the risk to government posed by coal price decline over the lifespan of the Project. Many of the environmental impacts in need of eventual reclamation will be created early in the Project's lifespan, but the threat of coal price decline is more of a longer-term issue (s.3.3.2). A risk, therefore, emerges that the Project's financial viability may be threatened at a time in its lifespan when it needs funds to pay for reclamation. While the BC government has recently introduced new rules with respect to the amount that mine developers must put forward as financial security to protect taxpayers from mine reclamation liability (BC MEMLCI 2022), it remains to be seen whether these new rules will in practice address this longstanding problem (OAGBC 2016). Therefore, financial parameters are not only material with respect to the magnitude of government revenue benefits already mentioned, but also with respect to future government costs.

For the purposes of my analysis, and given the limited information provided by TCL as well as the complexity of estimating tax revenues, I rely on TCL's estimates of government revenues provided in the application at s.1/s.3.8. I averaged TCL's tax payment estimate (totalling $368 million) for the period of construction through Project year 51 and ignored any potential payments to government after year 51. Given the time and budget constraints of my study, I have not attempted to quantitatively or estimate the potential incremental costs of the Project on government, but suffice it to say that the net benefit to government is less than the $368 million in revenues presented by TCL.

Lastly, note that from a CBA perspective, government revenue benefits are *transfers* between parties; the government tax revenues stem from revenues earned by TCL through coal production and thus are counted only once in the CBA net benefit calculation. The taxes do matter, though, for the calculation of the private investment case for the Project, and in discussions of government net revenues and risks to government and taxpayers.

3.6 Other Financial Interests

TCL acknowledges that there are a variety of other impacts on other commercial, industrial, and financial interests that may, or in some cases will with certainty, be affected by the Project. In its application (s.0/s.6, ss.5, 6) TCL acknowledges potential and in some cases certain effects on such things as:

- other employers, by way of competition for labour;
- tourism;
- housing and child care; and
- land and natural resource tenure-holders.

With the exception of the Visual Quality VC, TCL concluded in their application that the Project would have no significant effects, but from a CBA perspective the issue is not one of an EA determination of significance or no significance based upon subjective interpretations of effects characterization criteria (such as geographic extent, frequency, and context), but the magnitude of benefits and costs to other financial interests in a ratio numerical sense. Across their application and the VCs that covered the above-listed issues TCL observed potential adverse effects (i.e., costs from a CBA perspective) and identified mitigation measures that would be implemented to dull these adverse effects, but there is uncertainty as to the effectiveness of mitigation measures. It is beyond the scope of my study to quantitatively estimate these various effects of the Project on other financial interests, but it can be said that there will be costs.

3.7 Environmental and Other Benefits and Costs

TCL's application examines a range of other impacts of their proposed project to the environment and other values.

For benefits, TCL explains at s.1/s.3.9 that it expects the Project to have a variety of social and health benefits:

- sponsorship and scholarship program;
- community support such as food bank drives;
- education and training initiatives;
- mine site tours;
- sponsorship of sports teams;
- a staff health program;
- funds for employees to participate in health lifestyle activities; and
- programs for dealing with substance abuse issues.

On a general level, it is questionable if these items can all be counted as benefits of the Project, when they are largely mitigation measures intended to reduce adverse effects. Are mine site tours a meaningful benefit of the Project? Is providing funds for employees to participate in health lifestyle activities simply another way of saying that employees will be paid? Are the programs that TCL says it will provide for dealing with substance abuse issues the mitigation measures listed in s.6/s.5 (Community Well-Being VC)? No other detail on the above list of 'benefits' is provided by TCL, and these questions are suggestive of the need for more information. However, from a CBA perspective, in principle the above 'benefits' are such if there is a willingness to pay among Project employees and the public for these things. One could argue that there is a willingness to pay for some or all of these things, albeit presumably small in magnitude. In my CBA I therefore acknowledge these benefits in unquantified terms.

Much of the EA application (Application, ss.4-11) covers potential costs of the Project – on the environment but also on social, heritage, and health values. Other than that covered by their economic VCs, TCL examined potential adverse effects of the Project on the following VCs:

- the atmospheric environment, including GHG pollution;
- terrain and soils;
- surface water quantity and quality, including selenium pollution;
- ground water;
- aquatic resources;
- fish and fish habitat;
- vegetation;
- wildlife;
- avian species;
- (community) demographics;
- visual resources, i.e., visual quality;
- infrastructure and services;
- land and resource use;
- community well-being;
- heritage resources; and
- human health

Adverse impacts on Wet'suwet'en rights and interests are also anticipated by TCL, but I do not bring these impacts into my CBA due to the incompatibility of the CBA lens of benefits and costs with rights and legal issues.

TCL predicted adverse impacts on all of the VCs examined, even though TCL concluded that a significant adverse effect would only occur on the Visual Quality VC – a significant adverse effect on visual resources during Project construction and operations (s.0/s.6.3.2). These adverse effects (significant and non-significant) are costs from a CBA point of view that each detract from the Project's net benefits. It is outside the scope of my study to quantitatively estimate all of these adverse effects, though I do explore two of them further next.

First, it is common in CBA to monetize major projects' GHG emissions, and this can be done by multiplying the Project's GHG emission volumes by what is known as the social cost of carbon. TCL provides estimates of direct GHG emissions in s.4/Chapter 1 of its application. TCL estimates that its GHG emissions for year 5 of operations will be about 69 kt of CO_2e (s.4/ch1/p49). TCL did not estimate GHG emissions for other years of operations, nor for other phases of the Project. TCL then applies the minimization argument (also known as the 'scale trick'; Joseph 2019; Ohsawa and Duinker 2014) by arguing that the Project's emissions are quantitatively small relative to BC's and Canada's emissions and therefore they can be ignored. This argumentation fails to recognize global significance thresholds for GHG emissions, of which Canada and BC have signed on to – safe atmospheric concentrations of CO_2 in the atmosphere that limits climate change – and that BC and Canada have yet to bring GHG emissions in line with Canada's Paris and COP 26 commitments. New GHGs contribute to the cumulative effect of climate change, and it is noteworthy that the Tenas project is being proposed not only at a time when BC and Canada have commitments to sharply reduce GHG emissions but the Secretary General of the United Nations has said that "[n]ew funding for fossil fuels is delusional" (UN 2022).

The finding of non-significance by TCL with respect to its GHG emissions is therefore unjustified. TCL's GHG accounting is also problematic in that it doesn't provide a full accounting of emissions over the Project life, counter to typical assessments which provide estimates of emissions in each phase on a yearly or average annual basis. As well, TCL's assessment of GHG emissions ignores indirect emissions, i.e., emissions caused by the Project's demand for project inputs (e.g., diesel), as well as downstream emissions (e.g., by rail and marine shipping, and most significantly at point of coal combustion), the latter of which can be expected to be disproportionately large compared to the direct emissions at the mine site. Given the state of the global climate today and as expected over the Project's lifespan, the Project's mine site emissions over its lifespan and the Project's downstream emissions are non-negligible costs.

For my CBA, I assumed TCL's year 5 operations GHGs would be the same for all other operations years (i.e., years 1 to 4, and 6 to 21), and I multiplied these emission estimates by social cost of carbon estimates provided by Environment and Climate Change Canada (ECCC 2016). ECCC provides two sets of social cost of carbon estimates: (1) the 'updated central' series representing a moderate view of climate change damages, and (2) the '95th percentile' series which represents a more catastrophic view of climate change. The latter series may even underestimate climate change damages given that climate change is progressing more rapidly and severely than previously thought (Le Page 2018). Given the constraints of my study I did not try to estimate construction-related GHGs, GHGs associated with post-reclamation activities, nor downstream emissions, but these costs are real.

The second impact that I do consider further pertains to risks of failure with respect to mitigation and reclamation. Reiterating points I made above in ss.3.2, 3.3, and 3.5, there is a risk (i.e., potential cost) that TCL is unable to fulfil its various impact mitigation and reclamation measures, rendering its conclusions of 'non-significance' contingent upon mitigation and reclamation false, due to cost escalation and/or revenue decline, resulting in one or more of:

- TCL baulking at implementing its promised mitigation, or doing so in a reduced form, or
- TCL abandoning the Project, or selling the property to another entity, compromising mitigation and/or reclamation.

As a consequence, the environmental costs of the Project may fall on the public, government, and/or taxpayers. Reclamation liabilities in Alberta have led the auditor general there to warn of risks to the taxpayer (AGA 2015).

3.8 Time-Value of Impacts

An important part of CBA methodology is accounting for the time-value of impacts, commonly referred to as discounting. For several reasons, people tend to value benefits in the near-future higher than the same benefits occurring later in time, and people tend to prefer to defer costs to the future (Shaffer 2010). This fact is as applicable to financial (i.e., monetary) impacts as it is to others.

To address the time-value of impacts in CBA, a mathematical factor – called a discount rate – is applied to the benefits and costs of a project, with impacts occurring further into the future being more influenced by this factor than impacts closer to the present. Various technical and philosophical issues are relevant in setting the discount rate and discounting approach, and despite substantial effort over many decades these issues have not been resolved. Given the fact that people do discount, the best way to overcome uncertainty as to the appropriate discount rate and approach is to undertake sensitivity analysis.

For my CBA I undertook two alternative discounting approaches:

1. a dual discounting approach using a rate reflective of investor expectations for a return on capital invested (10.7%) and used in a recent CBA of the Grassy Mountain coal mine proposal (Joseph 2020) for all financial (i.e., market) impacts covered in the analysis, and a 3% rate for the social cost of carbon consistent with Environment and Climate Change Canada (ECCC 2016); and

2. a uniform discounting approach using an 8% rate for all impacts.

In neither approach were non-monetized impacts discounted numerically.

3.9 Tenas CBA Input Summary

My CBA was conducted by building a spreadsheet-based model of quantified costs and benefits of the Tenas project. The inputs to the CBA model are presented in Table 2.

Table 2. Tenas CBA inputs

Parameter	Input	Source
Capital, operational, reclamation costs[1]	Sensitivity analysis scenarios: • Proponent estimate • 25% higher	Application s.1/s.3; s.13.15/s.8 See s.3.2 of the present report
Mine production	800,000 tonnes per year	Application s.0.0/s.1
Coal price	Sensitivity analysis scenarios: • base case of $100 (2021CAD) over the life of the Project • high price case of 25% higher, or $125 (2021CAD) • low price case of 25% lower, or $75 (2021CAD)	BC MEMLCI (2021) US EIA (Undated) Also see other materials in s.3.3.2 of the present report
Employment	No impact; cost of labour part of capital, operational, and reclamation costs	See s.3.4 of the present report
Government revenues and costs	Proponent estimate of government revenues averaged over 53-year period, covering project years -0.5 to 51 Unquantified government costs	See s.3.5 of the present report

Parameter	Input	Source
Other financial interests	Unquantified benefits Unquantified costs	See s.3.6 of the present report
Environmental and other benefits and costs	Proponent estimate of operational emissions assumed for all operational years of Project Sensitivity analysis scenarios for the social cost of carbon: • 'updated central' estimates • '95th percentile' estimates Other unquantified costs	ECCC (2016) See s.3.7 of the present report
Time-value of impacts	Sensitivity analysis scenarios: • dual discounting approach using 10.7% for market impacts and 3% for GHG impacts • uniform discounting approach using 8% for all impacts	ECCC (2016) Sources in Joseph (2020) See s.3.8 of the present report

Notes: 1. While the CBA model disaggregates capital, operations, and reclamation costs, varying each of these cost items in isolation was found to be immaterial to the results, and so all are lumped together for discussion and presentation purposes.

3.10 Tenas CBA Results

Table 3 presents a summary of results for my limited-in-scope Tenas CBA, exclusive of unquantified benefits and costs. The results are presented in terms of the net present value (NPV) of quantified costs and benefits of the Project under alternative scenarios. NPV is a monetary figure that captures the net of quantified Project costs and benefits over the Project's lifespan but in discounted terms. Each row in Table 3 represents a different scenario composed of a unique combination of coal price, cost, social cost of carbon, and discounting approach. As my CBA considered three different coal prices, two different cost cases, two different sets of social costs of carbon, and two discounting approaches, there were 24 scenarios examined. Ten of the 24 combinations (42%) result in a positive NPV, and 14 (58%) result in a negative NPV, though none of the results in Table 3 reflect unquantified costs and benefits. Generally, from the perspective of CBA, a positive NPV suggests the Project is worthwhile from a societal point of view, and a negative NPV suggests not.

Table 3. Summary of results for limited-in-scope Tenas CBA (excluding unquantified costs and benefits)

Project costs[1]	Coal price	Social cost of carbon	Discounting approach	NPV (million 2021CAD)
Proponent estimates	25% higher ($125/t)	updated central	Uniform	280.7
25% higher	25% higher ($125/t)	updated central	Uniform	263.2
Proponent estimates	25% higher ($125/t)	updated central	Dual	189
25% higher	25% higher ($125/t)	updated central	Dual	174
Proponent estimates	25% higher ($125/t)	95th percentile	Uniform	127.8
25% higher	25% higher ($125/t)	95th percentile	Uniform	110.3
Proponent estimates	base case ($100/t)	updated central	Uniform	81.7
25% higher	base case ($100/t)	updated central	Uniform	64.3
Proponent estimates	base case ($100/t)	updated central	Dual	24.6
25% higher	base case ($100/t)	updated central	Dual	9.6
Proponent estimates	25% higher ($125/t)	95th percentile	Dual	-53.1
25% higher	25% higher ($125/t)	95th percentile	Dual	-68.1
Proponent estimates	base case ($100/t)	95th percentile	Uniform	-71.2
25% higher	base case ($100/t)	95th percentile	Uniform	-88.6

Project costs[1]	Coal price	Social cost of carbon	Discounting approach	NPV (million 2021CAD)
Proponent estimates	25% lower ($75/t)	updated central	Uniform	-117.2
25% higher	25% lower ($75/t)	updated central	Uniform	-134.7
Proponent estimates	25% lower ($75/t)	updated central	Dual	-139.9
25% higher	25% lower ($75/t)	updated central	Dual	-154.9
Proponent estimates	base case ($100/t)	95th percentile	Dual	-217.6
25% higher	base case ($100/t)	95th percentile	Dual	-232.6
Proponent estimates	25% lower ($75/t)	95th percentile	Uniform	-270.1
25% higher	25% lower ($75/t)	95th percentile	Uniform	-287.6
Proponent estimates	25% lower ($75/t)	95th percentile	Dual	-382.1
25% higher	25% lower ($75/t)	95th percentile	Dual	-397.1

Notes: 1. For the sensitivity analysis scenarios presented, project costs refer to all of capital, operations, and reclamation costs.

Another typical output of CBA is a project's internal rate of return (IRR), which is the discount rate at which a project is worthwhile from an investor's point of view. Generally, the IRR needs to be greater than investors' cost of capital, which is generally 10% or higher, to support a positive investment decision. In this case, taxes paid to government matter, as the mathematical test looks at the Project from the investor's point of view, but the social cost of carbon and other externalities do not matter as these costs are not (directly) paid by investors. Under the scenario using TCL's cost estimates and the base case coal price, the IRR for project years -0.5 to 21 is 7%, and with the same parameters but 25% higher costs, the IRR is 5.5%. In scenarios where the coal price is 25% higher, then the IRR is over 20%, but in scenarios where the coal price is 25% lower, the IRR is worse than 0%. Generally, the IRR results suggest the Project is not a worthwhile private investment, and if the investment is made, that there are risks with respect to government benefits and government and taxpayer costs.

A third output of CBA is the break-even price – the average coal price over the Project's operational lifespan needed to make the Project net positive. The 'social break-even price' is the price from a societal point of view, and in the case of my Tenas CBA, which includes not just financial impacts but also monetizes the social cost of carbon, any calculation of a break-even price assumes substitutability of natural and human capital, which is a 'weak sustainability' point of view (e.g., Ayres et al. 2001). With these caveats, under the scenario of proponent cost estimates, the 'updated central' estimates of the social cost of carbon, and the dual discounting approach, the social break-even price is \$96.27, but under the '95th percentile' estimates of the social cost of carbon, the price is \$133.08. Under the same conditions but the uniform discounting approach, the break-even prices are \$89.73 and \$108.94. The break-even prices are higher if Project cost escalation is assumed.

3.11 Interpretation of CBA Results

The underlying decision criterion of the 2002 *EAA* is whether or not a project is in the public interest (see ss.6, 17, and 31). TCL makes no direct analysis of the public interest case for the Tenas project in its EA application, and in some respects TCL confuses matters through the erroneous application of EconIA. In this report I present my own analysis of the public interest case for the Project using the standard method in economics designed for this purpose: CBA. While my CBA is limited in its scope due to time and budget constraints, the results are nonetheless informative.

The results of my CBA suggest strong caution with this Project. More than half (58%) of the scenarios tested result in a negative NPV, suggesting that the Project is not in the public interest. Of the smaller proportion of scenarios (42%) that resulted in a positive NPV, a result suggestive of a positive public interest case, most of these (60%) rely on an assumption of a 25% higher coal price, which is doubtful given international energy forecasts, industry trends, and climate policy expectations. Furthermore, all of the scenarios actually over-estimate NPV because none incorporate a variety of known but unquantified costs of the Project acknowledged by TCL as covered in ss.3.5 to 3.7 of my report.[5] Compounding this, the social cost of carbon estimates used likely underestimate climate damages given the global observation that climate change is worsening.

In non-technical terms, the Project's public interest case is in doubt because:

- Project costs are likely to be higher than what TCL estimates,
- Project revenues are at risk because of a poor outlook for the coal market over the Project's lifespan,
- there will be no incremental employment benefits from the Project,
- government benefits have not been validated, and incremental costs to government have not been tallied,

[5] Unquantified benefits are also excluded, but they are expected to be small – see s.3.7 of my report.

- other financial interests will be affected, increasing the costs of the Project on society, and
- a variety of environmental and other costs will be incurred, and the various benefits that TCL lists (e.g., minesite tours) appear minor,

all contributing to a disproportionate number of scenarios resulting in negative NPVs, low IRRs, and high break-even prices.

A serious concern of coal mining is mitigation of environmental impacts like potentially acid generating materials and selenium pollution, and eventual reclamation of the mine site upon mine closure to deal with these and other environmental impacts, and these concerns are at the heart of a key economic impact issue. Coal mine mitigation and reclamation are costly, and there is ample uncertainty about success, translating to risk of high cleanup costs and/or reclamation failure (ultimately resulting in legacy costs on society). While new BC policy regarding the financial security that new mines must provide may lessen this risk, the fact remains that there is substantial risk of ongoing and lasting environmental and associated economic costs. In a context of a declining market for coal over the Project's lifespan, there is a real risk that the revenues that mitigation and reclamation depend upon may not be available.

The two key parameters of the CBA were found to be coal price and the social cost of carbon associated with the Project's GHG emissions. Both of these parameters have at least a moderate relationship to climate change and climate policy. The future coal price that would be obtained by TCL will be shaped substantially by climate policy. TCL argues that there will be a strong market for steelmaking coal throughout the Project's life, but two of the most prominent international energy forecasts anticipate moderate to rapid decline in market demand. With climate change worsening, both energy forecasts note that climate policy must strengthen, and if it does, then the market demand for coal in all industries will diminish. Worsening climate also translates to greater a social cost of carbon for each new volume of GHG released, diminishing the value to society of a coal mine.

4. Conclusions

TCL proposes to develop the Tenas project near Telkwa, BC. The Project is currently being reviewed under EA legislation overseen by the BC EAO. The underlying decision criterion is whether or not the Project is in the public interest. The 45-day comment period on TCL's application will end on July 3rd, 2022.

TCL hasn't demonstrated that the Project is in the public interest, explicitly or implicitly. TCL's analysis of economic benefits relies upon flawed methodology, the limitations of this methodology are not transparent in TCL's application, and TCL has not been transparent about a key parameter foundational to the Project's economic benefits and public interest case – the future price of its coal.

The Northwest Institute is concerned about the economic benefits and impacts of the Project in light of environmental and other impacts of the Project and in the context of the public interest case for the Project. In this context, the Northwest Institute hired me – Dr. Chris Joseph of Swift Creek Consulting – to prepare an assessment of the Project's net economic benefits and comment on the Project's public interest case.

The evidence that I have gathered through the use of CBA casts serious doubt on whether the Project is in the public interest. CBA is the standard method in modern economics for assessing a project's net economic benefits and for evaluating a project's public interest case. While CBA was not required under the 2002 BC environmental assessment law that TCL chose to conduct its assessment under in 2022, modern environmental assessment in Canada recognizes the limitations of TCL's methods of assessment and the analytical value of CBA to major project evaluation.

To fill this information gap, I examined: Project costs, Project revenues, employment, government revenue and costs, impacts on other financial interests, and environmental and other benefits and costs. Uncertainties in these parameters were considered, and all were considered in terms of their time-value.

The results of my analysis suggest that the Project is not in the public interest. Fourteen (58%) of the scenarios resulted in a negative NPV, suggesting that that Project will not be a net benefit to society. The private investment case is also weak: under the scenario that uses TCL's cost estimates and the base case coal price, the IRR is 7%, and with the same parameters but 25% higher costs, the IRR is 5.5%, both substantially lower than typical investor expectations. In scenarios where the coal price is 25% higher, then the IRR is over 20%, but given international expectations that the future coal market will weaken over the life of the Project, such scenarios are unlikely. The break-even price for the Project is also high relative to historical and expected future coal prices. No incremental employment benefits are expected due to current and anticipated labour market conditions, and the many environmental and other impacts and risks pose further reasons to be skeptical about the Project's public interest case.

Overall, it is hard to see a positive public interest case for the Tenas project. TCL's application provides insufficient information on the Project's economic benefits and public interest case, and the information that I have gathered through my analysis helps fill these gaps, indicating that the future coal market, costs of development, the social cost of carbon, and the risks posed by coal mining to the environment and taxpayers all conspire against the Project's public interest case.

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Source

TECHNICAL MEMORANDUM

Date: July 4, 2022

To: Pat Moss, Northwest Institute

From: Patrick Littlejohn, Ph.D., P.Eng.

Subject: Technical Review of Tenas Coal Environmental Assessment Certificate Application

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Background

Source Environmental Associates Inc. (Source) was engaged by the Northwest Institute to conduct third party technical review of the Tenas Coal Project Environmental Assessment Certificate Application (the Application). This review was conducted by Dr. Patrick Littlejohn, P.Eng., Senior Chemical/Metallurgical Engineer with Source and a Qualified Professional in BC in the area of mine water treatment and discharge planning. This review was conducted to support the Northwest Institute during the public comment period for the Application.

This review was conducted with the following focus areas and questions in mind:

1. Geochemical sampling program – are the mineral samples collected representative of coal ore, ore halo & waste rock? Was the geochemical testing program rigorous? How much selenium is present in project rock?
2. Source control – does the Project apply appropriate Acid Rock Drainage (ARD) mitigation measures in ways that make sense and align with overall mine plan and water balance (i.e. Potentially Acid Generating (PAG) rock submergence, waste rock pile design)? What is the potential for selenium release?
3. Site water balance – is site water management infrastructure robust and capable of handling a wide range of weather conditions (i.e. wet years, dry years, extreme weather events)?
4. Mine contact water quality – how contaminated is mine contact water expected to be and are predictions reasonable? How sensitive are predictions to things that may be uncertain, like PAG characterization, site water balance?
5. Water treatment approach and capacity – how is water treatment applied, and are water treatment goals achievable with the technologies describe? Is water treatment capacity sufficient? Will treatment address potential selenium contamination?
6. Discharge location – does the project design follow BC best available technology/initial dilution zone policy?

Summary of Findings

Significant risks were identified with the Application in each of these subject areas. To summarize:

1. The geochemical sampling program is not sufficiently robust to characterize the ML/ARD potential of the disturbed material. The proposed approach to MLARD management relies entirely on source control, which leaves no room for error in materials identification and handling. Significant risk of onset of acid rock drainage, neutral metal leaching and selenium contamination exists with the proposed project.
2. The Application contains insufficient evidence/analysis supporting the idea that the implementation of source control is practical and can be executed under a range of climate conditions or in the context of geochemical uncertainty.
3. The Application includes water management features that are designed to meet 1-in-10 year storm events. Discussion of variable climate conditions (i.e. climate change) are limited. Given that the project is to operate for over 20 years with a total lifespan including closure/post-closure of close to 50 years, use of shorter or less conservative design basis adds risk of impacts to the environment.
4. Expectations of mine water quality are optimistic and do not entertain the possibility of onset of ARD if any aspect of the mine plan does not go according to plan (i.e. mishandling of PAG material, failure of source control measures, higher than expected geochemical source terms, or flushing of oxidation products prior to material submergence).
5. Water treatment is not included in the application. Any contamination that occurs in mine contact water is proposed to be released directly to the receiving environment without treatment. This is a significant deviation from best practices in BC and represents a major risk to the downstream environment.
6. The Application proposes site specific water quality targets that are significantly less conservative than BC's generic guidelines using a process that does not align with BC's policy. The Application does not include use of Best Available Technology to prevent contamination and so does not follow BC policy on initial dilution zones.

Overall, the project design is predicated on an optimistic interpretation of limited geochemical data and the ability to execute a mine waste and water management strategy with little margin for error. Modeling conducted by the proponent indicates that they expect the immediate receiving environment to be degraded with mine-borne contaminants including a 200 fold increase in selenium concentration in local creeks. The project does not follow BC policy on application of Best Available Technology to prevent contamination in the downstream environment. All of these factors mean that there is significant risk of the project having both short and long term negative impacts on water quality in the downstream environment.

Documents Reviewed

To conduct this review, Source reviewed the Application as available on the the Environmental Assessment Office Project Information Center (EPIC), including the following project related documents:

- 01.0 – Project Overview
- 04.3 – Surface Water
- 13.05 – Discharge Management Plan
- 13.06 – Explosives Management Plan
- 13.11 – Minesite Water Management Plan
- 13.12 – MLARD Management Plan
- 13.15 – Reclamation and Closure Plan
- Appendix 01.0 – AD Closure Cover Assessment
- Appendix 01.0 – AE Initial Dilution Zone Modeling
- Appendix 01.0 – F Water Management Report
- Appendix 01.0 – M Supplemental Geochemical Characterization
- Appendix 01.0 – Q PAG Management Alternatives
- Appendix 13.5 – B Water and Load Balance Report
- Appendix 13.5 – G Selenium Bioaccumulation Model
- Appendix 13.5 – J Selenium Management Plan
- Appendix 13.5 – K Calcite Management Plan
- Appendix 13.12 – A MLARD Characterization
- Tenas Metallurgical Coal Project Definitive Feasibility Study Results (March 2019)

The purpose of this memo is to summarize Source's findings on the focal questions and related topics.

Comments on the Application

1. Lack of Appropriate Water Treatment and Failure to Follow BC Policy on Initial Dilution Zones

The Application identifies the significant risks of acid rock drainage, selenium contamination, and blasting residues that will contaminate mine contact water. However, the Application fails to propose any water treatment beyond sedimentation, which will at best address only suspended solids in mine contact water and not any dissolved species. This is wholly inappropriate for a greenfield project and represents a failure to follow BC's policy on use of an initial dilution zone in mine water discharge planning. Technical Guidance 11, <u>Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations</u> (April 2019) states the following:

> *The Ministry of Environment and Climate Change Strategy (ENV) considers an Initial Dilution Zone (IDZ) only for authorized point source discharges to surface water and only if the following conditions are met:*
>
> *a) Best management practices (BMPs) for preventing or limiting harmful impacts to the environment should be applied;*
>
> ***b) Best Achievable Technology (BAT) has been considered in the proposed discharge plan. An IDZ should not be used as an alternative to reasonable and practical treatment of effluent or effluent stream.***

The Application does not include a Best Available Technology assessment or ‘reasonable and practical treatment of effluent’, meaning that the use of an IDZ is premature and inappropriate. The Application describes use of source control to prevent onset of ARD. Source control indeed falls under best management practices, but source control alone is not a sufficient mitigation for preventing impacts to the receiving environment from mine water discharge. The Application mentions active treatment as a potential contingency but no further information about the nature of such a contingency, how it would be executed, or what would trigger its execution was included in the Application.

There is no shortage of reasonable and practical water treatment approaches that could be considered for the Project that have precedent in BC. Treatment of ARD, neutral metal leachate and nitrogen species is very common. The application focuses on the risk associated with PAG rock and onset of ARD, but neutral metal leaching can release environmentally relevant concentrations of metals including selenium, zinc, cadmium and copper. Similarly, nitrogen species such as ammonia, nitrate and nitrite enter mine contact water through residue leftover from blasting. They dissolve in water readily and can have negative environmental impacts. Source control as described in the Application can be effective at preventing ARD but does not prevent other mechanisms for contaminant release into mine contact water.

The following section lists some relevant reference mine sites from BC that use active water treatment but is not an exhaustive list:

- Equity Silver, Britannia Mine - historic sites that use lime neutralization to treat ARD
- Silvertip (Coeur) - operating mine that treats metals and nitrogen species from contact water
- Premier (Ascot) - brownfield mine that includes a metals and nitrogen treatment system to support mine restart
- Blackwater (Artemis) - greenfield mine that includes water treatment for ARD, metals, nitrogen species and sulphate

- Cariboo Gold (Osisko) - brownfield mine that includes water treatment for ARD, metals, nitrogen species and sulphate
- Kemess (Centerra) is a brownfield mine that uses ion exchange for selenium and precipitation for neutral metal leaching

In BC's coal sector, a wide array of water treatment approaches have been implemented to remove selenium from mine contact water in response to the environmental impacts observed at some coal mines. For example:

- In the Elk Valley, Teck uses active biological treatment as well as saturated rock fill technology to remove selenium and nitrogen species from contact water in 3 separate treatment systems
- Brule (Conuma) uses biochemical reactors for selenium and nitrogen species removal from contact water
- The Wolverine-Hermann expansion (Conuma) proposes to use reverse osmosis and biological treatment to remove selenium and nitrogen species from contact water

All of these examples come from BC and include legacy, operating, and proposed mines. This indicates that practical and achievable treatment options exist to address the types of contamination likely to be generated by the Tenas project. Failure to consider these or other types of treatment in a Best Available Technology assessment indicates that the Tenas project is not following BC policy guidance.

Risk: The failure to follow BC policy on use of a Initial Dilution Zone and failure to include use of suitable water treatment that addresses the likely forms of contaminants represents a major risk for the project. Lack of treatment significantly increases the risk of environmental impacts in downstream creeks and rivers through increased release of contamination. If source control is less effective than expected and/or if disturbed material has greater metal leaching potential than expected then there is no backup mechanism to prevent contamination from entering the environment.

2. Contingency Water Treatment

The Application mentions active water treatment as a contingency that could be implemented if necessary. No information about what deployment of active treatment may entail or how it may be implemented is presented in the Application, so it is difficult to consider this as an actual contingency plan. That said, taking the statement at face value, there are two major challenges with implementing water treatment as a contingency, one financial and one practical.

Financial: The Application states that the project's initial total capital cost is estimated $123.5 M CAD. The total effluent flow rate ranges between ~16,000 m^3/d during operations and ~27,000 m^3/d during closure. The capital cost of implementing active treatment for ARD, nitrogen species and selenium as would likely be in the range of $10-30 M CAD depending on the nature of the system, with an operating cost of treatment in the range of \$0.5-1.5 CAD/m^3, or ~\$0.3-\$2.4 M CAD/a during operations given the amount of surplus water requiring management. These figures are an appreciable percentage of the total initial capital cost (~10-25%). While such a figure is achievable at numerous other projects in BC and aligns with best practices, a project like Tenas that is expected to generate a relatively small amount of revenue compared to the size of the environmental liability may find this level of financial burden unmanageable.

Further, if long term water treatment is required by a project then it is incorporated into reclamation security cost estimation and bonding for a site's environmental liability. If the cost of water treatment is not incorporated into the initial project plan and bond, then the mine operator may not be able to cover this liability if water treatment proves to be required later in the project. This risk is particularly relevant since onset of ARD typically occurs over a period of years, meaning that the need to execute contingency treatment may not be apparent until after a significant portion of the total project revenue has already come and gone.

This comment should not be misinterpreted - for many projects in BC the application of effective active water treatment is well within the financial capacity of the project. There are many such examples such as those listed in Comment #1. If a project is only financially viable if responsible management of environmental liabilities is excluded, then a project is not financially viable.

Risk: If the project were to proceed as proposed, then there would be a significant risk that treatment would be required, adding a significant unexpected financial burden to the mine operator. If the mine operator was not able to afford to implement treatment then the BC government/the public would be forced to cover the environmental liability of the project.

Practical: Given the limited water storage capacity described in the Application, there is likely to be insufficient time between recognition that contingency water treatment would be required and implementation of treatment at site to avoid uncontrolled release of water. In the event that contingency water treatment were required, the site operator would have to recognize this requirement, select and design an appropriate treatment system, construct, commission and then operate the system, all before water storage capacity at site was exhausted.

The Application states that in an average year the project is expected to release between 0.7 and 1.7 Mm^3 of surplus water from the site. The Tenas Control Pond is the main water storage body for the project and is designed to have a maximum capacity of approximately 1.0 Mm^3. With a minimum water volume of ~0.1 Mm^3 and a requirement to maintain ~0.1 Mm^3 of flood event storage capacity, the Tenas Control Pond would have approximately 0.8 Mm^3 of capacity at best. This is just over the amount of surplus water the site generates in an average year, and less than would be accumulated in a wet year. In practice, this would mean that all of the implementation steps listed above would need to be executed in ~6-12 months. This is not a realistic timeline for execution.

Risk: Implementation of contingency water treatment at site would likely not be achievable in the timeframe allowed by site water storage capacity. This would increase the risk of release of contaminated water to the receiving environment.

3. Relaxation of Water Quality Targets

The Application proposes use of Site Performance Objectives (SPOs) for selenium and other species rather than generic BC Water Quality Guidelines (BC WQG) as targets in the receiving environment. The proposed SPO for selenium is 0.008 to 0.034 mg/L compared to 0.002 mg/L as the BC WQG, 4 to 17 times higher than the generic guideline. Elsewhere in the Application, a discharge target of 0.05 mg/L selenium (25 times the generic guideline) is proposed. For reference, Goathorn Creek and other nearby watercourses have natural background levels of selenium on the order of 0.00015 mg/L, well below BC WQG and approximately 200 times lower than the proposed SPO.

Similarly, an SPO for nitrite of 0.0524 mg/L is proposed, above the long term (chronic) BC WQG of 0.02 mg/L and approaching the short term (acute) BC WQG of 0.06 mg/L. The natural background level of nitrite in Goathorn Creek is 0.0005 mg/L.

Use of site-specific targets rather than generic water quality guidelines is allowable in BC through development of Science Based Environmental Benchmarks (SBEBs). Development of SBEBs requires undertaking a rigorous process as per BC's policy document Technical Guidance 8, A Framework for the Development and Use of Freshwater Science-Based Environmental Benchmarks for Aquatic Life in Environmental Management Act Permitting for Mines (March 2016). Two critical criteria required before consideration of an SBEB can be entertained are:

- A Best Available Technology (BAT) study has been incorporated into the project
- Unique site characteristics such as high background water quality or absence of sensitive species in the receiving environment.

As stated in Comment #1 of this document, a BAT study including treatment of mine contact water has not been incorporated into the project. Natural background levels of selenium in the local environment are well below BC WQG. Appendix 13.5-G describes the selenium bioaccumulation model developed as the basis for the proposed SPO. The model is based on data from other sites and does not appear to use site specific data on the conditions and aquatic life in the local receiving environment. Technical Guidance 8 specifically states, "Development of an SBEB based solely on peer-reviewed scientific literature will not be accepted."

Technical Guidance 8 states that "only standard, peer-reviewed scientifically defensible models that are vetted through the ministry at the SBEB development plan stage are acceptable. For selenium bioaccumulation modelling, guidance on an acceptable approach is provided in the ministry's Companion Document to Ambient Water Quality Guidelines for Selenium Update (MOE 2014)." Detailed comparison between the modeling conducted and ministry guidance was outside the scope of this review but it is notable that the selenium SPO memo in the Application does not reference the cited Companion Document, nor does it provide a rationale for using the chosen models.

Overall, there does not appear to be reason to develop a site specific water quality target for the site instead of using generic BC WQG.

Risk: The proposal to significantly relax generic water quality objectives in the receiving environment may cause impacts to the receiving environment and aquatic life. Use of site specific objectives is not unheard of but requires a rigorous assessment to ensure that site specific objectives are still protective of the receiving environment. Use of SPOs as targets in the receiving environment rather than generic BC WQGs on the basis of data from other sites is a significant divergence from established policy in BC regarding the use of site specific water quality objectives.

4. Robustness of the Geochemical Sampling Program

A major risk of the project is the large-scale onset of ARD, which would add a significant load of metal contaminants and acidity to mine contact water entering the receiving environment. The Application describes how the primary means of mitigating this risk is source control, whereby potentially acid generating rock is submerged in management ponds and non-acid generating rock is used for covers, as construction material, dams, and is not submerged. If PAG material is left unsubmerged for the long term (i.e. used as construction material or incorporated into covers) then onset of ARD will occur and mine contact water will be contaminated. Since there is no active water treatment proposed for the project, there is no margin for error in the placement of PAG material. As such, a robust and conservative understanding of the geochemistry of disturbed material is required for this mitigation strategy to succeed.

The Mine Environment Neutral Drainage (MEND) ARD Prediction Manual which covers best practices on ARD management in the sector, describes minimum sampling frequency required to adequately characterize geochemistry of disturbed material and clearly understand potential for ARD. Table 1 below summarizes the number of samples required for assessing ARD potential. For large units of rock between 1 Mt and 10 Mt in size, MEND recommends that at least 26 and 80 samples are required to adequately characterize material sufficiently to understand its geochemical characteristics. Given the project design, whereby no active water treatment is proposed or feasible to implement in a timely manner (see Comment #2, subsection on practicality) and where determining the boundary between PAG and NPAG rock is of critical importance for executing effective source control, the geochemical program should be much more robust than the minimum guidance in industry best practices.

Table 1: Suggested initial sampling frequency based on tonnage when sampling without prior information (adapted from BCAMDTF, 1989), MEND 2009

Tonnage of Unit (metric tonnes)	Minimum number of Samples
<10,000	3
<100,000	8
<1,000,000	26
<10,000,000	80

The Application describes a number of categories of rock, including material from the different rock units/zones of the open pit, overburden, and materials that are proposed for use as construction material for the access road, rail station, etc. However, the Application does not clearly lay out the total tonnage of all units of rock and the corresponding number of geochemical samples collected. It is not clear from the Application if the sampling program conducted to date meets the minimum guidance suggested by MEND to understand ARD potential. This is a significant gap in the Application as a whole and in Appendix 13.12-A, the MLARD Supplemental Geochemical Characterization Report, as confidence on this topic is critical to prevent environmental impacts.

While the Application does not explicitly discuss the tonnage and number of samples of each rock unit and whether or not the program is sufficient to meet MEND's minimum guidance, Source found indications that the program is insufficient. Table 4-5 of Appendix 13.5, the water and load balance describes the tonnage of several different zones the Application identifies as PAG. This table states that the size of zones 1a, 55 and 6 are in the range of 4.5 Mt of material while zones 2, 3, 4 and 5 are over 10 Mt[1]. According to MEND guidance, these units would require minimum 26 and 80 samples to adequately assess ARD potential. Review of Appendix 13.12-A, shows that these zones of material were each sampled between 9 and 22 times, well below MEND's minimum guidance of 26 to 80 samples for rock units of this size. Further, the ARD maps in Appendix 13.12-A, the MLARD Supplemental Geochemical Characterization Report show a paucity of sampling on the central west portion of the pit.

A related concept is the distribution of minerals with acid generating/neutralizing potential in the bulk material. Depending on how acid generating and neutralizing minerals are disseminated throughout the material, then the functional acid generating potential and neutralization potential

[1] Assuming 2 tonnes/bench cubic meter of rock

of the bulk material may be over or underestimated. The difference in distribution could affect the timing of onset of ARD and should be assessed and incorporated into the choice of NPR ratio used for categorization of NPAG/PAG.

One other area of the Application where further detail is required is in the number of humidity cell tests that were used to inform source term development for use in the water and load balance for the project. Humidity cell tests are key geochemical characterization tests that reveal important information about both initial flushing of metals as well as long term potential generation of acidity. The water and load balance appears to use a very limited number of humidity cell tests to inform this model, which is a foundational to the overall water management strategy. Appendix 13.5, the model report, describes how certain humidity cell tests from highly PAG materials were excluded from the model on the basis that they are not representative of the bulk properties of the rock. Given the limited geochemical program conducted compared to MEND guidance, this statement is not sufficiently supported to make this claim.

Risk: The geochemical characterization program appears insufficient to confidently characterize material as PAG or NPAG and to quantitatively predict the quality of contact water from the site. Given that source control is the first and only line of defence against onset of ARD, uncertainty in geochemical predictions could lead to inappropriate mine design and subsequent impacts to the environment.

5. Neutralization Potential Ratio Threshold for PAG Classification

Neutralization Potential Ratio (NPR) is the relative magnitude of the neutralizing minerals (NP) and acid generating minerals (AP), which is the main criteria to classify materials whether it is PAG or NAG. The standard convention for NPR cut-off, assuming accurate AP and NP measure, indicates potentially net acid generating if NPR < 1, not potentially net acid generating if NPR > 2, and uncertain if NPR is between 1 and 2. The Application brings in the site-specific NPR value of 1.2 as the classification criteria for rock mined at the site. This implies that any mine rock material with NPR less than 1.2 is considered PAG, and it is NAG material if otherwise. For all other materials (overburden, processed rock, and coal) a NPR threshold of 2 is selected.

The geochemical properties of the deposit are described based on the stratigraphical zone. A total of 21 drill holes were distributed around the proposed pit area to sample different zones of material. The geochemical testing results indicate that all zones contain some PAG material, but with the use of the site-specific NPR and the average bulk properties, the ARD potential of the stratigraphical zones was classified as follows:

- PAG: Zone 1a and Zone 2/3
- Non-PAG: Zone 1, Zone 4, Zone 5, Zone 55, Zone 6, Zone 7, and Zone 8

The choice of NPR threshold will have a significant impact on the amount of NPAG material available for construction and the amount of PAG material requiring submersion.

Risk: Use of a PAG/NPAG threshold of 1.2 is lower than standard industry practice and appears to not be conservative, as there is little margin for error given the size of the rock units and the wide use of material classified as NPAG as construction material. Sensitivity analysis associated with the NPR cutoff threshold with respect to construction material availability and management pond capacity is warranted. As observed in each stratigraphic zone, areas with NPR far less than 1.2 are present in the NAG classified zone, some of which are concentrated at a particular section of the zone. Even if the material used for construction material, dams, or etc., is considered as NAG based on the average bulk properties of the zone, there is still potential for portions of PAG material not being submerged and contaminating contact water in the future.

6. Availability of the Proposed Coverage for PAG Rock and Construction Materials

Chapter 12 (ML/ARD) lays out the requirements for management of PAG material to mitigate risk of oxidation, metal leaching and acidity. These mitigation measures for various areas of the mine include coverage with various depths of inert materials salvaged during the mining process. Moreover, various construction materials will be sourced onsite including for construction of buttresses and dams. While the Application provides the schedule of production for different types of materials at the mine site, it is not clear if enough material will be available for implementation of the proposed cover or various aspects of construction as envisaged.

Risk: The primary mitigation measure proposed for ML/ARD mitigation from mining waste includes submergence of PAG materials to avoid release of contaminants. Failure to provide adequate coverage is expected to result in accelerated release of contaminants including sulfate, aluminum, arsenic, cadmium, copper and iron. The Application does not provide detailed discussion on the availability of NPAG material when needed for construction or the availability of pond capacity when PAG submergence is required.

7. PAG Material Submersion Timing

Chapter 12 (ML/ARD) states that coal samples were not included in the ML/ARD testing conducted recently but that historic testing has shown potential for immediate ARD generation. The plan also states that due to the uncertainty in the timing to the onset of acidic conditions in coal, stockpiles will be monitored and if acidic drainage occurs, the stockpile material will be placed in management ponds. The plan does not provide any details on the ability to submerge this material immediately within the management ponds. More importantly, the plan does not consider the impact of moving large quantities of already acidic and weathered stockpiles on the storage conditions of the management ponds. Although not evaluated in the Application, weathered and partially oxidized coal will release contaminants upon initial and continued exposure to water.

Risk: The timing and feasibility of submersion of any PAG material on site must be clearly presented in the Application including the potential movement of coal to the management ponds. This is a significant risk because the initial acidic plume and release of contaminants from weathered surfaces will add metal and acidity loading to water in the management ponds. This is a significant risk as no water treatment is available on site beyond sedimentation ponds.

8. PAG Materials Submergence in Dry Period

Modelling results presented in the water and load balance modelling report indicate periods of reduced process water supply during dry conditions. The report also states that the minimum process water volume has not been included in the model but that it is expected water supply will be maintained and that PAG materials will continue to be submerged. Evidence is required to support this statement and that the potential shortage of process water, or the presence of dry periods do not affect the submergence schedule for the PAG materials.

Risk: Process water needs may increase the likelihood of PAG exposure beyond the 6-12 months estimated in the Application, increasing the likelihood of onset of ARD.

9. Management of Zone 7 Material

The geochemical testing on Zone 7 results in numerous sampling locations with NPR less than 1.2, indicating this material is potentially acid generating. However, according to the MLARD Management Plan, Zones 7 and 8 will be handled as NPAG and will not be submerged if there is a plan to mine this area. NPAG rock is prevalent in the northern, western, and southern part of the pit. However, the eastern section of the pit is filled with PAG rock.

Risk: Various samples within Zone 7 show NPR under 1.2, with several significantly less than 1.0. This material represents a significant risk of ARD if it is mined and handled as NPAG.

10. Acid Generation Potential of Exposed Pit Wall

At closure, a high pit wall will exist above the pit lake composed mainly of Zone 6 sedimentary rock. Although the site-specific criterion concludes that zone 6 is NAG, the existing geochemical testing result within Zone 6 indicates various locations showing high acid generating potential. If PAG material is left exposed at the end of mining, onset of ARD will occur.

Risk: The exposed high wall of the pit at closure is expected to be a contributor of metals and acidity to the pit lake.

11. Availability and Geochemical Stability of Cover Materials

Overburden materials are planned for use in the construction of the dams and buttresses as well as for use as covers for PAG rock in management. The MLARD characterization report states that solid-phase analysis of samples of overburden materials showed appreciable quantities of metals including arsenic and cadmium. Arsenic, selenium, and other contaminants can be expected to be released from the material even under neutral conditions when exposed to the elements. The application states that overburden is depleted in sulfide and is expected to be NPAG with confirmatory testing planned at a frequency of one sample per 10,000 m^3 of excavated overburden. Metal leaching potential of these cover materials is important and must be considered in the water quality modelling. This is especially important for consideration in the analysis and modelling of seepage from the management ponds and other infrastructure.

Risk: If cover material is not suitable for use as covers owing to neutral metal leaching potential, then there will not only be reduced material available for covers, potentially reducing cover efficacy, but there may be additional material requiring covering.

12. Design Basis of Water Management Structures

The Application states that the Design Basis for operations phase diversion channels is to meet the 1 in 10-year 24-hour storm event for erosion protection (Table 6.3-2 of Minesite Water Management Plan). It is not clear if or how climate change was factored into this 1 in 10-year 24-hour storm event design basis. In any case, given that the proposed duration of the operations phase is 26 years, this design basis does not seem sufficiently conservative as it implies reasonable odds that the diversion will fail multiple times in the project lifespan. Erosion of engineered channels may deposit sediment into the receiving environment.

Similarly, Table 6.3-16 in the Minesite Water Management Plan describes that the minimum retention volume for sedimentation ponds including the Tenas Control Pond are based on the 1 in 10-year 24-hour flood event. Water inflow beyond this would be discharged via the pond spillways into the receiving environment.

Risk: Several water management features are designed using the 1 in 10-year 24-hour storm event as the design basis. Given that the total project lifespan is to be over 20 years of operations followed by closure, the 1 in 10-year basis is insufficient as failure and challenges with mine water management are likely to occur.

13. Release of Seepage and Contact Water at Closure

During operations, seepage from the East and North Management Ponds is to be collected and directed to the Tenas Control Pond via the channels C-01 and C-03. At closure, these two channels are to be breached and seepage from these ponds will be released directly to the environment. While waste rock and processed rock in the management ponds are to be submerged at this point, neutral metal leaching and reductive dissolution can contribute environmentally meaningful loading of contaminants even in the absence of ARD. Should metal loading from materials be greater than anticipated by the project proponent, large revisions would need to be made to the design of mine water management infrastructure to allow capture and containment of contact water.

Risk: The quality of seepage and other contact water at closure could be poor owing to reductive dissolution and neutral metal leaching from material in management ponds. Like the operations phase, the proposed closure plan for the project involves release of seepage and contact water to environment without treatment. This could impact water quality in Goathorn, Tenas and Four Creek and the downstream environment. Further evidence of this risk is provided in Appendix 13.5B, the water and load balance, which identifies seepage as a driver of exceedances of water quality guidelines in closure.

While the risk associated with release of untreated contact water to the receiving environment exists during both operations and closure, the risk is higher during closure for two main reasons. First, onset of ARD is generally a gradual process that occurs some time after material has been placed. As such, overall contamination and metal loading is likely to be worse in the later stages of operation and into closure than at the beginning of operations. Second, notwithstanding Comment #2 on contingency water treatment, during operations the site would be staffed and earning revenue, making it more likely that contamination would be observed earlier. In theory, the mine operator would have the financial means of executing mitigations if contact water was significantly contaminated during operations. In contrast, once the project is closed and no longer earning revenue, then the likelihood of implementing timely and effective mitigations drops precipitously.

14. Care and Maintenance Planning

Care and maintenance or temporary closure is an important aspect of mine planning. The potential for environmental impacts is significantly increased when a project is designed assuming a straight path from construction through operations and into closure/post-closure. Many mines in BC have entered period(s) of care and maintenance and can do so without a need to amend a permit or without any significant warning. Best practice is for mine proponents to evaluate a potential prolonged period of care and maintenance with water balance/water quality modeling and assessing the level of environmental risk.

Risk: Care and maintenance is not discussed in the Application. In the context of the Tenas Project, a significant risk during a period of care and maintenance is that disturbed PAG material that has not been placed and covered will generate ARD, causing contact water from site to be much more contaminated than would be expected in the case of going straight from operations to closure.

15. Integration of Mill Reagents into Water Quality Modeling Source Terms

The Application states that the water used for coal processing will be recycled. However, the use of chemical mill reagents do not appear to be considered in the development of source terms used for water quality modelling. The impact of recycling process water on mill process efficiency does not appear to be considered in the Application. The effect of accumulation of organic reagents (collectors and frothers) on process efficiency may limit the recyclability of process water.

Risk: If process water is less recyclable than anticipated then process water would have to be bled into the control pond, ultimately reporting to the environment without treatment. The lack of consideration of process reagents on water quality modeling is a gap in the Application.

16. Metallurgical Coal versus Thermal Coal

The Application describes the Tenas project as a metallurgical coal mine, i.e. coal extracted is suitable for steelmaking rather than thermal coal used for power generation. The Application describes variability in the coal ore in terms of moisture content, rank etc. but it isn't clear if the proponent expects that all coal produced would be suitable for steelmaking. Often coal from a single mine varies by rank, meaning that a portion is sold for steelmaking and a portion is sold for power generation.

Risk: The absence of discussion on whether any portion of the coal is expected to be thermal is relevant because the markets of the two products are different and their marketability may vary over the 20 year proposed life of the project. While steelmaking coal is expected to be in demand for the near future as alternatives to metallurgical coal are developed and deployed, demand for thermal coal is already softening owing to increased use of alternative power generation methods that are less carbon intensive. If the project is relying on revenue from thermal coal and thermal coal demand falls (or is subject to carbon taxes, etc.) then part of the project assets may become stranded, heightening environmental risk due to increase financial stress on the mine operator.

17. Contingency use of Management Ponds as Saturated Rock Fills

The Water and Load Balance report states that the management ponds could be used as saturated rock fills to remove contaminants from water (see Comment #1). However, the Application provides no discussion of how the management ponds would be designed with this purpose in mind or how such a contingency would be executed.

Risk: Use of management ponds as saturated rock fills is not described in any detail. Without a basis for this assertion there is risk that this contingency measure is not practical.

Closing

Thank you for the opportunity to provide third party technical review of the Tenas Coal project. If you have any questions about the points raised in this document, please contact the undersigned.

Yours sincerely,

Source Environmental Associates Inc.
per:

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