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EA1415-01-Phase 2 Risk Assessment Technical Report Cover Letter Prairie Creek All Season Road

In this cover letter we condense the main lines of thought which form our opinion related to future risks along the road, based on existing CNZ documents/reports/records and Riskope's analyses performed to date.

The failure criteria for this access road risk assessment covers many aspects. Failure is defined in the report as at least:

- an event forbidding a truck, its cargo, or their drivers to reach their destination, OR
- an event with high potential impact on drivers, vehicles and their cargo, i.e. those where a truck or parts of it go off-road (off-road excursions), OR
- events with various levels of impact on the environment involving a truck or its cargo.

Risk is the chance (probability of occurrence) of a failure (undesired event, for example a concentrate truck accident) TOGETHER with its potential damages to people (H&S), the environment, the business, etc. (the Consequences). The undesired event constitutes the

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hazard situation (example: a truck accident at km xx of the road due to a rock sitting on the road).

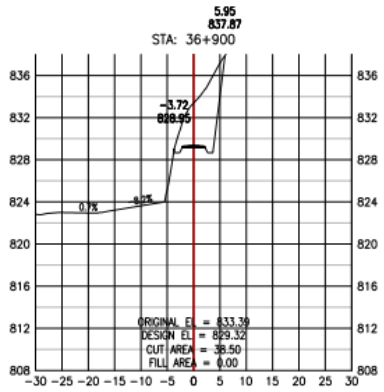
Consequences of accidents are a function of type of cargo, i.e.:

- concentrate,
- environmental significant cargo like, for example, mill supplies and reagents (e.g. Soda ash, Sulfuric acid, Diesel, etc...),
- empties, and

the environment (water courses, wildlife, sensitive drainages) as well as local topography (how steep, how far a vehicle may slide, roll or fall off the road).

Chances of accident are a function of:

- local road characteristics,
- drivers attitude and psycho-physical shape,
- meteorology (slippery road),
- occurrence of natural hazards (before transit or during transit).



Cross section example: 7 m "vertical fall" and high cut in rock at km 36.9. Implementation of berms/barriers downhill-side, gabions uphill-side seems difficult due to the lack of space.

For communication ease we have transformed chances (probabilities) of accidents in number of expected accidents over the service life of the road.

The Prairie Creek All Season Road project (the project) has adopted forestry road standards and selected a minimal width that, as noted in the selected standards, does not allow for any slippage of vehicles. We note that 5m or 4m wide running surface with no shoulders correspond to a narrower effective road width, in particular with respect to the selected slopes of the fills.

The elements above lead to a particularly troublesome situation for two main reasons:

1) hauling concentrate and environmentally significant loads has a very different potential impact than hauling wood logs (e.g. increases the risk because the consequence part of the risk equation is increased).
2) The narrow roadbase will make it very difficult (impossible?) to install barriers or berms (to avoid vehicles to "fall off" the road) in areas that would require them (See cross section example figure).

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Bridges at 4.3m width (with rather tight approach curves) and narrow sections at 4m width are also present. Width mitigation is proposed in the form of pullouts (one per kilometer).
It is considered that this specific mitigation would be sufficient provided the:

- traffic is regulated as proposed (one convoy leaving in the morning, coming back in the afternoon,
- NO private traffic,
- every concentrate or maintenance or "bypasser" (i.e. maintenance workers) constantly linked by radio, etc. and
- all conditions and assumptions described in the report are complied with.

Retaining walls and shoulders are cited but are not present in the design presented so far. It is unclear how certain road fill will be built, although the use of rock blocks and gabions has been cited. The areas that would require the most robust barriers are those along the creeks and other sensitive environments, bridges approaches, etc. Given the cross section of the road, placing any barrier seems impossible in many locations, both from an available space and foundation point of view. Thus, it may well be that, if the road is permitted as proposed, no barriers will be implemented for reasons that are already evident today. Snow removal will only complicate matters further.

Cargo safety rules should be adapted to this project that will carry environmentally sensitive cargo through environmentally sensitive areas with no barriers, a minimal width road, where any slippage may result in an off-road excursion, leading up to catastrophic accidents.

At present, the road design is known with detail for less than 20km over a total of 180km, through drawings sheets called Stratifications 1 to 10 and some so called Special Sections. CNZ has declared the drawing are representative of the entire road, Stratification per Stratification. However, there is no way to ensure that statement is correct especially as CNZ has declared they have not developed the entire project. Also for example not a single U turn (switch direction) is noted on the Stratifications drawings whereas CNZ has indicated the intention to build one every 10km.
Thus Riskope's report takes Canzinc statement that Stratifications are representative and assumes that the risks developed for each Stratification segment can be extrapolated to the entire Stratification. Obviously, due to the lack of cross sections, this introduces an uncertainty.

We compared our study's forecast (number of serious/very serious accidents with the presently proposed level of mitigation) with real life roads for which we had factual accidents numbers. The comparison seemed reasonable and comforted our belief that we

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have built a realistic, although approximated model (e.g. number of off road excursion of various Consequences). We noted that the rate of accidents in the real life roads was considered unacceptable by their respective owners or the competent authorities after the accidents occurrences (which justified their request for a risk assessment and mitigation studies). The root causes for those real life accidents were driver-related and not natural hazards related. We have found a similar result in this study, with the limitations explained below.

In IR#2, question 8, Canzinc provided a number of accidents (ranging from minor to catastrophic consequences) they would consider acceptable. The CNZ acceptable numbers are significantly lower than the risk assessment forecast for some Consequences Classes, in particular:

- Minor (of little concern, but may be the "seed" for more critical accidents as getting used to small recurring events, not adjusting to act on them, will lead to catastrophic events).
- Significant (in general due to environmental concerns, wildlife) and
- Serious to Very Serious (2 to 5 times larger forecast on events that would be considered acceptable if they occurred 2 to 0.1 time during the entire service life)

This demonstrates an insufficient level of mitigations to reach CNZ's own expectations.

The geo-hazard risk assessment done by Tetra-Tech and the avalanche study performed by Alpine were used in the report. We understand both of them are preliminary as the first focuses on larger, low velocity events (for example landslides and some rockfalls) and the second states a path forward in terms of detailed assessment and specific mitigative measures. In our experience, especially in areas where roads run at the toe of scree, surmounted by rock faces, high velocity-small volume events can generate high risks to infrastructure and traffic. The same can occur from high cuts in rock (as the one depicted in the cross section above). Highway department in mountainous/rocky areas (BC, NY, WA, OR, Switzerland; Canadian and US railroads) have the knowledge that those man-made slopes generate frequent and damaging slides and rockfalls which have not been evaluated to date due to lack of information.

The care that CNZ will take in designing and performing the cuts, together with possible mitigations will dictate the increase/or decrease of risks. Only a study of man-made cuts for the whole road could help to understand how the risk is changed. Risks could be reduced in various environmentally sensitive areas with beneficial effects to the overall project. Residual risks could be brought to accidental tolerance level if detailed analyses of mitigations is carried out and mitigations are then implemented and monitored.

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In the absence of detailed drawing of the entire road, the riskiest locations have been defined by Stratification type as listed below. The highest risk locations are those where Serious to Very Serious accidents could occur, followed by those characterized by Significant consequences on the environment. Risks are generated by a combination of road hazards and natural hazards.

- Stratification 1-4: bridges, watercourses and caribou & Arctic Grayling population.
- Special Sections: high embankments, presence of creeks, significant down slopes, caribous and Arctic Grayling population (in the first segments of the road).
- Stratification 5: presence of sensitive drainages proximity to creek.
- Stratification 7-8: water crossings, drainage and karstic environment.

The list above can be approximately summarized by kilometers as follows:

- The first 40kms of the project, in particular nearby river crossings, when adjacent to water courses, or nearby wildlife locations, such as for example Stratification 2 (km 6.5-13) corresponding to Funeral Creek and Stratification 3, 4 from km 23.8-39.4 corresponding to the Sundog sector have high forecast consequences. The same occurs for six Special Sections also located within the first 40kms.
- Stratification 5 is located between km 86.3-90.3 with mostly minor consequences, increasing in the vicinity of water courses and crossing.
- Stratification 7 is is split in 9 sub-segments from km 39.4-143.1. Consequences are high nearby sensitive drainages, benign elsewhere, but drawings only cover 2.5km out of over 50km, leaving great uncertainties.
- Stratification 8 covers a total of 6 km split in three sub-segments as follows: Poljie Creek km 50.9-53.9, Fishtrap Creek km 94.3-95.3, Grainger River km 124.3-126.3km

IN CONCLUSION:

It becomes apparent that mitigations, as proposed to date, are not sufficient to bring the risks within the accidental tolerance levels described by CNZ. The main reasons are:

- the environmentally sensitive context of the project, and, closely related,
- the local topography,
- the narrow roadbase, which does not consider any margin for slippage of the vehicles, especially as there are doubts related to the feasibility of protective works, such as berms, in many environmentally sensitive locations, and
- the lack of details related to future man-made slopes risks and high velocity-low volume rockfalls.