SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	John Roberts, PEng, Vice President Environment	**Client:**	TMAC Resources Inc.
From:	Maritz Rykaart, PhD, PEng	**Project No:**	1CT022.002
Reviewed By:	Sarah Portelance, PEng	**Date:**	December 1, 2015
Subject:	Response to IR: NRCan IR-1d – Tailings Pore Water Expulsion and its Effect on Shallow Groundwater		

1 NRCan Information Request 1d (NRCan IR-1d)

1.1 Subject

Design and stability of the proposed Tailings Impoundment Area (TIA).

1.2 Reference

Package 2 (3.5), Package 6 (P6-13), Package 5 (P5-2 sec 2.9, 3.7, 5.9; P5-3 sec 2.4, 2.6, 2.8).

1.3 Rationale

A significant modification to the Project is the design of the TIA. The approved Project consisted of subaqueous disposal of tailings and a water cover at closure. The planned extension of underground mining means that a greater volume of tailings will be produced and these cannot be accommodated in the TIA that was originally approved. Subaerial deposition (slurry deposition) of floatation tailings is now proposed. Tailings will be deposited in the south end of the TIA between the South Dam and an Interim Dike (new feature). Closure will include a dry cover. Leach tailings which are potentially acid generating will be disposed of as mine backfill.

It is NRCan's understanding that the approved TIA was considered to be a walk-away-solution for tailings disposal with no need to ensure the integrity of the dams in perpetuity. Under the revised plan for the TIA, the dams and dikes will need to remain in perpetuity. It is therefore not clear whether a site presence and monitoring will be required over the long-term following closure to ensure stability of the TIA including dams and dikes.

Freezing of the tailings pile and the foundation (i.e. current unfrozen lake bed sediments) is anticipated and will enhance the performance of the TIA. It is unclear whether the potential for frost heave within the tailings (or the foundation materials) and its potential effect on performance of the protective cover (due to deformation), and the pile stability have been considered in the impact analysis. It is also not clear whether pore water expulsion during freezing of the tailings

and potential migration of contaminants into the underlying talik and shallow groundwater have been considered in the impact analysis.

1.4 Information Request

a. Please clarify whether frozen conditions in the tailings pile and foundation are required to ensure long-term performance of the TIA.

b. Please clarify whether a site presence and ongoing monitoring beyond closure is required to ensure the integrity of the TIA, including dams and dikes, over the long-term.

c. Please clarify whether the potential for frost heave, associated with freezing of the tailings and the underlying foundation materials, has been considered in the stability analysis including the potential for deformation and impacts on performance of the protective cover.

d. Please clarify whether pore water expulsion during freezing of tailings and potential impacts on shallow groundwater has been considered in the impact analysis.

2 TMAC Response

This response relates specifically to item (d) above.

Tailings management for the Project entails deposition of 2.5 Million tonnes (Mt) of tailings at a solids content of 39% with an assumed dry density of 1.4 t/m^3. The tailings are expected to consolidate over time, reaching a final tailings density of about 1.8 t/m^3. As a result of the consolidation process, about 396,000 m^3 of pore water will be released over time (likely to be over the course of many decades). Through normal drying processes (including evaporation), and consolidation, the long-term tailings moisture content is expected to be about 22% (gravimetric moisture content) (MEND 1.61.2, 1996). This means that about 306,000 m^3 of water will be permanently locked up within the pore space of the 2.5 Mt of deposited tailings.

The tailings are also expected to freeze within a timeframe of about six (6) years after placement. With pure water occupying pore spaces, the freezing process would result in a tailings moisture content of about 5%. With saline water, the moisture content could remain as high as 25% (MEND 1.61.2, 1996). At Doris, the tailings pore water is essentially mill process water which is neither pure, nor saline, so it has been assumed that the final moisture content after freezing in the tailings would be about 10%. Accordingly, the freezing process would release about 167,000 m^3 of pore water over the life of the Project, which when combined with the consolidation process, a cumulative release of about 563,000 m^3 of pore water from the entire tailings mass is expected. Based on experience and engineering judgement, this release will however occur over time, likely decades, but conservatively estimated, it is assumed that this time is six (6) years, which is roughly the same as the freeze back period, the annual release of pore water is about 94,000 m^3.

If it is assumed that 100% of this pore water is released to the TIA Reclaim Pond at the discharge elevation of 28.3 m, this annual pore water release is equal to 3.9% of the contained volume of

the Reclaim Pond, or equivalent to a 26:1 dilution. These numbers exclude the approximately 500,000 m^3 of natural drainage and direct precipitation from the TIA catchment, which if accounted for, reduces these numbers to 3.2% and 31:1 respectively. Therefore, even if 100% of the tailings pore water finds its way to the Reclaim Pond, it is such a small volume that it would not result in negative effects to the water quality. It is however important to reiterate that the quantitative example shown is overly conservative, and in reality the annual release of pore water would be much slower and over a substantially longer time period which further reduces any potential impact.

It is anticipated that a portion of this pore water will be released to the talik underneath the TIA instead of to the Reclaim Pond. The extent of the talik underneath the TIA was evaluated in SRK (2005). This study, supported by ground temperature data, suggests that there could be an open talik beneath the TIA, but that between the TIA and Doris Lake, the closest water body, there is a zone of permafrost at least 425 m wide and 130 m deep. This permafrost is in competent in-tact bedrock and therefore the likelihood of any groundwater flow is improbable. Since the groundwater has been confirmed to be highly saline and therefore is not deemed a useable resource, there are no conceivable hydraulic connections to other fresh water bodies, and the contribution from tailings pore water is negligible in volume, there is not deemed to be any impact on groundwater quality. Therefore, any pore water, whether from freezing expulsion or consolidation entering the TIA talik will not have any effect outside.

3 References

MEND 1.61.2 (1996). Acid Mine Drainage in Permafrost Regions: Issues, Control Strategies and Research Requirements. pp. 103, July.

SRK Consulting (Canada) Inc. 2005. Groundwater Assessment, Doris North project, Hope Bay, Nunavut, Canada. Report prepared for Miramar Hope Bay Limited, Project 1CM014.006, October.