Memorandum

To:	Lou Kamermans
From:	Mike Setterington, R.P.Bio.
Date:	July 23, 2019
Project No:	19Y0006
Re:	Railway Embankment "Sensitivity" Analysis for Caribou Crossing Potential

The Government of Nunavut (GN) in technical comment GN-TCR 12 and follow-up specific request from Technical Meeting 1, requested that Baffinland provide a "sensitivity" analysis of the railway embankment as a potential barrier to caribou movement. Specifically, Baffinland was requested to "*… re-analyze the potential impacts to caribou crossing of the railway. This re-analysis will include alternative combined embankment + superstructure + rail heights of ≤1.5, ≤2.0, and ≤2.5 metres, and slope and embankment grain size as potential barriers to caribou movement.*" This request was made to address the uncertainty of the height criteria used for the Approved Southern Rail and Phase 2 Northern Rail presented in Figure 1 of TSD 10 (attached below). Those criteria did not consider grain (material) size. This memo focuses on the alternative analyses of differing embankment height criteria.

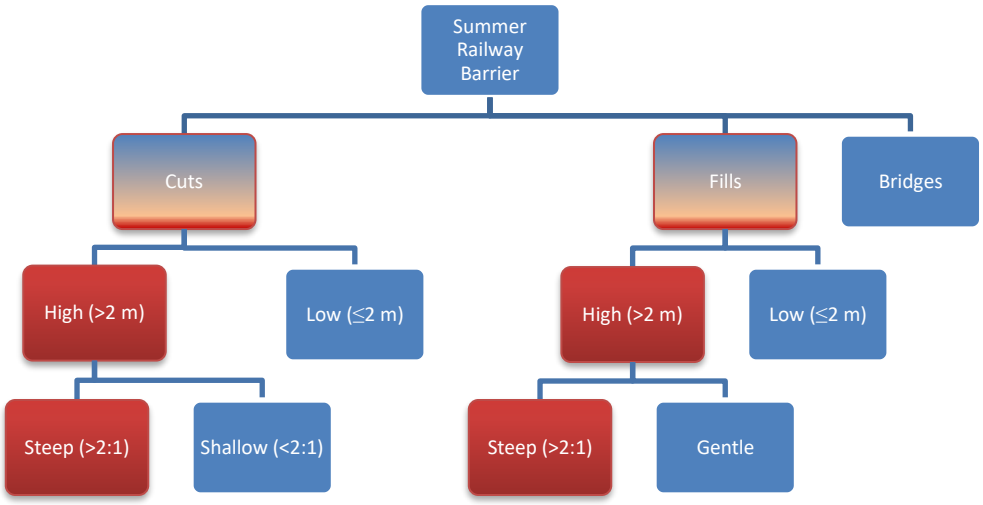

Figure 1. **Flowchart for determining the potential of the Railway or Road embankment to be a physical barrier to caribou movement.**

The Issue

Some of the key issues raised by the GN regarding the railway embankment as a potential physical barrier to caribou movement were that:

- Most of the embankment length is higher than set criteria (> 2 m)
- The initial assessment did not include height of "superstructure"
- The boulder material used as part of Run of Quarry material is likely too large and may entrap caribou legs
- The slope may be too steep along most of alignment (when compared to the 2H:1V (<~26˚ slope suggested for mitigation, as is used at Ekati Diamond Mine (e.g., Dominion Diamond 2015)

The "Sensitivity" Analysis of Embankment Height

Using height criteria alternatives from ≤ 1.5, ≤2 and ≤ 2.5 m, potential permeability in the absence of any other mitigation ranges from 19 to 43% (Table 1). Without further mitigation by design (e.g., flattening slope to anything as gentle or gentler than 2H:1V [26˚ slope], filling larger rock voids with finer material) up to 43% of the northern rail may be suited for caribou crossing. As a conservative approach (i.e., overestimating a potential negative effect), we are assuming that none of the cut sections are permeable, but approximately 50% (of 17.7 km) of cuts will be at a slope of 2H:1V ranging in depth from 0–10 metres.

Table 1. Potential proportion of the North Rail embankment that is permeable to caribou based on embankment height criteria

Embankment Height	Proportion of North Rail
≤ 1.5 m	19%
≤2 m	32%
≤ 2.5 m	43%

The numbers above do not suggest either a significant or not significant impact because of uncertainty in caribou response to structures in the north Baffin Island landscape, and in the absence of there being any significance criteria for this type of disturbance. Further, this analysis is oblivious of local knowledge by the expectation for specific criteria of where caribou will/will not cross the rail, based on measures of embankment height, slope and "grain" size of material used for embankment construction. A further consideration is the adjacent landscape, and whether the rail crosses through low, flat, elevated, or rough terrain, or along the base of a cliff (as it does near Milne Port) where caribou are either not crossing, or would be moving in alignment with the direction of the rail. These numbers alone are not reflective of the absolute permeability of the rail line.

Path Forward

To better address the possible uncertainty about caribou crossing or not crossing a railway embankment, Baffinland has proposed an on-site workshop that will provide on-the ground experience with the landscape and proposed structure. This workshop will include land users from Pond Inlet and Igloolik familiar with the area and with caribou and human travel, the Qikiqtani Inuit Association, and the Government of Nunavut. The workshop will include an overview of this and other analysis, a review of known caribou movement patterns, on-site observation of the proposed route, and observation and discussion around constructed railway embankments that are replicas of what will be built for the northern rail. Baffinland feels that this empirical approach involving local Inuit knowledge holders is a more direct way of determining the risk of the rail embankment to disturbing caribou movement. A report of the workshop will be available by the end of August 2019.

Literature Cited

Dominion Diamond. 2015. Lynx Access Road Caribou Crossings Location and Design Plan. Submitted to Wek'eezhii Land and Water Board, Yellowknife, NWT, Canada. (http://reviewboard.ca/upload/project_document/EA1314-01_Ekati_Lynx_-_Caribou_Crossings_Plan_-_Lynx_Access_Road_-_Design_and_Locations.PDF)

Prno, J. 2017. Mary River Project — phase 2 proposal, technical supporting document no. 03: results of community workshops conducted for Baffinland Iron Mines Corporation's phase 2 proposal. Prepared for Baffinland Iron Mines Corporation by Jason Prno Consulting Services Ltd., Peterborough, Ontario.