DORIS MINE

REVISIONS TO AMENDMENT APPLICATION NO. 1 OF PROJECT CERTIFICATE NO. 003 AND WATER LICENCE NO. 2AM-DOH1323: PROPONENT'S RESPONSE TO NIRB TECHNICAL COMMENTS

January 2016

Prepared by:

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January 18, 2016

Kelli Gillard, Technical Advisor
Nunavut Impact Review Board (NIRB)
P.O. Box 1360
Cambridge Bay, NU X0B 0C0

Dear Ms. Gillard;

Re. TMAC Resources Inc.'s *Revisions to Amendment Application No. 1 of Project Certificate No. 003 and Water Licence No. 2AM-DOH1323*: Proponent's Response to NIRB Technical Comments (NIRB File 05MN047)

Thank you for the opportunity to provide TMAC Resources Inc.'s (TMAC) response to the technical comments received from the Nunavut Impact Review Board (NIRB) on January 8, 2016. TMAC wishes to thank all the parties for their hard work on this matter. The enclosed materials provide responses to the submissions received from the following parties:

- Kitikmeot Inuit Association;
- Government of Nunavut;
- Government of Canada including:
    - Environment and Climate Change Canada;
    - Fisheries and Oceans Canada;
    - Indigenous and Northern Affairs Canada;
    - Natural Resources Canada; and
    - Transport Canada;

As suggested by the NIRB, TMAC has drafted its response in a manner which outlines TMAC's understanding of the issues raised as well as its proposed plans to address and resolve the issues and related concerns. TMAC will also provide a list of commitments to the NIRB prior to commencement of the Technical Meetings on January 26, 2016.

TMAC looks forward to continuing our discussion with a view to resolving any outstanding matters at the upcoming technical meeting in Cambridge Bay on January 26 and 27, 2016.

Regards,

M John Roberts
Vice President, Environmental Affairs

Encl.

cc: Ryan Barry, Nunavut Impact Review Board
Stephanie Autut, Nunavut Water Board

DORIS MINE

Responses to Technical Comments, Nunavut Impact Review Board

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Acronym	Definition
AANDC	former acronym for Indigenous and Northern Affairs Canada
ABA	Acid Base Accounting
AEMP	Aquatics Effect Monitoring Program
AMF	Aquatic Monitoring Framework
ARD	Acid Rock Drainage
CCME	Canadian Council of Ministers of the Environment
DEIS	Draft Environmental Impact Statement
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
ERM	ERM Consultants Canada Ltd.
FEIS	Doris North Final Environmental Impact Statement
FOS	Factor of Safety
FSL	Full Supply Level
GCL	geosynthetic clay liner
HAZID	Hazard Identification
HCT	humidity cell test
IEAC	Inuit Environmental Advisory Committee
IIBA	Inuit Impact and Benefit Agreement
INAC	Indigenous and Northern Affairs Canada
IR	Information Request
KHS	key habitat sites
KIA	Kitikmeot Inuit Association
LFS	Canadian Labour Force Survey
LIDAR	Light Detection and Ranging
MMER	Metal Mining Effluent Regulations
NHS	National Household Survey
NIRB	Nunavut Impact Review Board
NOC	National Occupational Classification
NP	Neutralization Potential
NP/AP	neutralization potential ratio
NRCan	Natural Resources Canada
NWB	Nunavut Water Board

OPEP	Oil Pollution Emergency Plan
OPPP	Oil Pollution Prevention Plan
PAG	Potentially Acid Generating
PCP	Pollution Control Pond
RPD	relative percent differences
SRK	SRK Consulting (Canada) Inc.
TC	Transport Canada
TDC	total dissolved solids
TIA	Tailings Impoundment Area
TIC	total inorganic carbon
TMAC	TMAC Resources Inc.
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
VEC	Valued Ecosystem Components
WAD	weak acid dissociable
WMMP	Wildlife Mitigation and Monitoring Plan
ZOI	zone of influence

1. ID# DFO 3.1.1

1.1 SUBJECT

Life-of-Mine and Fisheries Act Authorization Conditions

1.2 REFERENCE

Package 2: Project Description (June 2015): p. iv

Package 4: Identification of Potential Environmental Effects and

Proposed Mitigation (June 2015): 4-38

Package 5: P5-2, Interim Closure and Reclamation Plan (June 2015): p. 19

Fisheries Act Authorization NU-02-0117.2: Condition 5

1.3 SUMMARY

TMAC notes that the proposed changes will "add approximately 4 years of mine life to the approximately 2 years originally reported in the Final Environmental Impact Statement… bringing the total life of mine to about 6 years." (Package 2, p. iv)

The fish habitat monitoring program was developed to monitor the stability and successful use of fish habitat compensation structures, specifically the jetty and shoals in Roberts Bay." (Package 4, 4-38)

At closure, the existing jetty and marine outfall berm associated with the proposed discharge pipeline "will be partially removed, to an elevation 0.3 m below the low water level. The rock fill will be placed into the surrounding water. The mooring points and buoys will be removed from site." (Package 5, P5-2, p. 19)

1.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

This relates to TMAC's obligations under Fisheries Act Authorization NU-02-0117.2.

1.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.1.1 DFO requests that TMAC reflect the implications of the adjusted Life-of-Mine will be in revised Monitoring Plans and closure activities associated with Fisheries Act Authorization NU-02-0117.2. These updates may require

modifications to the current Fisheries Act authorization and will be addressed during the regulatory phase of the proposed Project amendments.

Gap/Issue: Fisheries Act Authorization NU-02-0117.2 refers to a schedule of monitoring that includes, among other details, setting the timing of monitoring activities relative to years of construction, years of mine operation, and years post-closure, at which point the existing jetty constructed in Roberts Bay will be lowered below the high water level.

Disagreement with Amendment Proposal conclusion, and reasons: The proposed amendments, including an extension of Life-of-Mine by approximately 4 years, are not reflected in Roberts Bay Habitat Compensation Monitoring Plans, as well as closure plans to lower the existing jetty in Roberts Bay.

1.6 TMAC RESPONSE

As recommended by DFO, TMAC will consider the implication of the adjusted Life-of-Mine by revising relevant Monitoring Plans and closure activities associated with Fisheries Act Authorization NU-02-0117.2. If required, any modifications to the current Fisheries Act authorization will be requested through the DFO regulatory process.

1.7 ATTACHMENTS

Not Applicable

2. ID# DFO 3.2.1

2.1 SUBJECT

Reduction in Doris Lake Water Levels

2.2 REFERENCE

Package 2: Project Description (June 2015): p. v, 16

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): various pages as indicated below

DFO (June 21, 2010) DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut.

Fisheries Act Authorization NU-02-0117.3

2.3 SUMMARY

The proposed Project will result in additional water losses from Doris Lake. TMAC notes that "the maximum groundwater inflow encountered at full mine development under Doris Lake is expected to be 3,000 m^3/day. The modelling indicates a risk that some of the water entering the mine will originate in Doris Lake, and could infiltrate at a rate that could cause reductions in Doris Lake water levels. Based on modelling and review of baseline data, the changes to Doris Lake are considered to be mostly within the natural variation of flows in the system. Should changes occur outside of natural variation, TMAC will offset for any negative effects to fisheries." (Package 2, p. v)

TMAC does not, however, request that this water be incorporated into allowable withdrawals allocated in its Water Licence. "Additional water beyond the current permitted withdrawal volume will not be required to be withdrawn from Doris Lake. As such, no additional water allowance is being requested in this Amendment Application." (Package 2, p. 16)

2.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Importance of issue to impact assessment

It is not yet clear whether any residual serious harm to fish as a result of the Project will be incurred from these additional water losses in Doris Lake, which would require Authorization under the fisheries protection provisions of the Fisheries Act, as well as

development of an Offsetting Plan to offset for impacts to fisheries productivity in Doris Lake. Residual serious harm to fish is that which cannot be avoided or mitigated.

2.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.2.1 DFO recommends that TMAC conduct the described baseline studies, including those to determine the location and suitability of fish habitat spawning shoals for all fish species in Doris Lake that are part of or support a commercial, recreational or Aboriginal fishery, including Lake Trout, Lake Whitefish and Lake Cisco. This should include the quantity of spawning habitat that will be exposed to ice scour or desiccation following additional loss of water from Doris Lake to underground mining activity. This information will be needed to determine the amount of residual serious harm to fish as a result of the proposed Project that cannot be avoided or mitigated, and must be Authorized and offset according to the applicable provisions of the Fisheries Act.

Gap/Issue: TMAC indicates that modelling predicts volumes lost from Doris Lake into the underground mine may be more than double the volumes allocated for its withdrawal from Doris Lake under the Water Licence: "Annual withdrawal of 480,000 m^3 from Doris Lake is currently permitted (Type A Water Licence 2AM-DOH1323). … [it is] estimated that in addition, loss of water from Doris Lake into the underground workings could be up to 610,000 m^3/year at its peak." (Package 4, p 2- 20)

TMAC suggests that this additional loss is likely to result in serious harm to fish: "The maximum potential water level decrease due to the extraction of the currently permitted 480,000 cm/year from Doris Lake is within the range of natural variability, and no adverse effects are predicted in the Doris North FEIS. … The cumulative water losses from Doris lake, included the permitted withdrawal volume combined with the loss to the underground mine, are predicted to result in serious harm to fisheries and an Offset Plan and DFO Authorization will be obtained." (Package 4, p. i) [emphasis added]

DFO concurs with TMAC that water levels in Doris Lake fluctuate annually. Between 2004 and 2014, the mean water level fluctuation for Doris Lake was 0.54 m, with a minimum of 0.29 m and a maximum of 0.74 m over various time periods (Package 4, Table 2.3-2).

DFO also notes that total annual withdrawals, assuming maximum withdrawal under the Water Licence and including the additional losses from Doris Lake, come to approximately 4% of the total lake volume. "Doris Lake…has a surface area of 337.8 ha, a volume of 27, 275,094 m^3, an average depth of 8.1 m." (Package 4, p. 2-11).

TMAC calculates that water loss will decrease outflow from Doris Lake by on average 13.7 %, resulting in a draw-down of lake levels by 23 cm during the winter (less than 4 %

of the lake volume under 2 m ice). This is within the general 10% maximum winter withdrawal guideline recommended by DFO for lakes in the Northwest Territories and Nunavut (DFO, 2010); however, this does not preclude consideration of potential impacts to fish and fish habitat in the nearshore littoral zone in a site-specific manner. (Package 4, p. 2-24 to 2-26)

DFO notes that much of the shoreline is bedrock, but that habitats that may be suitable as spawning substrates for fish in Doris Lake are also located primarily near shore, which suggests that spawning habitat may be both limited, and vulnerable to lower lake water levels. (Package 4, p. 2-11).

TMAC has also discussed the effects of water reduction in Doris Lake on subsequent outflows and areas downstream. "As a result of the winter water withdrawal, onset of Doris Lake outflow will be delayed by 10 days compared to baseline conditions." (Package 4, p. 2-21 and Table 2.5-1). Furthermore, "the total number of flow days in Doris Lake Outflow and Creek will decrease by 15 days (baseline flow days = 131, project = 116." (p. 2-26) This represents a reduction in available rearing habitat used by Arctic Char, Lake Trout and Ninespine Stickleback by an 11% on average) and up to a maximum of 18% (for dry years) for the six years during which the water loss during mining may persist." (p. 2-27)

Further on, "Effects of water loss from Doris Lake are diminished downstream of Little Roberts Lake (Table 2.5-2)." "This represents a potential reduction in fish passage… and access to habitats… by Arctic Char, Lake Trout by less than 1% (on average) and up to a maximum of 5% (for dry years) for the six years during which the water loss during mining may persist." (Package 4, p. 2-28).

TMAC notes that more information is needed and is to be obtained. "To quantify the amount of serious harm required to be offset (i.e., up to 18% reduction in flow days and the 27.9% reduction in discharge), additional modeling and characterization of Doris Lake Outflow and Doris Creek are required." (Package 4, p. 2-27).

Mitigation has been proposed by TMAC: "Use of intercepted groundwater for drilling purposes [to] reduce the demand from freshwater and lake drawdown." (Package 4, p. 2-28)

Disagreement with Amendment Proposal conclusion, and reasons: DFO agrees with TMAC that additional studies are needed to verify the location, and suitability, of spawning habitats for Lake Trout in Doris Lake, but also recommends that TMAC establish the location and suitability of spawning shoals for Lake Whitefish and Lake Cisco, also known to be present in Doris Lake. Lake Whitefish and Lake Cisco are fish species known to be part of, or support, commercial, recreational or Aboriginal fisheries.

It is not yet clear whether all of the avoidance and mitigation measures, which may be used by the proponent to address the impacts of potential water loss in Doris Lake and

downstream environments, will be insufficient to address potential serious harm to fish as a result of the Project. DFO has not yet been determined whether Authorization and offsetting would be required. Furthermore, it is not clear what proportion of the intercepted groundwater may be used in place of freshwater withdrawals, nor is it clear how much of the Water Licence-allotted 480,000 m^3 per year TMAC is actually planning to draw from Doris Lake during the time which Doris Lake will also be losing water to underground mining operations. Thus, the extent to which use of intercepted groundwater will avoid or mitigate impacts to fish and fish habitat has not been clearly established.

DFO notes that monitoring for offsetting associated with Fisheries Act Authorization NU-02-0117.3 is ongoing in Roberts Lake Outflow. It is not clear how potential negative impacts to Roberts Lake Outflow offsetting as a result of reductions in flow will be incorporated into future monitoring.

DFO also notes that a revised Aquatic Effects Monitoring Program does not appear to be included in the application documents. It is not clear whether water levels in Doris Lake and/or its outflows will be monitored, so that the actual amount of lake drawdown may be determined and additional mitigation measures put into place if thresholds are reached (including the possibility of cessation of water withdrawal from Doris Lake, such that total water losses from the Lake either do not exceed what is permitted in the Water Licence, or do not cause unauthorized serious harm to fish).

One further mitigation measure that could be considered would be the withdrawal of freshwater from an alternate source.

2.6 TMAC RESPONSE

TMAC has completed the data collection for a field program designed to quantify potential effects to fish and fish habitat in Doris Lake (providing for the species Lake Trout, Lake Whitefish and Cisco). Appendix B: DFO 3.2.1 - 1 presents these results.

The results demonstrate the mine drawdown outside of the natural range of variability, up to the maximum predicted levels is unlikely to affect lake trout or white fish. Mine related drawdowns that are within the natural range of variability is also unlikely to cause serious harm to Cisco.

2.7 ATTACHMENTS

Appendix B: DFO 3.2.1 – 1 Doris Lake, Doris Creek, and Little Roberts Outflow Fisheries Assessment Memorandum

3. ID# DFO 3.2.2

3.1 SUBJECT

Reduction in Doris Lake Water Levels

3.2 REFERENCE

Package 2: Project Description (June 2015): p. v, 16

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): various pages as indicated below

DFO (June 21, 2010) DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut.

Fisheries Act Authorization NU-02-0117.3

3.3 SUMMARY

The proposed Project will result in additional water losses from Doris Lake. TMAC notes that "the maximum groundwater inflow encountered at full mine development under Doris Lake is expected to be 3,000 m^3/day. The modelling indicates a risk that some of the water entering the mine will originate in Doris Lake, and could infiltrate at a rate that could cause reductions in Doris Lake water levels. Based on modelling and review of baseline data, the changes to Doris Lake are considered to be mostly within the natural variation of flows in the system. Should changes occur outside of natural variation, TMAC will offset for any negative effects to fisheries." (Package 2, p. v)

TMAC does not, however, request that this water be incorporated into allowable withdrawals allocated in its Water Licence. "Additional water beyond the current permitted withdrawal volume will not be required to be withdrawn from Doris Lake. As such, no additional water allowance is being requested in this Amendment Application." (Package 2, p. 16)

3.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Importance of issue to impact assessment

It is not yet clear whether any residual serious harm to fish as a result of the Project will be incurred from these additional water losses in Doris Lake, which would require Authorization under the fisheries protection provisions of the Fisheries Act, as well as

development of an Offsetting Plan to offset for impacts to fisheries productivity in Doris Lake. Residual serious harm to fish is that which cannot be avoided or mitigated.

3.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

3.2.2 DFO recommends that TMAC explore all possible mitigation measures to avoid and mitigate serious harm to fish in Doris Lake as a result of the proposed Project. This includes consideration of alternate water sources, and providing more detailed assessments of the extent to which intercepted groundwater may be used in place of freshwater withdrawals in Doris Lake. Precise estimates of actual water withdrawal rates during the phase of the proposed Project when underground mining operations will occur will also be required to determine the effectiveness of their proposed mitigation regarding impacts to fish and fish habitat.

3.6 TMAC RESPONSE

TMAC evaluated a large number of diverse measures to avoid or mitigate the potential for serious harm to fish in Doris Lake. These are summarized below:

- Option 1: Dike and/or Dewatering of Doris Lake. This option considered isolating the Doris Central and Connector mining zones that are located under Doris Lake from the lake using a series of dewatering dikes and dewatering strategies. The dikes considered are analogous to those used at the Diavik and Meadowbank mines. This concept would require maintaining normal flow in all fresh water courses. Three primary dike/dewatering options were considered and the steps involved in each of are described below:

  - "Wet" Ring Dike: Construct a "wet" dike within Doris Lake (i.e. in-water construction); Dewater the area inside the dike; Develop and operate the mine while actively dewatering the area inside the dike; At closure, re-flood the area inside the dike, to bring Doris Lake back up to its normal elevation and breach the ring dike (see Appendix A: Figure DFO 3.2.2 - 1).
  - Partially Drain Doris Lake: A permanent pumping diversion would be constructed to transfer water from the south end of Doris Lake to Doris Creek. A "wet" ring dike would be constructed, as described above. The area within the dike would be dewatered. Develop and operate the mine while actively dewatering the area inside the dike. At closure, re-flood the area inside the dike, to bring Doris Lake back up to its normal elevation. The dike would be breached and the pumping diversion decommissioned (see Appendix A: Figure DFO 3.2.2 - 2).
  - "Dry" Ring Dike Construction: A temporary pumping diversion would be constructed to transfer water from Ogama Lake to Doris Creek. A secondary pumping system would dewater Doris Lake. A "dry" ring dike would be

constructed around the mine area (see Appendix A: Figure DFO 3.2.2 - 3). Doris Lake would be allowed to re-flood and the temporary diversion, from Ogama Lake to Doris Creek would be decommissioned. Develop and operate the mine while actively dewatering the area inside the dike. This would be the same as described above (see Appendix A: Figure DFO 3.2.2 - 1). At closure, re-flood the mine area, inside the dike, to bring Doris Lake back up to normal elevation and breach the ring dike.

- There is not a strong enough business case that would support the capital cost of this option, and therefore it cannot be considered for the current project. More importantly however, this option would undoubtedly result in serious harm to fish within the donor waterbodies (Doris Lake or Ogama Lake).
- Option 2: Eliminate Inflow Constraints Upstream of Doris Lake. A desk-top evaluation was done to determine if there are any natural flow restrictions upstream of Doris Lake that, if removed, would increase the natural inflow into Doris Lake and as a result mitigate against serious harm to fish in Doris Lake.
- The Doris Lake watershed includes Patch Lake, which flows to P.O. Lake (aka Patch Ogama Lake) which flows to Ogama Lake and into Doris Lake. The total elevation difference between Patch Lake and Doris Lake is approximately 4.5 m. A geomorphological terrain evaluation of the streams connecting these lakes indicate the channels run through ice rich, fine grained sediments (marine silts and clays) as indicated by the small kettle ponds along the channel alignments. There are several bedrock outcrops along each of the stream channels but these bedrock outcrops are only along one side of the channel and do not restrict the flow. As well, there are no restrictions to the flow of water at either the inlet or outlet of the streams connecting Patch, P.O., Ogama, and Doris Lakes.
- Based on a review the topography and orthophotos, there are no restrictions, in surface water flow, between the lakes of the Doris Lake watershed. Even if there was, any earth-works to increase the capacity of the stream channels would be technically challenging given the ice-rich permafrost terrain. Furthermore, changing any part of the system would require a careful hydrological evaluation of the entire system to ensure that any serious harm to fish is not being relocated from Doris Lake to another system upstream. The nature of the lakes in the watershed, suggest similar conditions to those in Doris Lake and therefore a net benefit is unlikely. See Appendix A: Figure DFO 3.2.2 – 4.
- Option 3: Import Water to Doris Lake. This option would see fresh water being pumped into Doris Lake from another watershed. Four potential sources of water were considered to supplement Doris Lake as illustrated in DFO 3.2.2 – 5.
  - The Windy Watershed: The current Exploration Water License (2BE-HOP1222) permits the withdrawal of 1.3 Mm^3/yr (i.e. 343 m^3/day). This is comprised of 200 m^3/day for seasonal withdrawal (May through September) for dust

suppression purposes on the Doris-Windy All-Weather Road, 63 m^3/day for potable use at Windy Camp, and the remainder for exploration drilling. An additional 63 m^3/day (22,995 m^3/yr) are permitted for domestic use at the Doris North Camp under the current Doris North Water License (2AM-DOH1323). An additional volume of water is planned for withdrawal under the Madrid bulk sample program (application under review). Beyond this cumulative withdrawal volume from the Windy Watershed (i.e. from Windy or Glen Lakes), it is expected that any water withdrawn may result in serious harm to fish. Moreover, Windy Lake is the site of fisheries offsetting and monitoring program under Fisheries Authorization NU-02-0117.3. Thus, an additional assessment of potential serious harm to fish and the fisheries offsetting project within Windy Lake would be required.

- Tailings Impoundment Area (TIA): TIA water will be used as process make-up water for the Doris North mill. Although there are excess TIA effluent that will be discharged to the ocean annually (up to 4,000 m^3/day during the open water season), this water would have to be treated to allow it to be pumped back to Doris Lake as a supplemental source.
- Roberts and Little Roberts Lakes: These lakes are known to support a productive Arctic Char population and fisheries offsetting project under Fisheries Authorization NU-02-0117.3. Withdrawal of water from this system has the potential to result in serious harm to a known CRA fishery and impact the current fisheries offsetting program
- Koignuk River: Supplemental water could be withdrawn from the Koignuk River. This would require an approximate 3.6 km long access road to be constructed from the existing Doris-Windy All-Weather Road to the point of withdrawal. Additional surface infrastructure would consist of pumps and heat traced pipes to transfer water into Doris Lake.

- Option 4: Recirculation of Doris North Mine Water. Mine water inflow consist of both Doris Lake water and connate groundwater as described in Supporting Document P6-3, Groundwater Inflow and Quality Model of the Amendment application. The Doris Lake water mixes underground with the connate water which is saline. The resultant mixed water still is saline which makes the water unsuitable for use as process water in the mill. The only viable treatment method to reduce the salinity to concentrations suitable for the mill is Reverse Osmosis (RO), but at the salinity feed values the treatment plant efficiency is less than 40%. This means that for every 1.0 m^3 of mine water treated, less than 0.4 m^3 would be useable, with the remaining volume becoming a super concentrated brine.

- Arguably, attempts could be made to segregate the Doris Lake inflow water from the connate water inflows in the mine, but as described in Supporting

Document P6-3, the groundwater inflow is complex and it is unlikely that such segregation could be done practically and effectively.

- As described in the application, groundwater will be reused as far as practical for underground drilling purposes; however the total amount of groundwater used in this manner is negligible.
- Option 5: Doris Lake Outflow Structure. An outflow control structure to Doris Lake can be constructed across Doris Creek. This outflow control structure would result in raising the water Level in Doris Lake and possibly mitigate serious harm in Doris Lake and Creek by seasonally releasing water through this structure using engineered stop-logs. Analysis confirmed that for this structure to perform effectively the water level in Doris Lake would have to be raised by 1 m over its current level, which would result in an increased flooded lake surface are of 10 ha, to 357 ha, i.e. less than 3% increase. This method could potentially result in serious harm to fish by submerging the inflow of Doris Lake (entering from Ogama Lake) and the outflow of Doris Lake (to Doris Creek) and by delaying freshet and decreasing flow in Doris Creek during the period required to raise the level of Doris Lake. Additional mitigation to avoid potential serious harm within Doris Lake would be required to prevent erosion and sedimentation along the newly submerged lake margins.

Considering all of the options described above, and weighing that against the potential for serious harm to fish in Doris Lake as a result of Doris Lake water inflow into the mine, TMAC believes that the approach put forward in the amendment application is reasonable and practical.

The Doris North Project will use water from Doris Lake for Mill Make-up Water and other Industrial use as described in supporting document P6-10, Site-Wide Water and Load Balance Model. Figure 6-6 in Section 6.2.2 of that document graphically presents the mean Doris Lake inflows and outflows graphically. Figure DFO-3.2.2 – 1a below, plots the same information but focuses on the period of active mining, and only presents the water withdrawals components as a result of the mining activities undertaken by TMAC. This demonstrates that the peak water draw from Doris Lake as a result of mill make-up water and other industrial use is about 422,000 m^3/year (blue line), and this occurs for only two years of operations.

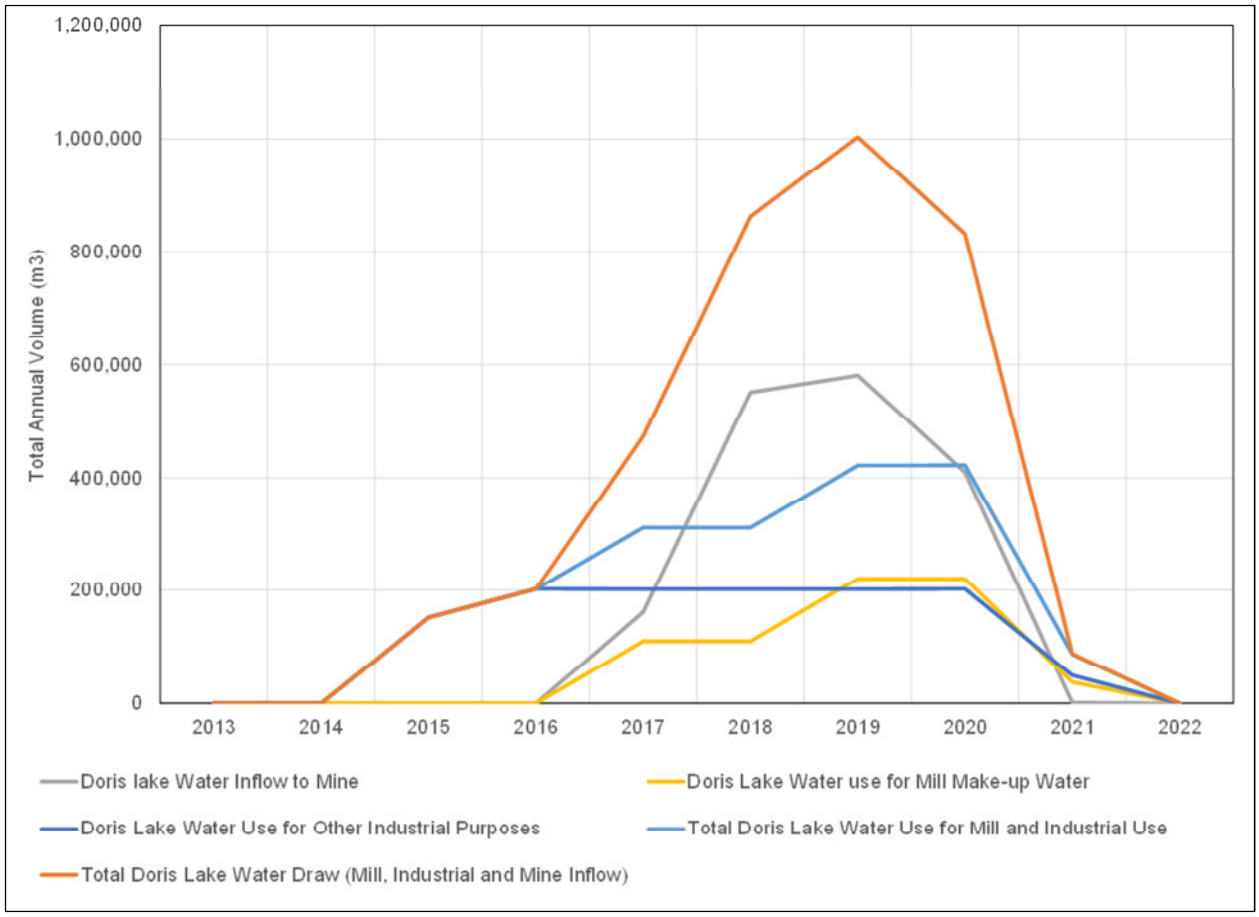


Figure DFO-3.2.2 – 1a. Water Withdrawal and Losses Doris Lake during Operations

3.7 ATTACHMENTS

Appendix A:

- Figure DFO 3.2.2 –1: Option 1 – "Wet" Dike Constructed in Doris Lake Immediately Around Mining Area
- Figure DFO 3.2.2 – 2: Option 1 – "Wet" Dike Constructed in Doris Lake Diking off Half of the Lake
- Figure DFO 3.2.2 – 3: Option 1 – "Dry" Dike Constructed After Draining Doris Lake
- Figure DFO 3.2.2 – 4: Streams within the Doris Watershed
- Figure DFO 3.2.2 – 5: Supplemental Water Sources for Doris

4. ID# DFO 3.2.3

4.1 SUBJECT

Reduction in Doris Lake Water Levels

4.2 REFERENCE

Package 2: Project Description (June 2015): p. v, 16

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): various pages as indicated below

DFO (June 21, 2010) DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut.

Fisheries Act Authorization NU-02-0117.3

4.3 SUMMARY

The proposed Project will result in additional water losses from Doris Lake. TMAC notes that "the maximum groundwater inflow encountered at full mine development under Doris Lake is expected to be 3,000 m^3/day. The modelling indicates a risk that some of the water entering the mine will originate in Doris Lake, and could infiltrate at a rate that could cause reductions in Doris Lake water levels. Based on modelling and review of baseline data, the changes to Doris Lake are considered to be mostly within the natural variation of flows in the system. Should changes occur outside of natural variation, TMAC will offset for any negative effects to fisheries." (Package 2, p. v)

TMAC does not, however, request that this water be incorporated into allowable withdrawals allocated in its Water Licence. "Additional water beyond the current permitted withdrawal volume will not be required to be withdrawn from Doris Lake. As such, no additional water allowance is being requested in this Amendment Application." (Package 2, p. 16)

4.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Importance of issue to impact assessment

It is not yet clear whether any residual serious harm to fish as a result of the Project will be incurred from these additional water losses in Doris Lake, which would require Authorization under the fisheries protection provisions of the Fisheries Act, as well as

development of an Offsetting Plan to offset for impacts to fisheries productivity in Doris Lake. Residual serious harm to fish is that which cannot be avoided or mitigated.

4.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

3.2.3 DFO recommends that TMAC revise their Aquatic Effects Monitoring Program to include monitoring of water levels in Doris Lake and outflows, as well as threshold water levels beyond which additional mitigation measures must be taken to avoid serious harm to fish.

4.6 TMAC RESPONSE

TMAC can confirm that Doris Lake and Outflow levels are currently monitored annually, and that TMAC commits to continuing to monitor these sites.

At present, water level monitoring results are reported annually to the NWB in the Hydrology Compliance Report, which captures a variety of other water level monitoring that occurs associated with the Doris North Project. However, as a part of the March Aquatic Monitoring Framework (AMF) Working Group meeting proposed by TMAC, consideration will be given to whether the water level information specific to the potential drawdown of Doris Lake be instead included in the AMF Report.

A component of the development of a Response Framework within the AMF will include establishment of 'Action Levels' such as threshold water levels beyond which additional mitigation measures must be taken to avoid serious harm to fish.

Final results from the 2015 field program are attached as Appendix B: DFO 3.2.1 and indicate that that there is limited suitable spawning habitat for lake trout and lake whitefish within the range of potential effects in Doris Lake. Bedrock and fine sediments dominate the section of the lake where effects might occur, with neither substrate being suitable for spawning for these species. Optimal spawning habitats were found to be at 4 to 8 m water depths, associated with islands, submerged peaks, and points of land. Extensive suitable Cisco spawning substrate occurs within the potential zone of effects, however, water temperatures were found to be coldest immediately beneath the ice, and are at times within the range of lethal effects for Cisco. Consequently, water temperatures may prevent Cisco from spawning within the range immediately below the ice.

4.7 ATTACHMENTS

Appendix B: DFO 3.2.1 – 1 Doris Lake, Doris Creek, and Little Roberts Outflow Fisheries Assessment Memorandum

5. ID# DFO 3.2.4

5.1 SUBJECT

Reduction in Doris Lake Water Levels

5.2 REFERENCE

Package 2: Project Description (June 2015): p. v, 16

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): various pages as indicated below

DFO (June 21, 2010) DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut.

Fisheries Act Authorization NU-02-0117.3

5.3 SUMMARY

The proposed Project will result in additional water losses from Doris Lake. TMAC notes that "the maximum groundwater inflow encountered at full mine development under Doris Lake is expected to be 3,000 m^3/day. The modelling indicates a risk that some of the water entering the mine will originate in Doris Lake, and could infiltrate at a rate that could cause reductions in Doris Lake water levels. Based on modelling and review of baseline data, the changes to Doris Lake are considered to be mostly within the natural variation of flows in the system. Should changes occur outside of natural variation, TMAC will offset for any negative effects to fisheries." (Package 2, p. v)

TMAC does not, however, request that this water be incorporated into allowable withdrawals allocated in its Water Licence. "Additional water beyond the current permitted withdrawal volume will not be required to be withdrawn from Doris Lake. As such, no additional water allowance is being requested in this Amendment Application." (Package 2, p. 16)

5.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Importance of issue to impact assessment

It is not yet clear whether any residual serious harm to fish as a result of the Project will be incurred from these additional water losses in Doris Lake, which would require

Authorization under the fisheries protection provisions of the Fisheries Act, as well as development of an Offsetting Plan to offset for impacts to fisheries productivity in Doris Lake. Residual serious harm to fish is that which cannot be avoided or mitigated.

5.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.2.4 DFO recommends that TMAC address how potential impacts to Roberts Lake Outflow will affect the effectiveness and monitoring of offsetting constructed for Fisheries Act Authorization NU-02-0117.3, and how any such impacts can be avoided or mitigated.

5.6 TMAC RESPONSE

With respect to Authorization NU-02-0117.3, there are no potential impacts to Roberts Lake Outflow resulting directly from activities described in the amendment application because Roberts Lake Outflow is located upstream of the confluence with Doris Creek. For this reason, TMAC is not anticipating a change to the effectiveness and monitoring of the offsetting measures constructed and amendment to the Authorization is not needed. The outflow from Roberts Lake flows from Roberts Lake into the eastern bank of Little Roberts Lake. Reduction in discharge is predicted only in Doris Creek and Little Roberts Lake Outflow, both of which lie downstream of Roberts Lake Outflow. There is no potential for reduced discharge that could cause disruption in migratory fish passage through Roberts Lake Outflow, nor at the fisheries offsetting monitoring fence located within Roberts Lake Outflow.

There is the potential for restriction to the migration of Arctic Char and Lake Trout downstream of Little Roberts Lake Outflow, where fish must pass prior to reaching Roberts Lake Outflow and the fish offsetting monitoring fence. This potential effect is described in Document P4-1, p. 2-28 for Little Roberts Lake Outflow. The assessment modeling predicted that discharge will be reduced by 6.2% (on average) and up to 10.8% for a one-in-twenty dry year. The assessment concluded that this was indistinguishable from natural variation as outlined in DFOs streamflow requirements document (DFO 2013).

DFO's concern with the potential for fish passage through Little Roberts Lake Outflow has been investigated further through hydraulic modeling. There are two main pathways by which migration may be disrupted by changes in stream discharge: changes to flow velocity and changes to water depth. Changes to stream flow/velocity may act as barriers primarily when flow exceeds the swimming performance of fish. As discharge (volume) is being reduced by a small amount (6.2% to 10.8%), rather than increased, the reduction in flow velocity is very unlikely to restrict migration. Reduction in discharge may restrict fish passage by lowering water depth beyond that naturally experienced. This may disrupt migration by decreasing stream

depth to a level which prevents swimming or by uncovering physical barriers (e.g boulder garden).

Hydraulic modelling results are presented in Appendix B: DFO 3.2.4 - 1 should be read in conjunction with Appendix B: DFO 3.2.1 - 1, which considered the modelling results the context of the related fisheries.

TMAC's conclusion is that there will be no disruption of migration of Arctic Char and Lake Trout from Roberts Bay to the spawning and overwintering habitat found in Roberts Lake. Consequently, there is no anticipated effect on the fish offsetting monitoring program set forth in Fisheries Act Authorization NU-02-0117.3.

Reference:

DFO. 2013. Framework for Assessing the Ecological Requirements to Support Fisheries in Canada. DFO. Can.Sci. Advis. Sec. Proceed. Ser. 2013/017. Fisheries and Oceans Canada: Ottawa, ON.).

5.7 ATTACHMENTS

Appendix B: DFO 3.2.4 – 1 Doris Creek and Little Roberts Outflow Fisheries Assessment –

Hydraulic Modelling Results Memorandum

Appendix B: DFO 3.2.1 – 1 Doris Lake, Doris Creek, and Little Roberts Outflow Fisheries Assessment Memorandum

6. ID# DFO 3.3.1

6.1 SUBJECT

Roberts Bay Discharge Pipeline

6.2 REFERENCE

Package 2: Project Description (June 2015): p. v, 21

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): various pages as indicated below

DFO letter to NIRB, January 17, 2014: "TMAC Resources Inc.'s Proposed Modifications to the Doris North Gold Mine Project and Reconsideration of the NIRB Project Certificate No 003 Terms and Conditions."

6.3 SUMMARY

TMAC is proposing to construct a large discharge pipeline in Roberts Bay. "The pipe will enter the marine environment, armoured by riprap. The pipeline will run approximately 2 km from shore to the bathymetric contour." (Package 2, p. v)

"The discharge pipeline will enter the Roberts Bay marine environment through a Marine Outfall Berm, which extends from the shoreline to approximately the 4 m bathymetric contour. … The pipeline will thus consist of both armoured and exposed sections. Construction of the Marine Outfall Berm to the 4 m bathymetric contour protects the pipeline from ice scouring and displacement." (Package 2, p. 21)

"Berm installation will involve the placement of two layers of geogrid covering an area of 2490 m^2 on the seabed prior to the placement of rock fill. Placed rock will cover approximately 1,550 m^2 of the seabed, leaving 940 m^2 of geogrid to exposed below the MHHWL, extended outwards ~5m from the toe of the marine outfall berm. It is expected that this exposed geogrid will rapidly be covered by sediments through tidal deposition. … The berm structure will be comprised of clean Run of Quarry (ROQ) and Rip Rap (i.e., armor rock), with smaller substrate sizes ranging from 250-500 mm in diameter, and upwards of 1 to 1.5 m for the larger Rip Rap that will be required at the toe of marine outfall berm." (Package 4, p. 4-60).

"After emerging … at the toe of the marine outfall berm, the pipeline, still protected within the 24" diameter (610 mm) steel pipe for approximately 5 m, will continue along the bottom for approximately 2191 m to the 40 m isobaths, ending at the diffuser… the current design of the proposed pipeline is expected to have a footprint of up to

approximately 628 m^2 if 50% settlement occurs (i.e., no suspension). … The pipeline will be ballasted with concrete weights that will stabilize (and possibly suspend) the pipeline along the bottom of the seafloor. Each ballast is expected to have a footprint of … 0.32 m^2 [and there will be]….438 exposed ballast weight units. Thus the total footprint of the ballast weights will be approximately 140 m^2." (Package 4, p. 4-61).

"With current information, the total area permanently altered/lost by the construction of the subsea pipeline and associated infrastructure… will be upwards of 2,318 m^2… consisting primarily of fine/mud substrates, which are abundant in Roberts Bay." (p. 4-62)

6.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Although DFO considers it unlikely that the proposed Roberts Bay Discharge Pipeline, as currently planned, will result in a localized impact to fish populations, DFO notes that survey methodology to assess the presence of marine mammal species in the region is non-standard and may result in underestimates of abundance.

6.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.3.1 DFO recommends that TMAC use a precautionary approach, in determining the extent to which mitigation measures are employed, during the construction and operation of the proposed Roberts Bay Discharge Pipeline, as it is possible that marine mammal abundance in the region has been underestimated.

Gap/Issue: TMAC has suggested that the proposed discharge pipeline, including the outfall berm, may result in serious harm to fish in Roberts Bay. "It is recognized that construction of the Marine Outfall Berm in the marine environment may constitute Serious Harm and that a Fisheries Authorization will be required from DFO." (Package 2, p. 22)

Roberts Bay contains a number of species that are part of, or support, commercial, recreational and Aboriginal fisheries. "A total of 17 confirmed [fish] species have been captured in Roberts Bay… in addition to 3 unconfirmed species… for a total of 20 species" (Package 4, 4-49). Additionally, "three species of marine mammals, the beluga whale…, ringed seal…, and bearded seal…, have been observed in marine environments surrounding the Doris North Project." Narwhals have also been recently noted nearby in Cambridge Bay (Package 4, 4-45). Marine mammal abundance was determined via "two survey methods…, an [aerial] survey was flown in early spring of 2010 to document the presence and distribution of seals … [and] a ship-based survey was also conducted in late summer of 2010 between Cambridge Bay and Roberts Bay

to document the presence of larger marine mammals, such as belugas" (Package 4, 4-45). During the barge survey, "one observer scanned for seabirds and marine mammals from either the port or starboard side of the vessel; the observer selected the side that had the least wind and glare to minimize error" (Package 4, 4-47).

In the proposed area of infrastructure development, shoreline was assessed to be 51% cobble, 15% boulder, 15% gravel, 14% fines and 5% bedrock; "the substrate in the littoral zone is also dominated by cobble (48%) and boulder (31%). … whereas offshore areas consisted primarily of mud" (p. 4-30).

"It is proposed that the permanent alteration/loss of habitat … will be offset through a combination of infrastructure design and offsetting replacement habitats including: the use of coarse rocky substrates (dominated by ~1 m^2 diameter rip rap at toe of berm, remaining substrates between 250 to 300 mm in diameter) for construction of the marine outfall berm (surface area below MHHWL of approximately 650 m^2); new surface area created by the concrete ballast contributing up to 2.12 m^2)… and the creation of two rock shoals." (p. 4-63)

"Importantly, the pipeline and its construction is not expected to obstruct the migration of marine fish such as capelin, which undergo seasonal movements to spawning grounds east of Roberts Bay as installation will be timed to occur during the most appropriate window to ensure minimal interference with sensitive life stages of most fish species known to exist in Roberts Bay." (p. 4-63)

Disagreement with Amendment Proposal conclusion and reasons: DFO notes that the survey method used by TMAC to assess the presence of marine mammals apart from seals (Barge Survey) is non-standard methodology, representing a single transect and that observers were only present on one side of the ship. Thus, the abundance of marine mammals in Roberts Bay and the surrounding area may be underestimated. DFO notes that appropriate selection of mitigation methods and timing windows to avoid impacts to fish and marine mammals in Roberts Bay requires suitable baseline knowledge of the species present in the region.

However, DFO notes that the proposed discharge pipeline has not currently been assessed as likely to result in residual serious harm to fish requiring a Fisheries Act Authorization. As DFO noted previously to TMAC and NIRB, "There are new works and undertakings proposed in the marine environment, specifically the installation of the diffuser array and the associated pipeline and ballast. DFO has determined that this will not result in serious harm to fish and a Fisheries Act Authorization will not be required to carry out these works." (DFO Letter to NIRB, January 17, 2014, p. 1—2). Furthermore, DFO has determined that, as currently designed and presented in the Application, the marine outfall berm is unlikely to result in a localized effect to fish populations."

6.6 TMAC RESPONSE

Based on TMAC's understanding of DFO's submission comment, the Marine Outfall Berm, as currently presented in the Application, is unlikely to result in a localized effect to fish populations and thus no Authorization (or offsetting) will be required for its construction.

In accordance with DFO requirements, TMAC will be conducting a pathways of effects assessment approach as part of the DFO 'request for review' process. Through this process, site-specific mitigation measures will be identified such that serious harm does not result. These mitigation measures may include, but not necessarily limited to sediment control and turbidity monitoring, implementation of marine mammal exclusion zones and marine mammal observations.

6.7 ATTACHMENTS

Not Applicable

7. ID# DFO 3.4.1

7.1 SUBJECT

Roads – Water Crossings

7.2 REFERENCE

Package 2: Project Description (June 2015): p. v

Package 4: Identification of Potential Environmental Effects and Proposed Mitigation (June 2015): p. 2-24

7.3 SUMMARY

An additional 550 m of road and pipe length will extend to the northwest of the existing jetty and laydown area." (Package 2, p. v)

Two new water crossings will be required in the proposed Project. "A combined wastewater pipeline and road crossing is required over a small, unnamed stream that flows into Roberts Bay West…. Only Ninespine Stickleback have previously been captured [in this stream]. Additional sampling will be completed prior to crossing installation to confirm species composition and distribution. … Doris Connector Vent Raise Access Road crosses a small unnamed tributary to Doris Lake…. Since this stream has not previously been sampled, it will be assessed in advance of crossing installation to determine whether it bears fish or not." (Package 4, p. 2-24).

7.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

If appropriate avoidance and mitigation practices are not employed in water crossing design, construction and maintenance, serious harm to fish may result.

7.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.4.1: DFO recommends that TMAC implement all available best management practices to avoid and mitigate serious harm to fish as a result of water crossing construction, operation and decommissioning when it comes to fish-bearing streams. This includes, but is not limited to, appropriate design of water crossings to facilitate fish passage at both high and low flows, timing windows that incorporate spawning, incubation and hatch times for all species using water courses, sediment and erosion control, protection and replanting of riparian vegetation, and other forms of bank stabilization.

Gap/Issue: TMAC indicates that "Several DFO operational statements … will be used as best management practices, along with DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat. As a result of mitigation and best management practices, no residual effects are anticipated on freshwater fish and fish habitat due to the construction of stream crossings." (Package 4, p. 2-24 and 2-25)

Disagreement with Amendment Proposal conclusion and reasons: TMAC has highlighted the use of mitigation practices, such as those presented in DFO's former Operational Statements, in water crossing construction. However, it is unclear at this time, in the absence of detailed engineering designs, what the full suite of measures is that TMAC intends to implement to avoid, mitigate or offset serious harm to fish as defined in the Fisheries Act as a result of water crossings proposed for the Doris North Project. Furthermore, the fish-bearing status (and fish community present) in both streams that will be crossed as a result of the Project has yet to be determined.

7.6 TMAC RESPONSE

TMAC intends to implement all available and feasible best management practices to avoid and mitigate serious harm to fish as a result of water crossing construction, operation and decommissioning for fish-bearing streams. Furthermore, TMAC will also consider potential effects from constrKIA-1uction activities occurring at non-fish-bearing crossings that may be located upstream to fish-bearing waterbodies. TMAC will provide DFO with detailed engineering plans of these water crossings for review prior to construction, including the type of crossing, mitigation measures to be employed, timing of construction and measures taken to ensure water flow and fish passage is maintained at both high and low flows. TMAC will conduct a self-assessment to evaluate potential pathways of effects leading to serious harm to aid in the selection of site-specific mitigation measures to implement at crossings.

Recent sampling conducted in 2015 indicates that the streams that intersect with the Doris Connector Vent Raise and Roberts Bay Discharge Access Road are fish-bearing (ERM 2015). The fish community at both sites are made up of a single species, Ninespine Stickleback, which occurs at low densities. At the Doris Connector Vent Raise crossing, 1,962 seconds of electrofishing was conducted and four Ninespine Stickleback were captured (Catch-per-Unit-effort [CPUE])= 0.20 fish/100 s of electrofishing). All of these fish were caught or observed in a 3 m section of stream just upstream of the existing single 6" diameter culvert, confirming that fish are able to pass from the lake upstream through the existing culvert. At the Roberts Bay Discharge Access Road crossing, four Ninespine Sticklebacks were captured downstream of the proposed new crossing location in 4,284 seconds of electrofishing (CPUE = 0.10 fish/100 s of electrofishing).

The construction and maintenance of stream crossings will follow DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat to ensure that fish and aquatic habitat are not adversely affected by development.

Timing of in-water construction activities will conform to Nunavut restricted activity timing windows for the protection of fish and their habitat. For stream activities, the window is in place to avoid the spring spawning for Ninespine Stickleback, occurring from May 1 to July 15.

7.7 ATTACHMENTS

Appendix B: DFO 3.4.1 - 1 Proposed Access Road Fisheries Assessments, Doris North Project, 2015

8. ID# DFO 3.4.2

8.1 SUBJECT

Roads – Water Crossings

8.2 REFERENCE

Package 2: Project Description (June 2015): p. v

Package 4: Identification of Potential Environmental Effects and

Proposed Mitigation (June 2015): p. 2-24

8.3 SUMMARY

An additional 550 m of road and pipe length will extend to the northwest of the existing jetty and laydown area." (Package 2, p. v)

Two new water crossings will be required in the proposed Project. "A combined wastewater pipeline and road crossing is required over a small, unnamed stream that flows into Roberts Bay West…. Only Ninespine Stickleback have previously been captured [in this stream]. Additional sampling will be completed prior to crossing installation to confirm species composition and distribution. … Doris Connector Vent Raise Access Road crosses a small unnamed tributary to Doris Lake…. Since this stream has not previously been sampled, it will be assessed in advance of crossing installation to determine whether it bears fish or not." (Package 4, p. 2-24).efer to DFO 3.4.1

8.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

If appropriate avoidance and mitigation practices are not employed in water crossing design, construction and maintenance, serious harm to fish may result.

8.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Recommendation/ Request: 3.4.2: DFO recommends that the TMAC provide DFO detailed plans of all water crossings for review prior to construction, including the type of crossing, mitigation measures to be employed, timing of construction and measures taken to ensure water flow and fish passage is maintained at both high and low flows.

8.6 TMAC RESPONSE

TMAC commits to providing detailed design drawings (as well as plans including mitigation measures to be employed, timing of construction and measures taken to ensure water flow and fish passage), which will need to be issued prior to construction of the Marine Outfall Berm and the Roberts Bay Discharge Access Road stream crossing.

8.7 ATTACHMENTS

Not Applicable

9. ID# ECCC-1

9.1 SUBJECT

Sampling Locations - Incorporation of ocean currents and tides

9.2 REFERENCE

EC IR #1

P4-1 Environmental Effects Assessment

9.3 SUMMARY

Oceanographic conditions in Roberts Bay will dictate where the effluent plume goes after release and should be used to identify which areas of the Bay should be monitored for plume related effects. It is unclear if the Proponent used their understanding of the tides and currents in Roberts Bay to inform sampling site selection.

9.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The placement of sampling stations is critical to detecting and mitigating impacts. All available information should be used to ensure that sampling stations are placed where they are most likely to detect effects.

9.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The sampling locations that have been selected for baseline data collection in Roberts Bay cover a large area but are sparsely distributed. In response to EC IR#1, the Proponent states that they did not use plume modelling for sampling site selection, stating that sites were selected prior to the consideration of ocean discharge, with additional sites being selected later on. EC is concerned that the current sampling design may not be adequate to detect effluent related effects.

Understanding the characteristics of the water body and factors such as currents and tides will aid in predicting how the effluent plume is likely to move in the system which will, in turn, provide useful information for identifying sampling locations that will most accurately be able to detect effects in the receiving environment.

Recommendation/Request: Discuss how the influence of ocean currents and tides on plume migration will be incorporated into the selection of sampling locations in Roberts Bay

9.6 TMAC RESPONSE

TMAC has committed to the development of an overarching Aquatic Monitoring Framework in consultation with the appropriate authorities and stakeholders, with marine monitoring designed to fulfill Metal Mining Effluent Regulations/ Environmental Effects Monitoring (MMER/EEM) requirements and broader Aquatic Effects Monitoring Program (AEMP). The marine monitoring design will have fixed monitoring sites in Roberts Bay, including a near-field site proximate to the diffuser and a site further afield towards the mouth of the inlet (see Appendix A: Figure ECCC-1/ECCC-8 – 1 map for potential sites), and a deep-water reference site in the adjacent Ida Bay. The goal of the marine monitoring program will be to determine potential environmental effects on the receiving environment as a whole, not specifically the effluent plume.

Tides in Roberts Bay are small, in the order of 30 cm, and have little influence on the circulation of the bay, and therefore would contribute little to site selection. Numerical simulations of Roberts Bay circulation indicate that inlet circulation is primarily wind driven (as opposed to tides or riverine inputs) and the deep waters of Roberts Bay circulate throughout the main basin of the inlet (Rescan 2012). Thus, it can be expected that the plume will interact with much of the broader inlet over time and fixed site sampling will be sufficient.

Reference:

Rescan. 2012. Doris North Gold Mine Project: 2011 Numerical Simulation of Roberts Bay Circulation. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Ltd.

9.7 ATTACHMENTS

Appendix A: Figure ECCC-1/ECCC-8 – 1: Proposed AEMP Sampling Stations

10. ID# ECCC-2

10.1 SUBJECT

Marine Water Quality Objectives

10.2 REFERENCE

EC IR#2/EC IR#6

Water Load and Balance – Table 6-3

10.3 SUMMARY

The Proponent proposes to limit the assessment of parameters of concern to those with existing marine water quality guidelines under the Canadian Council of Ministers of the Environment (CCME). Environment Canada notes, however, that the effluent may contain contaminants for which there are no CCME marine water quality guidelines and that these contaminants should be assessed as they have the potential to impact the Roberts Bay receiving environment.

10.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Parameters for which there are no CCME marine water quality guidelines could cause significant impacts in the receiving environment. Modelling of all parameters of potential concern in the effluent, including those for which there are no marine water quality guidelines, will provide a better understanding of the quality and potential effects of the discharge and will inform management and mitigation decisions.

10.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent response to EC IR# 2 concluded that the only parameters which need to be considered are those which have CCME marine guidelines or Metal Mining Effluent Regulations (MMER) discharge limits. TMAC did not respond to EC's recommendation that all effluent constituents be modelled in order to identify the need for site specific water quality objectives for parameters that will exceed background concentrations.

The Proponent has stated that they are committed to evaluating water quality parameters with established benchmarks and will add additional parameters if the monitoring framework reveals that the project is negatively impacting ambient water quality. Given that CCME marine water quality guidelines have only been developed for four metals and one nutrient this approach excludes a large number of parameters from evaluation. The Proponent also proposes to use the eight parameters listed in the

MMER authorized limits for deleterious substances to evaluate effluent quality. If the proposed approach is accepted the Proponent will only provide predicted concentrations for nitrate, total cyanide, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc at the marine outfall mixing box.

The limited set of parameters proposed by the Proponent does not include all the potential contaminants that may enter the receiving environment when the effluent is released. All potential contaminants in both the TIA and the groundwater effluent should be modelled and evaluated. Modeled concentrations should be carried through to the combined marine outfall mixing box effluent to identify which parameters exceed guidelines available from other jurisdictions or are significantly elevated over background receiving environment conditions.

Recommendation/Request: Identify, analyze and model all contaminants of potential concern in the effluents and in the combined effluent. Discuss which parameters, including those for which there are no guidelines, have the potential to become elevated above background in the receiving environment. For each parameter of concern, discuss whether treatment or a site specific water quality objective is necessary.

10.6 TMAC RESPONSE

TMAC's approach to the marine end-of-pipe and receiving water criteria will follow the same framework of the current Doris North Water Licence No 2AM-DOH1323 and adhere to current relevant and applicable regulated standards and guidelines provided by the governing jurisdictions. Specifically, the effluent will meet Metal Mining Effluent Regulations (MMER) requirements before being discharged and will meet the Canadian Council of Ministers of the Environment (CCME) marine water quality guidelines for the protection of aquatic life at a compliance site in the receiving environment to be determined in accordance with the proposed Aquatic Monitoring Framework (AMF). There are currently five metals that have marine water quality guidelines (silver was added in 2015), and future water quality parameters will be added to the monitoring program as they become interim or approved guidelines.

TMAC agrees to model additional parameters at the mixing box, as was done previously for CCME water quality parameters (Table 6-3, Document 6-10). Furthermore, TMAC commits to carrying out three-dimensional hydrodynamic water quality modelling (using DHI's MIKE3 software) to predict water quality concentrations in Roberts Bay in response to Tailings Impoundment Area (TIA) and/or groundwater discharge. In this exercise, water quality concentrations will be predicted within Roberts Bay during the operation (6 years) and post closure of the Discharge System, for parameters with current CCME guidelines, with MMER discharge limits and those proposed parameters with MMER limits. The predictions will be evaluated against

marine CCME guidelines and baseline conditions. This information will be presented at the Technical Meeting.

TMAC does not see the need for site-specific water quality objectives given that ambient Roberts Bay water quality is below each of the marine CCME water quality parameters. Current projections indicate that no direct treatment of the TIA or groundwater is required to meet MMER requirements; the TIA Reclaim Pond will function as a settling pond, promoting TSS removal and ensuring MMER compliance. TMAC proposes to monitor the effluent and the water quality near the marine discharge location during operations to confirm that MMER regulations and CCME guidelines are being met within Roberts Bay. Under the Aquatic Monitoring Framework, if monitoring indicates MMER and/or CCME criteria are not being met, discharge will cease, a treatment plant will be commissioned, and the TIA and/or groundwater will be treated prior to further discharge.

10.7 ATTACHMENTS

Not Applicable

11. ID# ECCC-3

11.1 SUBJECT

Expected Groundwater Quality

11.2 REFERENCE

Section 2.3.5 – Groundwater Quality
Table 5 – Summary of Groundwater Quality from samples collected under Doris Mine (75th Percentile)

11.3 SUMMARY

A review of the groundwater quality modelling indicates that not all contaminants with the potential to cause negative impacts on Roberts Bay were fully modelled.

11.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Modelling of contaminant concentrations in the effluent is critical to predicting potential negative effects to the receiving environment and will inform treatment and management decisions in order to mitigate impacts.

11.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent presents a summary of the groundwater parameters that were analyzed in Table 5. EC notes that modelling was not used to predict effluent quality at the marine outfall mixing box for some parameters even though their concentrations were found to be elevated and they have the potential to cause effects in the receiving environment. These parameters include ammonia (GW – 3.5 mg/L, Roberts Bay median – 0.0025 mg/L), iron (GW – 4.81 mg/L, Roberts Bay median – 0.014 mg/L), Strontium (27.6 mg/L, not measured in Roberts Bay).

Recommendation/Request: EC recommends that the concentrations of ammonia, iron, and strontium from the groundwater be incorporated into the overall site water quality model and that the Proponent incorporate the modelling output into their description of how these parameters will be managed/treated in the effluent.

11.6 TMAC RESPONSE

Ammonia, iron, and strontium were not modelled in the marine effluent discharge or Roberts Bay as there are no associated Canadian Council of Ministers of the Environment (CCME) marine water quality guidelines. TMAC's approach to the marine

end-of-pipe limits and receiving water guidelines follows the same framework of the current Doris North Water Licence No 2AM-DOH1323.

Ammonia that would be discharged to Roberts Bay would be quickly converted into the non-toxic ammonium ion (NH_4^+) and iron would precipitate into iron oxyhydroxides becoming largely unavailable to Roberts Bay biota. The median total strontium concentration in Roberts Bay between 2009 and 2011 was 5.86 mg/L.

As per TMAC's response to ECCC -2, these parameters will be included in both the mixing box and Robert's Bay models.

11.7 ATTACHMENTS

Not Applicable

12. ID# ECCC-4

12.1 SUBJECT

Effluent Quality Modelling for Free Cyanide, Mercury, and Selenium

12.2 REFERENCE

Section 6.3 – Water Quality Results (Water Load Balance)

12.3 SUMMARY

The Proponent did not model the concentration of free cyanide in the tailings impoundment area nor mercury or selenium in the mill effluent water.

12.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Cyanide, mercury and selenium have the potential to cause effects in the receiving environment and should be modelled in order to understand potential impacts.

12.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent has stated that mercury and selenium have not been included in modelling of TIA effluent because the high detection limits in the dataset could artificially elevate predictions of the TIA effluent.

Additionally, free cyanide has been excluded due to lack of data for developing source terms. Without knowing the modelled concentrations of these parameters in the TIA, the eventual combined modelled discharge effluent at the marine outfall mixing box is not accurate. These parameters still need to be modelled in order to gain an understanding of the potential for effects in the receiving environment.

Recommendation/Request: Additional sampling should be completed and analyzed using lower detection limits for cyanide, selenium and mercury so that modelling for the TIA and marine outfall mixing box effluent is accurate. Should predicted concentrations of these parameter exceed guidelines the Proponent should describe how these parameters will be managed/treated in the effluent.

12.6 TMAC RESPONSE

TMAC has reviewed the geochemical testing data available for cyanide, selenium and mercury, and have identified some alternative test results that can be used to develop process water source terms for these parameters. The alternative source of data is a

series of aging tests completed on samples of the Doris Central flotation tailings, Doris Connector flotation tailings, and Doris Connector mixed tailings (SRK 2015, Appendix L and M; Document P6-12b; provided to parties and the NWB upon request on Nov 20, 2015). Aging tests were also completed on the Doris Central detox tailings, but the cyanide detoxification process used to generate this sample was not representative of the process currently proposed for the site, and therefore, the aging test results for this sample are not representative for cyanide, cyanide degradation products, or any of the metals that are known to complex with cyanide (e.g. mercury).

Process solutions from the proposed operation will be comprised of a blend of 86% flotation tailings water, and 14% detox tailings water. The aging test results for the two flotation samples are representative of the process water associated with the flotation tailings. The aging test results for the mixed tailings sample provide the best representation of blended process water. As indicated previously, the detox tailings are not representative for many parameters due to incomplete cyanide destruction, but may provide an indication of worse case concentrations for this portion (14%) of the tailings stream. A summary of the results for weak acid dissociable (WAD) cyanide, selenium and mercury are presented in Table ECCC-4 - 1, and a discussion of them follows:

- WAD cyanide is essentially equivalent to free cyanide for the purpose of assessing potential environmental effects. WAD CN concentrations in the aging tests were all below 0.27 mg/L except in Doris Central detox sample which is not considered to be representative for this parameter.

- The results for Hg were all below 0.000079 mg/L except in samples where a higher detection limit was used. Although there was limited aging data available for mercury at low detection limits, there was also a substantial amount of data from the humidity cell testing programs (Appendix H of SRK 2015, Document P6-12b). These results indicate that Hg concentrations will be very low in water that is in contact with the tailings. Most of those results showed Hg of <0.00002 or <0.000002 mg/L, with the highest HCT concentration of 0.000013 mg/L in the Doris Central Detox tailings sample (HC 67).

- The results for selenium were all below 0.0075 mg/L, and most were below 0.002 mg/L.

The maximum concentrations from the aging tests (0.27 mg/L WAD CN, 0.000079 mg/L Hg, and 0.0075 mg/L Se) will be included in the water and load balance model to evaluate the potential effects of these parameters on water quality in the TIA and at the point of discharge in Roberts Bay

These new values are not expected to result in adverse effects, but they will be included in the sensitivity analysis runs of the Water and Load Balance Model that will

be prepared and made available at the Technical Meeting in Cambridge Bay in January 2016.

Table ECCC-4 – 1. Summary of Aging Test Results for WAD CN, Hg and Se

Test	WAD CN mg/L	Hg mg/L	Se mg/L
Doris Central Flotation	n/a**	<0.0001	0.0002 to 0.0018
Doris Connector Flotation	<0.01 to 0.27	0.000002 to <0.0001	0.003 to 0.0075
Doris Connector Mixed	<0.01 to 0.02	0.000079 to <0.0001	0.0002 to 0.0015
*Doris Central Detox**	*0.16 to 8.41*	*<0.0001 to 0.0002****	*0.002 to 0.06*

*Notes: * Results not representative due to insufficient CN destruction.*
*** n/a - parameter was not tested (note that cyanide would not have been used in this part of the process, and therefore this process stream would not be expected to contain cyanide.*
**** value of 0.0002 mg/L is considered erroneous because it was close to the analytical detection limit that was used and other results from this sample were all below detection limits.*

References:

SRK Consulting, 2015. Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay – Supporting Data, June.

12.7 ATTACHMENTS

Not Applicable

13. ID# ECCC-5

13.1 SUBJECT

Dissolved versus total metal concentrations

13.2 REFERENCE

2.3.5 – Groundwater Quality (Groundwater Model)

Table 2.3.5 (Groundwater Model)

Table 6-3 (Water and Load Balance)

13.3 SUMMARY

Not Applicable

13.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Guidelines and MMER values are based on total metal concentrations, it should be noted that dissolved metal concentrations are not directly comparable.

13.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Groundwater data is reported as dissolved metal concentrations, while effluent quality from the TIA is reported as total metal concentrations. These two values are then combined to create the predicted monthly concentration at the marine outfall mixing box and then compared to the CCME Marine Water Quality Guidelines and MMER Maximum Authorized Monthly Mean Concentrations. Combining dissolved and total metal concentrations in the calculations is inappropriate. Dissolved metal concentrations are not directly comparable to total metal concentrations. In general dissolved metals represent only a portion of the metals found in the sample and would therefore provide an underestimation of the total metal concentrations.

Recommendation/Request: Describe how the data have been transformed or interpreted, specifically for the groundwater data, in order to allow comparison of dissolved values to guidelines based on total values. If this has not been incorporated, provide estimates of total concentrations for the dissolved parameters, with rationale for the method used.

13.6 TMAC RESPONSE

Groundwater quality data are typically presented as dissolved metals because residual particulate matter from drilling remains in the well for an extended period of time after drilling is complete, and is not representative of the formation water. During sampling, these particulates are re-suspended and show up in the unfiltered samples. For this project, both total and dissolved metal analyses were completed, but only the dissolved metal analyses, which are considered representative of the formation water were carried forward for use in the water and load balance modelling.

In response to this request, TMAC have compared the results of total and dissolved metal analyses for the Doris groundwater samples. The results are shown in Table ECCC-5 - 1, with relative percent differences (RPD) for comparisons between 75th percentile results for total and dissolved metals, median results for total and dissolved metals, and 75th percentile results for dissolved metals and median results for total metals. The table also compares total and dissolved concentrations for five individual samples with low turbidity (NTU) - indicating low amounts of total suspended solids (TSS), and highlights the number of those samples that had RPD values of greater than 20%. The results show that the majority of parameters had similar total and dissolved metal concentrations indicating that use of total metal concentrations in the modelling would not result in an appreciable change in the results. Exceptions included Al, Cr, Co, Cu, Fe, Pb, Ni, U and Zn.

Each of these exceptions were closely reviewed to determine why total concentrations were higher than dissolved concentrations.

- To determine whether the differences could be explained by fine particulates originating from the rock, a calculation was completed to determine the metal concentrations that would be associated with 20 mg/L of TSS, assuming that the TSS was derived from typical basalt (as reported in the geochemical characterization reports). For Al, Co, C and Fe, the differences between total and dissolved concentrations would easily be accounted for by the presence of fine particulate matter from the basalt. Total metals associated with finely ground rock are associated primarily within silicate minerals, which are not soluble and which do not have the same toxicological implications as soluble mineral particles. For this reason, it remains appropriate to use dissolved metal concentrations from the groundwater for the subsequent effects assessment for these parameters.

- A review of the results for Pb indicated that both the total and dissolved concentrations were at or very close to analytical detection limits, and that in some cases, the detection limits differed for the total and dissolved samples. Therefore, for lead, it remains appropriate to use the dissolved metal concentrations in the effects assessment.

- A review of the results for U indicated that almost all of the samples had very similar total and dissolved concentrations, and that the 75th percentile values were a rare exception where a difference was present. Given that the pairwise comparisons generally show comparable results, it remains appropriate to use the dissolved metals concentrations in the effects assessment.

- For Cr, Ni, and Zn, there were no obvious reasons for the differences between total and dissolved concentrations, and the differences were sufficient to warrant additional evaluation.

  - Dissolved Cr concentrations in the bedrock groundwater were 0.0005 mg/L (0.0009 mg/L when blended with groundwater inflows from the lake – see Sections 3.2.9 and 4.2.3 of Document P6-10), while total Cr concentrations were 0.0048 mg/L. In contrast, total Cr in the TIA effluent was 0.01 mg/L. Since the potential effects of discharging only TIA effluent have been evaluated, and the TIA effluent has higher total Cr concentrations than the groundwater, there does not appear to be any need for further evaluation of Cr concentrations in the groundwater only scenario.
  - Dissolved Ni concentrations in the bedrock groundwater were 0.0014 mg/L (0.0018 mg/L when blended with groundwater inflows from the lake), while total Ni concentrations were 0.0036 mg/L. In contrast, the TIA . In contrast, total Ni in the TIA effluent was 0.013 mg/L. Since the potential effects of discharging only TIA effluent have been evaluated, and the TIA effluent has higher total Ni concentrations than the groundwater, there does not appear to be any need for further evaluation of Ni concentrations in the groundwater only scenario.
  - Dissolved Zn concentrations in the bedrock groundwater were 0.16 mg/L (0.15 when blended with groundwater inflows from the lake), while total Zn concentrations were 0.49 mg/L. Total Zn concentrations in the TIA were lower than either of these values. Therefore, further evaluation of the effects of total Zn concentrations is warranted. These results will be provided at the Technical Meeting in Cambridge Bay in January 2016, together with the planned sensitivity analysis of the Water and Load Balance.

Table ECCC-5 - 1. Comparison of Total and Dissolved Concentrations in Groundwater

Parameter	%Difference			Low NTS	Explained by	Other comments
	P75T to P75D	P50T to P50D	P75D to P50T	samples	TSS in basalt	
Aluminum (Al)	70%	37%	37%	5/5 samples	yes	retain dissolved values in assessment
Antimony (Sb)	8%	12%	-21%	-	-	
Arsenic (As)	11%	0%	-33%	-	-	
Barium (Ba)	2%	4%	-6%	-	-	
Beryllium (Be)	0%	0%	0%	-	-	
Bismuth (Bi)	0%	0%	0%	-	-	
Boron (B)	-1%	0%	-4%	-	-	
Cadmium (Cd)	0%	2%	-16%	-	-	
Calcium (Ca)	2%	1%	-13%	-	-	
Cesium (Cs)	1%	0%	-9%	-	-	
Chromium (Cr)	81%	71%	71%	5/5 samples	partially	reason for difference not established - use totals in assessement
Cobalt (Co)	34%	41%	9%	4/5 samples	yes	retain dissolved values in assessment
Copper (Cu)	39%	13%	1%	2/5 samples	yes	retain dissolved values in assessment
Gallium (Ga)	0%	0%	0%	-	-	
Iron (Fe)	20%	16%	-5%	3/5 samples	yes	retain dissolved values in assessment
Lead (Pb)	34%	10%	10%	2/5 samples	no	results are all very close to detection limits
Lithium (Li)	-1%	0%	-27%	-	-	
Magnesium (Mg)	0%	1%	-5%	-	-	
Manganese (Mn)	2%	2%	-17%	-	-	
Mercury (Hg)	0%	0%	-67%	-	-	
Molybdenum (Mo)	9%	5%	-16%	-	-	
Nickel (Ni)	44%	52%	24%	4/5 samples	no	reason for difference not established - use totals in assessement
Phosphorus (P)	0%	0%	0%	-	-	
Potassium (K)	1%	-1%	-7%	-	-	
Rhenium (Re)	0%	0%	0%	-	-	
Rubidium (Rb)	-1%	1%	-11%	-	-	
Selenium (Se)	0%	0%	0%	-	-	
Silicon (Si)	4%	3%	-3%	-	-	
Silver (Ag)	0%	0%	0%	-	-	
Sodium (Na)	1%	1%	-2%	-	-	
Strontium (Sr)	3%	1%	-16%	-	-	
Tellurium (Te)	0%	0%	0%	-	-	
Thallium (Tl)	0%	0%	0%	-	-	
Thorium (Th)	0%	0%	0%	-	-	
Tin (Sn)	0%	0%	0%	-	-	
Titanium (Ti)	0%	0%	0%	-	-	
Tungsten (W)	8%	3%	-19%	-	-	
Uranium (U)	52%	0%	-12%	no	no	only difference is evident in P75 data, pairwise comparisons show very similar results, retain dissolved in assessment
Vanadium (V)	0%	0%	0%	-	-	
Yttrium (Y)	0%	0%	0%	-	-	
Zinc (Zn)	51%	51%	28%	3/5 samples	no	appears to be a valid difference, not attributed to particles, use totals in assessment.
Zirconium (Zr)	0%	0%	0%	-	-	

13.7 ATTACHMENTS

Not Applicable

14. ID# ECCC-6

14.1 SUBJECT

CCME Marine Water Quality Guidelines and MMER Authorized Limits

14.2 REFERENCE

Water Load and Balance – Table 6-3

14.3 SUMMARY

Use of incorrect Total Chromium guideline and inappropriate use of MMER limits as objectives for As, Cu, Pb, Ni, and Zn.

14.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Appropriate guidelines should be used for comparison.

14.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Table 6-3 in the Water Load and Balance document identifies a marine guideline of 0.0575 mg/L for total chromium however the source of this guideline is unclear as there is no CCME marine guideline for total chromium. The CCME guidelines are for the hexavalent and trivalent forms, but not total chromium. Additionally, the MMER Maximum Authorized Monthly Mean Concentrations for arsenic, copper, lead, nickel, and zinc are listed under the "marine guideline" column. It should be noted that these values are not guidelines for the protection of marine aquatic life and are instead maximum discharge concentrations pertaining to effluent.

This difference between CCME marine water quality guidelines which are designed to protect aquatic life in the receiving environment and MMER maximum authorized monthly mean discharge concentrations should be clearly identified.

Recommendation/Request: Discuss how the chromium marine guideline listed was arrived at and clearly differentiate between CCME guidelines and MMER discharge concentrations.

14.6 TMAC RESPONSE

The predicted monthly mean and maximum concentrations at the Marine Outfall Mixing Box for the three scenarios modelled are provided in Table ECCC-6 - 1. These concentrations are compared to Metal Mining Effluent Regulations (MMER) discharge

limits and marine CCME guidelines. Marine Canadian Council of Ministers of the Environment (CCME) guidelines for hexavalent chromium (0.0015 mg/L) and trivalent chromium (0.056 mg/L) were investigated as guidelines for total chromium does not exist. The most stringent of the two compositions (hexavalent) was used as the comparison for CCME assuming that modelled total chromium is composed of hexavalent only.

All discharge scenarios meet MMER discharge limits at the end of the pipe. Water quality results for cadmium, mercury and total chromium (conservatively assuming total chromium is composed of hexavalent chromium) were found to exceed CCME marine guidelines at the end of pipe; however. CCME guidelines will be achieved at the edge of the mixing zone in Roberts Bay as described in Document P4-1, Section 4.

14.7 ATTACHMENTS

Not applicable

Table ECCC-6 – 1. Predicted Concentrations at Marine Outfall Mixing Box

Parameter	MMER (mg/L)	Marine CCME (mg/)	Predicted Monthly Concentrations (mg/L)								
			1				2	3			
			Groundwater + TIA Effluent Mean		Groundwater + TIA Effluent Max		GW Only4	TIA Effluent Only Mean		TIA Effluent Only Max	
Nitrate_N[1]		4.5	0.65		0.80		0.93	0.19		0.40	
Total Cyanide	1.0		0.0043		0.0053		0.0036	0.0041		0.086	
Metals			***Diss.***	***Total***	***Diss.***	***Total***	***Diss.***	***Diss.***	***Total***	***Diss.***	***Total***
Arsenic	0.5	0.0125	0.0025	0.0026	0.0034	0.0035	0.0024	0.0040	0.0041	0.0092	0.0092
Cadmium		0.00012	0.00013	0.00013	0.00018	0.00018	0.00012	0.00019	0.00019	0.00046	0.00046
Chromium[2]		0.0015	0.0020	0.0029	0.0031	0.0039	0.00086	0.0039	0.0047	0.0095	0.010
Copper	0.3		0.013	0.013	0.021	0.021	0.0012	0.030	0.030	0.074	0.074
Lead	0.2		0.00054	0.00058	0.00083	0.00087	0.00029	0.0010	0.0010	0.0025	0.0025
Mercury[3]		0.000016					0.000049				
Nickel	0.5		0.0030	0.0032	0.0044	0.0046	0.0018	0.0053	0.0055	0.013	0.013
Zinc	0.5		0.074	0.074	0.080	0.080	0.15	0.020	0.020	0.047	0.048

Notes:

1. CCME Marine Guideline for Nitrate based on long term marine guideline of 200 mg/L. Nitrate-N (mg/L) = 0.2259 x Nitrate-NO3 (mg/L)

2. There is no marine guideline for total chromium. Used hexavalent Chromium marine guideline.

3. Mercury for mixed concentrations and TIA concentrations are not reported due to high detection limits in Mill effluent source term (shaded in grey).

4. Groundwater reported as dissolved metals only.

15. ID# ECCC-7

15.1 SUBJECT

Toxicity Testing of Effluent

15.2 REFERENCE

EC IR#6

15.3 SUMMARY

Toxicity testing results and inputs not provided

15.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Analysis required to verify toxicity test results

15.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent's response to EC IR#6 states that 96 hour acute toxicity tests on 3-spine stickleback were completed in October of 2010. The test results are discussed, however, the laboratory results are not provided in the amendment application or in their response. It was also unclear whether the groundwater sample used for testing was an accurate representation of the anticipated groundwater quality that will be managed and discharged.

Recommendation/Request: Provide the laboratory reports on the ground water toxicity testing that was conducted in October of 2010. Discuss the location, depth and quality (provide chemical characterization analytical results) of the ground water sample used in the testing. Indicate what criteria were used to determine that the groundwater sample used was reflective of anticipated effluent quality. Discuss any additional testing that is proposed to assess the toxicity of "end of pipe" effluent.

15.6 TMAC RESPONSE

Laboratory results for toxicity testing on 3-spine stickleback are included in Appendix B: ECCC-7 - 1.

Groundwater Sampling Methodology

The groundwater sample used for the stickleback toxicity test mentioned above was collected at the Westbay well 10WBW001, located in an open talik, at the vicinity of the

proposed Doris Central stopes. Groundwater was sampled from Port 6, which accesses a zone ranging from 246 to 274 meters below ground surface (mbgs) along the drillhole (221 to 246 mbgs vertical depth). The estimated Westbay zone volume is 168 Liters. This zone is associated with the highest observed hydraulic conductivity.

Between July and August 2010, SRK field staff developed the drilling water in each zone of 10WBW001. After development was completed, the Westbay PVC pipe was re-filled with glycol-water mix to prevent freezing.

SRK collected the groundwater sample in October 2010. Prior to sample collection, the glycol-water mix inside the Westbay pipe was pumped into drums, and then an additional 2,543 Liter of groundwater (or 15.1 times the zone volume) purged from Port 6 using the airlift method. The average pumping rate was 21 L/min.

Two types of samples, which have been labelled as "discrete" and "airlift" samples, were collected and sent to the analytical laboratory:

- The discrete sample corresponds to a small volume of groundwater sampled down hole, directly at the port, using a specialized tool that prevents contact with the atmosphere until they are poured into sample bottles. These samples are considered the most representative samples of the actual formation water, although some aeration and depressurization of the fluid still occurs when the bottle valve is opened and the sample bottle is filled. The small capacity of the tool and the long sampling time were not practical for sampling large volumes of groundwater, therefore discrete samples were only taken for QA/QC before and after airlift samples.

- The airlift sample corresponds to groundwater sampled at surface from the airlift discharge pipe. It has undergone considerable aeration before sampling and as a result of the addition of air, the concentration of some parameters (e.g.: alkalinity, redox, isotopes, and other parameters) may have changed compared to true formation water. However, as the inflow into the mine would likely be aerated through pumping, they do provide a reasonable representation of the groundwater quality discharged at surface during operation.

Additional samples were also taken for QA/QC including duplicates, rinse water blanks, samples of the drilling water and samples of the water inside the Westbay.

"Airlift" samples were also sent to a separate laboratory for toxicity testing. These samples were collected in new 20L plastic gas cans. They were triple rinsed before use, initially with reverse osmosis (RO) water, and the final rinse with DI water.

Laboratory samples were analysed for routine parameters: total dissolved solids (TDS), total metals, dissolved metals, nutrients, and isotopes. The samples were analyzed using the traditional methods of ion chromatography, Inductively Coupled Plasma Mass

Spectrometry (ICP-MS), and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), or High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICPMS). The former type of analyses were labelled as "water" analysis and the second "seawater" analysis.

QA/QC of the Water Samples

The analyses of the duplicates, ion balance, and rinsate blanks or DI blanks showed sample quality was acceptable. Tables showing the results of the QA/QC comparisons are provided in Appendix B: ECCC-7 -2. Conclusions are presented below:

- The duplicate samples were reviewed and the majority of parameters had a relative percent difference (RPD) of less than 20%.
- The ion balances were within 7%.
- A rinsate blank from the vessels in which the toxicity sample was collected showed elevated levels of zinc and aluminum. Total aluminum was 0.0086 mg/L, which for comparison equates to 30.6% of the final discrete sample concentration at 10WBW001 Port 6. Dissolved zinc was 0.0031 or 16.7% of the discrete sample.

Other parameters were detected in the rinsate blank sample, but at low concentrations relative to concentrations in the groundwater, such that they are likely of low importance to the overall results. Detected parameters in the sample blank included: total barium, boron, copper, lead, silver and uranium, and dissolved cadmium and copper.

The comparison of repeated samples over time indicated that variability occurs in natural concentrations of groundwater, some of which may be induced by the pumping and drawing in groundwater from locations further from the well, from the different sampling methods (airlift vs. discrete samples), and/or lab analysis methods (water vs. seawater analysis). Figure ECCC-7 - 1 shows the progressive changes in concentration of total dissolved solids (TDS) throughout the development, between 19,000 and 39,000 mg/L.

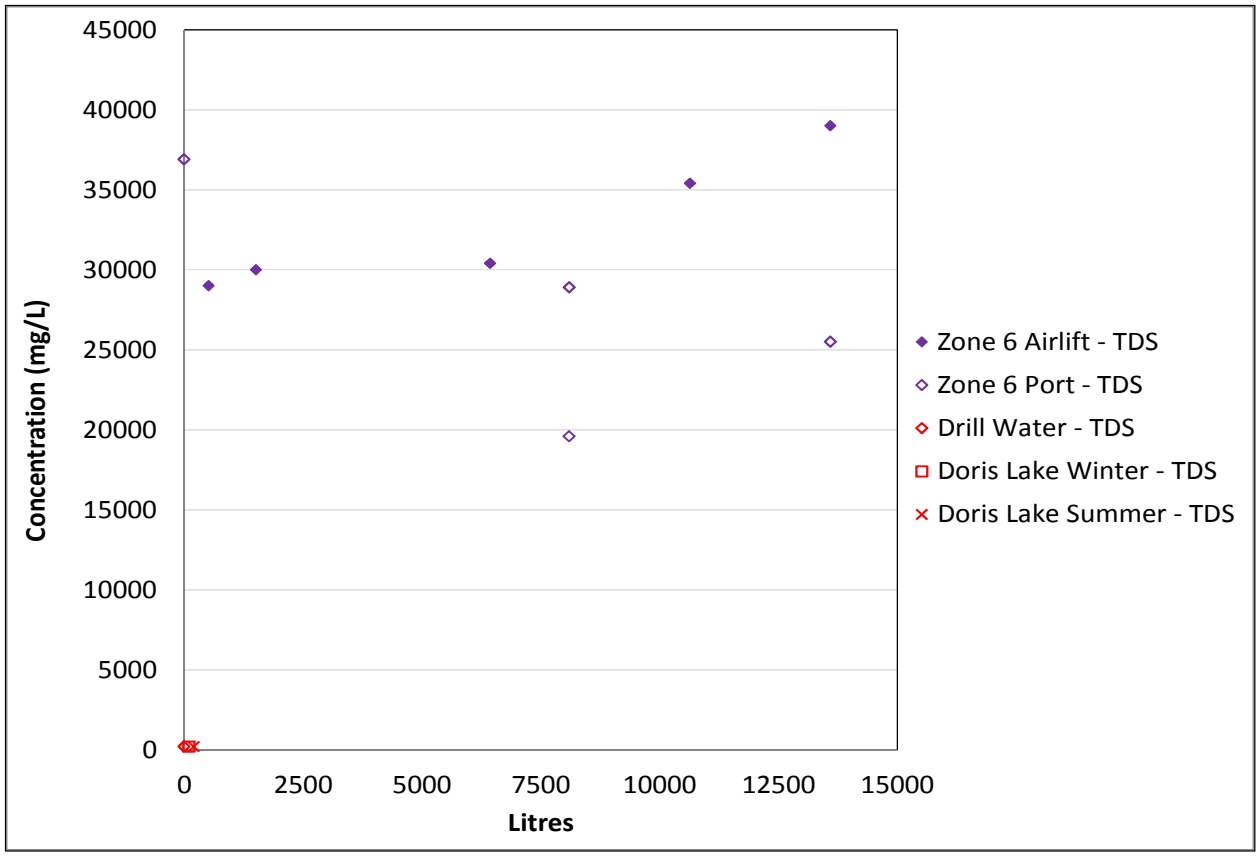


Figure ECCC-7 - 1. Concentration of Total Dissolved Solids in 10WBW001 Zone 6

Graphs showing trends for pH, conductivity, dissolved magnesium, chloride, dissolved calcium, sulphate, dissolved sodium and total barium are provided in Appendix B: ECCC-7 - 2. Concentrations for each of these parameters, except total barium, followed a similar pattern to TDS, showing variability throughout the development, close to being stable but still increasing slightly, and all at much higher concentrations than drilling water. Barium, along with other metals, showed some difference in concentrations between airlift and port samples, making any overall concentration trends difficult to determine.

Appendix B: ECCC-7 - 2 includes a table comparing airlift samples and discrete samples taken at Port 6. The comparison showed:

- The two discrete samples taken in October, before and after the process of purging, were quite similar. All the major ion concentrations had relative percent differences (RPD) of less than 20%, and only a few trace metals at low concentrations exceeded this RPD.
- For many parameters, the airlift samples had 30 to 80 % higher concentrations than the discrete samples (i.e. higher TDS, EC, hardness, alkalinity, sulphate,

chloride, bromide, silicate, total arsenic, boron, calcium, lithium, magnesium, manganese, potassium, sodium, and strontium);

- Total iron concentrations were higher in the airlift samples (4.5 mg/L in airlift compared with 2.3 mg/L in discrete);
- The difference between total and dissolved iron was much less in the airlift samples. The discrete samples had large differences between average total iron (2.3 mg/L) and dissolved iron (0.23 mg/L), compared with a difference of only 4.5 mg/L to 4.4 mg/L from total to dissolved for the airlifted method;
- Lower pH in the airlift samples; and
- Lower turbidity in the airlift samples.

Quality of the Water Toxicity Testing Sample

SRK considered the groundwater sample collected for toxicity testing to be likely representative of the range of concentrations expected in natural formation water. Substantial volumes have been developed and the relatively high K rock in the zone must have also provided natural flushing. The QA/QC completed throughout the sampling events showed that variability occurs in concentrations of groundwater although it has been reduced by the repeated purge of the Westbay zones. The sampling procedures and handling processes have not lead to significant cross-contamination of the groundwater samples.

Additional Testing

As a part of mill commissioning prior to Operations, TMAC plans to conduct testing to confirm the mill operates as planned, including toxicity testing to assess end of pipe effluent toxicity. Given the anticipated salinity of the effluent, TMAC has identified 3-spine stickleback as a potentially suitable species for toxicity testing. Rainbow trout is not a suitable species for effluent toxicity testing wherein the effluent is > 10 parts per thousand salinity and discharged to the marine environment. TMAC anticipates working closely with Environment Canada's regional laboratory in order to determine a suitable species for toxicity testing.

Other Information

TMAC understands that ECCC has initiated a priority scientific activity to identify a salt tolerant species for situations where saline effluent is discharged to marine environments. TMAC also understands that the necessary changes to the MMER may not be completed until 2017. As a mitigation measure, in the event that TMAC must commence operations prior to completion of ECCC processes, TMAC has identified an engineering alternative which would defer the need to discharge saline groundwater directly to the marine environment. The concept would involve using the volume in the TIA to store saline groundwater temporarily. TMAC is in a preliminary stage of review of

this option and will present further details during the Technical Meeting in Cambridge Bay.

15.7 ATTACHMENTS

Appendix B for:

- ECCC-7 – 1 Threespine Stickleback Toxicity Testing
- ECCC-7 – 2 Groundwater Results QA/QC
- ECCC-7 – 3 Groundwater Analytical Results

16. ID# ECCC-8

16.1 SUBJECT

Aquatic Effects Monitoring Program

16.2 REFERENCE

Section 4.5.8.1 (Package 4)

EC IR #8

16.3 SUMMARY

Aquatic Effects Monitoring Program (AEMP) has not been updated for the amendment application and does not include appropriate monitoring sites in Roberts Bay.

16.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

16.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Monitoring Sites must be identified ahead of time in order to collect adequate baseline data so that effects can be detected once effluent discharge begins.

Recommendation/Request: Provide the updated AEMP for review.

16.6 TMAC RESPONSE

TMAC intends that development of an Aquatic Monitoring Framework (AMF), which satisfies the NWB requirement for an Aquatic Effects Monitoring Plan (AEMP) and is harmonized with the Metal Mining Effluent Regulations (MMER) Environmental Effects Monitoring (EEM) requirements, will be a collaborative process in accordance with the **Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the NWT (INAC 2009)**. TMAC will seek participation by EC, NWB, KIA, DFO, NIRB and the Hope Bay Inuit Environmental Advisory Committee (IEAC) in a Working Group in early 2016 to review and provide input on appropriate modifications to the existing AEMP. It is proposed that the first meeting of the Working Group be scheduled for March 2016, to allow; 1) consideration of any relevant outcomes of the Technical Meeting, 2) the initiation of 2016 baseline data collection at agreed sites, and 3) facilitate the finalization of the AMF by June 1, 2016.

TMAC additionally notes that, in section 4.5.8.1 of Document P4-1 in the Amendment Application submission, proposed modifications to the existing AEMP sampling program

include study area expansion to include the geographic area of the diffuser, the potential area of influence of the TMAC effluent discharge as well as an additional deep-water reference site. A map of proposed new sampling locations relative to the diffuser is attached for illustrative purposes (see Appendix A: Figure ECCC-1/ECCC-8 – 1). The sampling frequency and parameters of the existing AEMP reflect the MMER EEM requirements, and as such TMAC proposes that they would largely remain suitable for the amended project, but would be discussed in depth in the March AMF Working Group meeting.

16.7 ATTACHMENTS

Appendix A: Figure ECCC-1/ECCC-8 – 1: Proposed AEMP Sampling Stations

17. ID# ECCC-9

17.1 SUBJECT

Water Licence Limits

17.2 REFERENCE

Table 5-1 (Water Load and Balance)

17.3 SUMMARY

Water Licence limits need to be updated for new discharge location and effluent management

17.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Impacts to the receiving environment are linked to concentrations of contaminants in the effluent; the effluent quality criteria identified in the water licence will determine loadings and environmental concentrations and effects.

17.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Table 5-1 of the Water Load and Balance document includes the current water licence limits for the Doris North Project. Water Licence limits should be revised to accommodate the proposed changes in discharge location and predicted changes in effluent composition.

The Proponent does not identify end-of-pipe limits that are deemed achievable using Best Available Technology Economically Achievable; this information should be included in the amendment application along with a rationale for the proposed effluent quality criteria. Discharge criteria should be set to ensure that concentrations of parameters in the receiving environment remain at levels below protective water quality objectives.

Recommendation/Request: Discuss and propose potential changes to water licence criteria including:

- Suitable sampling/compliance locations
- Additional parameters to be included in the licence
- Applicability of current licence limits to different discharge locations and effluent qualities

17.6 TMAC RESPONSE

TMAC has proposed end-of-pipe discharge limits. TMAC proposes in the water license application to meet Metal Mining Effluent Regulations (MMER) discharge limits. TMAC further proposes to meet Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of marine life in Roberts Bay. TMAC will also implement an environmental effects monitoring program as required by MMER that is consistent with the broader Aquatic Monitoring Framework (AMF) for the Doris Mine. This approach is consistent with the approach taken to the existing water license.

17.7 ATTACHMENTS

Not Applicable

18. ID# ECCC-10

18.1 SUBJECT

Sediment Quality and Effluent Buoyancy

18.2 REFERENCE

EC IR #5

EC IR #9

Table 5 (Groundwater Model) Table 4.3-1 (Marine Environment)

18.3 SUMMARY

Potential impacts to marine sediments during periods of groundwater only discharge

18.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Understanding the characteristics of the effluent will inform the understanding of potential effects on the receiving environment.

18.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent has indicated that they are relying on buoyancy of the effluent to mitigate potential impacts to sediment in the area of the diffuser. They have stated that the discharge will be less dense than the receiving environment and will therefore be buoyant and not interact with the sediments. Table 4.5-3 predicts the maximum salinity of the mixed groundwater and TIA effluent as 27.6‰. However, during the winter only the groundwater, with a salinity of 31.86 ‰ (Table 5 – modelling estimates), will be discharged to Roberts Bay and will therefore exceed the salinity of Roberts Bay. This higher salinity effluent will be denser than the surrounding marine water and when combined with a discharge rate of 81 L/s and the associated turbulence would cause scouring of sediments, disturbing the benthic community and increasing turbidity.

Recommendation/Request: Discuss how effluent will be managed such that it remains buoyant at all times. Discuss potential mitigation measures if effluent is more dense and saline than the receiving environment and how impacts to sediments will be minimized.

18.6 TMAC RESPONSE

The salinity value of 31.86‰ from Table 5 (Groundwater Model, Document P6-3) indicated above in the 'Detailed Technical Comment' refers to the 75th percentile salinity value from groundwater quality samples taken from a Westbay well. Predicted maximum effluent and ground water salinity values in Roberts Bay (Table 4.5-3, Document P4-1) were calculated from *maximum* mixing box chloride predictions, in other words, the effluent just before it is discharged to Roberts Bay. A time series of chloride concentrations from mine inflow are available in Table 9 and Figure 15 of the Groundwater Model Report (Document P6-3), and indicate a maximum chloride concentration of 14,750 mg/L or 26.7‰ (based on a 0.00180655 conversion). This salinity level is predicted to peak during the first month of Year 3 of operations and quickly decrease to approximately 6,000 mg/L or 10.8‰ through Year 6 of operations. Based on these predictions, the effluent plume will be less dense than the Roberts Bay bottom waters; particularly following the first few months after mine water inflow is encountered, and will be buoyant.

With respect to discharge rates, the maximum salinity levels will occur in the groundwater and will be discharged at a maximum rate of 35 L/s during winter not the 81 L/s mentioned above in the Technical Comment; 81 L/sec is a maximum discharge rate during summer. Much fresher Tailings Impoundment Area (TIA) water (43.4 mg Cl/L; 0.08‰ salinity) will be combined with groundwater during the open-water season and will be discharged at a maximum rate of 81 L/s; however, this water will be much more buoyant (6,359 mg Cl/L; 11.5‰) and will rise in the water column following passage through the diffuser.

The buoyancy of the effluent will be confirmed through effluent monitoring and through physical profiling as part of the Aquatic Monitoring Framework that will be developed for Roberts Bay. Water quality, sediment quality, and potential biological effects will be evaluated through the Metal Mining Effluent Regulations/ Environmental Effects Monitoring (MMER/EEM) program in Roberts Bay. Project effects will be adaptively managed such that if effects to the receiving environment are determined using the EEM protocols in conjunction with the Aquatic Monitoring Framework the appropriate mitigation measures will be put in place to negate the effects.

18.7 ATTACHMENTS

Not Applicable

19. ID# ECCC-11

19.1 SUBJECT

Cumulative impacts of shipping on marine birds in sensitive areas

19.2 REFERENCE

-ECCC-IR#12

-Package 4-Identification of Potential Environmental Effects and Proposed Mitigation: 4.3.1 Proximity to

Designated Environmental Areas

-FEIS Project Description: 4.8.7.1 Marine Vessels and Barges, and 4.8.7.2 Vessel Routing,

-Environment Canada. 2014. Environment Canada's input to the Nunavut Planning Commission regarding Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area. April 2014. Available on-line at: http://www.nunavut.ca/files/2014-05-09%20EC%20Map%20Book%20re%20Migratory%20Birds.pdf

-Dickson, D.L. 2012. Seasonal movement of Pacific Common Eiders breeding in arctic Canada. Canadian Wildlife Service Technical Report Series No. 521 Available online at: http://ec.gc.ca/Publications/default.asp?lang=En&xml=65AD25CF-A8D8-4407-9B5C-7BAB469B3403

19.3 SUMMARY

ECCC is concerned about the cumulative impacts of shipping on migratory birds and on their key marine habitat sites as development and shipping traffic increases in the Kitikmeot region. In addition to community re-supply, several other projects are proposed in the area (e.g. Back River, Hackett River, Bathurst Inlet Port and Road, Izok) which would increase shipping traffic. The Proponent has not provided specific shipping routes in the amendment application.

19.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Many key marine habitat sites for migratory birds are located along known shipping routes and there is a potential for significant impacts where they overlap.

19.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

In their response to ECCC-IR#2 (2015), the Proponent indicated that activities proposed under the amendment would not increase annual shipping levels. At that time shipping traffic was described as including one tanker of fuel, two freighters of cargo (east and west port sources) and barge (river route) traffic of varying tonnages based on cost and availability of supplies. The Proponent concluded that there would be no changes to marine impacts due to the proposed amendment.

However, in the 2005 Final Environmental Impact Statement (FEIS) marine shipping serving the proposed mine was describe as one dedicated sealift from Hay River per year, travelling down the Mackenzie River and along the Arctic coast to the Doris North Project. The charter would typically consist of one tug and five 1500 series barges leaving in mid-July arriving in mid-August. In addition, the scheduled community sea lift barge run would likely call in at the Doris North site in mid-September to bring in late delivery materials during the mine's operating life.

ECCC concludes that the 2015 marine shipping description in the amendment proposal differs from the description provided in the 2005 FEIS submission. The information provided in 2015 indicates that more ships will be serving the mine and, at least one additional route has been added since submission of the FEIS in 2005. These changes were not assessed in the amendment application.

In addition, ECCC recently published studies identifying important marine habitats for migratory bird populations, including Bathurst Inlet and Melville Sound. These studies were not available at the time of the original environmental assessment but should be considered when assessing shipping related impacts..

ECCC has identified several important migratory bird areas, referred to as "key habitat sites" in Nunavut and the Northwest Territories. Key habitat sites (KHS) are marine or terrestrial areas supporting at least 1% of the Canadian population of at least one species of migratory birds (or in some cases subspecies). Key habitat site information is updated as our knowledge about distribution and abundance of migratory birds in the northern portion of their range increases. The Bathurst and Elu Inlets KHS contains more than 10% of the Pacific Common Eider and Thayer's Gull national population (Environment Canada 2014). The Bathurst and Elu Inlets KHS was classified as "highly risk intolerant" in EC's input to the Nunavut Planning Commission (Environment Canada 2014). ECCC conducted aerial surveys of the Bathurst Inlet and Melville Sound area in July of 2015 re-affirming the importance of the area to common eiders (ECCC unpublished data).

In August and September, marine shipping could impact broods and moulting (i.e. flightless) adult common eiders through disturbance and pollution incidents. During this stage of their lifecycle, common eiders are under physiological stress: duckling growth

rates and food demands are high while the adults are moulting. As a result eiders congregate along specific areas of coast and offshore islands where food is abundant and the risk of predation is low. Disturbance during this period could impact common eider fitness and affect their survival rates. Pollution of these areas could cause direct bird mortality and/or indirect impacts through contamination of food sources.

Using satellite transmitters, Dickson (2012) identified several high use moult locations in Bathurst Inlet and Melville Sound as well as along the western shipping route. Disturbance impacts in important moulting areas in Bathurst Inlet and Melville Sound are unknown and cannot be determined without the ability to overlay a detailed shipping route and having a better understanding of the shipping schedule and eider distribution throughout the shipping period.

A major fuel spill in the marine environment poses one of the greatest risks to marine bird populations and other wildlife along arctic shipping routes. The Proponent or their shipping contractors will likely be the first responders to any spill event and, given the remote location of the Project; it may take considerable time to obtain additional assistance should it be required. Therefore, it is critical that the Proponent and their shipping contractors demonstrate that they are sufficiently prepared and adequately equipped to effectively protect wildlife in the event of a spill.

The Spill Contingency Plan and Oil Pollution Prevention Plan (OPPP) / Oil Pollution Emergency Plan (OPEP) mention that reasonable measures, including hazing, will be taken to prevent wildlife access to affected areas and that external resources will be consulted and retained as required. The OPPP/OPEP also includes an Oiled Bird Response Guidance Plan in Schedule 13. However, a list of available equipment to implement priority response measures, such as hazing and bird collection, as well as possible external resources is lacking in any of the plans.

The Spill Contingency Plan also indicates that the Proponent will rely on the shipping contractor for primary marine spill response under their Shipboard Oil Pollution Emergency Plan (SOPEP) while bulk fuel and containerized shipments of hydro-carbon based products are in transit.

Recommendation/Request:

Detailed shipping routes and schedules should be provided to identify opportunities to minimize impacts to marine birds and risks to key marine habitat sites.

The OPPP/OPEP should include a list of available equipment to implement priority wildlife response measures, such as hazing and bird collection, as well as list possible external resources that could be consulted or retained in the event of a spill affecting marine birds.

The Proponent should require that their shipping contractors outline in their SOPEP:

i) specific measures to keep wildlife, particularly marine birds, out of a contaminated area,

ii) location and specifics of equipment available to do this,

iii) what measures would be taken if wildlife do come in contact with the spill, and
iv) when such procedures should be used.

19.6 TMAC RESPONSE

Appendix A: Figure ECCC-11 -1 illustrates the detailed shipping routes used by the Project as well as the KHS areas identified by ECCC. TMAC will provide contracted shipping companies with the ECCC documents cited by ECCC for their consideration.

Prior to TMAC's next bulk fuel delivery, the OPPP/OPEP will be revised to include equipment available to implement priority wildlife response measures, in consideration of the Birds and Oil – CWS Response Plan Guidance document (http://www.cnlopb.ca/pdfs/arkexlsggs/responseplan.pdf). In addition to the equipment that is already listed in the OPPP/OPEP (such as personal protective wear and spill containment and retrieval equipment), wildlife response equipment may include hazing tools such as handheld noise deterrents (e.g. air horns), use of small watercraft, and bird collection supplies. In previous fuel offloads, arrangements have been made with external companies to ensure they are on standby during fuel offload to provide wildlife response support in the event of a spill. The revised OPPP/OPEP will list such contact information.

As outlined in the OPPP/OPEP, it should be noted that Shippers hold responsibility for the fuel until it enters the on-shore tank valve, which is located inside of the 20 million liter tank containment berm in Roberts Bay. TMAC will, however, cooperate in a response to any spill event.

19.7 ATTACHMENTS

Appendix A: Figure ECCC-11 -1 Shipping Routes through Bathurst Inlet and Melville Sound

20. ID# ECCC-12

20.1 SUBJECT

Avoiding incidental take of migratory birds

20.2 REFERENCE

Package 4-Identification of Potential Environmental Effects and Proposed Mitigation: 3.4.3 Terrestrial Wildlife

Wildlife Mitigation and Monitoring Plan – March 2013

20.3 SUMMARY

The Proponent concludes that potential interactions with terrestrial wildlife, including migratory birds, are limited to habitat loss from the proposed expanded footprint. This interaction was assessed as negative and mitigable. The Proponent undertakes to maintain existing mitigation measures to minimize impacts to migratory birds. The description of measures lacks sufficient detail to allow assessment potential incidental take during proposed land clearing.

20.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

A detailed description of the mitigation measures and the monitoring of the effectiveness of these measures is necessary to ensure impacts to migratory birds are non-significant and mitigatable.

20.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The Proponent concludes that potential interactions with terrestrial wildlife, including migratory birds, are limited to habitat loss from the proposed expanded footprint. Although migratory birds are noted as using the habitat types identified in the proposed footprint, disturbance to adults and nests will be minimized as land clearing will be conducted outside the breeding season. However, the Proponent also indicates that they will maintain existing mitigation measures, including the use of qualified personnel to conduct pre- clearing surveys if clearing occurs within sensitive wildlife periods, which presumably includes the breeding seasons of migratory birds.

Although these measures appear to be appropriate in principle, details are lacking in the amendment application, and in the most recent Wildlife Mitigation Monitoring Plan (WMMP). Furthermore, there appears to be insufficient information on: i) what is considered the breeding period; ii) pre-clearing survey methods to be used iii) how

survey outcomes will be used to inform implementation of mitigation strategies and, iv) on how the effectiveness of mitigation measures would be assessed on an ongoing basis, so as to allow for adaptive management.

Paragraph 6(a) of the Migratory Birds Regulations prohibits the disturbance or destruction of the nests or eggs of migratory birds. Migratory birds, the nests of migratory birds and/or their eggs can be inadvertently harmed or disturbed as a result of many activities including but not limited to clearing trees and other vegetation, draining or flooding land, and the use of fishing gear. The inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is known as "incidental take".

Incidental take, in addition to harming individual birds, nests or eggs, can have long-term consequences for migratory bird populations in Canada, especially through the cumulative effects of many different incidents.

The regulations do not provide for authorizations or permits for the incidental take of migratory birds or their nests or eggs in the course of industrial or other activities. As such, to minimize the possibility of contravening the law, taking reasonable care and avoidance are the best approaches to use when contemplating any activity or decision that has the potential to impact migratory birds, nests or eggs. The Proponent is responsible for taking appropriate measures to ensure that they comply with the legislation and regulations.

The following information is provided as general guidance to assist the Proponent in planning their field activities. For further information, the Proponent should consult the ECCC webpage at: www.ec.gc.ca/paom-itmb for general guidance on avoidance of incidental take of migratory birds.

In the Arctic Plains and Mountains region of the Northwest Territories and Nunavut (Nesting Zone N9), where this project is located, migratory birds may be found nesting from mid-May until mid-August.

If nests containing eggs or young of migratory birds are located or discovered, all disruptive activities in the nesting area should be halted until nesting is completed. Any nest found should be protected with a buffer zone appropriate for the species and the surrounding habitat until the young have naturally left the vicinity of the nest. Moreover, if there are migratory bird nests where work is proposed, options like avoiding, adapting, rescheduling or relocating activities that could disturb or destroy the nests should be considered. To help with the determination of appropriate setback distances for the circumstances, examples of setback ranges for different groups of tundra-nesting birds are provided in Table ECCC-12 – 1. It is important to note that these general examples should serve as an initial basis for review and should be adjusted after assessing effectiveness.

Table ECCC-12 – 1. Setback Distances

Migratory Bird Species Group	Setback Distance for Pedestrians / ATVs (m)	Setback Distance for Roads / Construction / Industrial Activities (m)
Songbirds	30	100
Shorebirds	50[a]	100[a]
Terns/Gulls	200	300
Ducks	100	150
Geese	300	500
Swans/Loons/Cranes	500	750

[a]*For American Golden Plover, these setbacks should be increased to 150 m for pedestrians/ATVs and 300 m for roads/construction/industrial activities respectively.*

Except when nests are known to be easy to locate without disturbing them, active nest searches are generally not recommended. They have a low probability of locating all nests, and are likely to cause disturbance to nesting birds. In many circumstances, incidental take is likely to still occur during industrial or other activities even when active nest searches are conducted prior to these activities.

To determine the likelihood that migratory birds, their nests or eggs are present in a particular location, the proponent should use a scientifically sound approach that considers the available bird habitats, the migratory bird species that are likely to be encountered in such habitats and the time periods when they would likely be present. This will help the Proponent plan work activities to avoid affecting nesting birds. If further investigation is required to determine the presence of breeding birds, consider conducting an area search for evidence of nesting (e.g., presence of birds in breeding habitat through observation of singing birds, alarm calls, distraction displays) using non-intrusive search methods to prevent disturbance. In all cases, the nest itself should never be marked using flagging tape or other similar material as this increases the risk of nest predation. If necessary, flagging tape can be placed at the limits of the buffer zone.

Recommendation/Request:

The Proponent should carry out all phases of the project in a manner that protects migratory birds and avoids harming, killing or disturbing migratory birds or destroying, disturbing or taking their nests or eggs. The Proponent should consult Environment Canada's web page at: www.ec.gc.ca/paom-itmb/ for general guidance on avoidance of incidental take of migratory birds and the linked fact sheet "Planning Ahead to Reduce the Risk of Detrimental Effects to Migratory Birds, and their Nests and Eggs".

Specifically, ECCC recommends that:

- Detailed mitigation measures reflecting current advice to help reduce the risk of incidental take of migratory birds, nest and eggs be included in the Wildlife Mitigation and Monitoring Plan (WMMP).

- Avoid clearing land during the migratory bird nesting season (mid-May to mid-August).

- In the event that clearing or disturbance cannot be scheduled outside of the nesting season, using a scientifically sound approach to determine the likelihood of nesting birds. If necessary, using non-intrusive search methods conduct an area search for evidence of nesting before clearing.

- Surveys should be carried out by an avian biologist or naturalist with experience with migratory birds and migratory bird behaviour indicative of nesting (e.g. singing birds, alarm calls, distraction displays, carrying nesting material or food, etc.).

- Include as a starting point ECCC's recommended setback distances for tundra nesting birds in their WMMP.

- Include monitoring of the effectiveness of mitigation measures (including results of area searches for evidence of nesting) in their WMMP annual report.

- Continue the monitoring and reporting of wildlife mortalities, including migratory birds to inform mitigation measures and allow for adaptive management.

20.6 TMAC RESPONSE

Construction activities of the project will continue to be preferentially conducted outside of the migratory bird nesting and breeding season.

TMAC has conducted extensive scientific surveys of birds in the project area, and has many years of data on the bird presence in the Doris North area during the nesting period. That said, TMAC will continue to conduct surveys for bird nesting activity prior to construction activities that commence between mid-May and mid-August. As per ECCC's request, personnel trained at identifying indicators of bird nesting behaviours will conduct this through minimally intrusive auditory and visual observations. It is noted that confirming nest locations is inherently difficult. The easiest way to detect them is if a female is flushed off one. Thus, if it is uncertain whether a bird nest is present in the area based on the auditory/visual survey, a walking survey may be conducted, taking similar care as used for the foot-based bird compliance monitoring surveys. If a bird nest is present in an area, buffer distances will be applied with consideration to ECCC's recommendations and the specific circumstances and species involved.

The mitigation measures outlined here will be included in the future revision of the WMMP Annual Report. Additionally, results of the pre-construction surveys will be

provided in the Annual Report, as well as the wildlife mortalities (including bird mortalities) that are currently reported.

20.7 ATTACHMENTS

Not applicable

21. ID# GN-1

21.1 SUBJECT

Project Employment

21.2 REFERENCE

TMAC Resources Inc. Responses to IR Comments

21.3 SUMMARY

"The purpose of the 2015 Amendment Application is to conduct an assessment of the potential effects of the proposed changes to the Phase 1 Doris North Project on the natural and human environment. To meet this requirement for socio-economics, TMAC provides an analysis that focuses on the effects of the Project, as detailed in the 2005 Environmental Impact Statement, and considers whether the proposed changes to the Project would alter the previously documented (2005 FEIS) socio-economic effects of the Project (Miramar 2005). Specifically, the 2015 Amendment Application provides:

1. Information on the recent socio-economic baseline conditions and description of changes that have occurred since the 2005 Doris North Final EIS Submission (Miramar 2005);

2. Information on the actual recent and expected future direct employment and expenditures by the Project;

3. Review of the 2005 Doris North Final EIS migration and effects assessment conclusions; and

4. A screening of the effects of the proposed changes in the Project in relation to the identified mitigation and effects assessment conclusions.

TMAC acknowledges that an updated economic model and related analysis may assist with local and regional planning, but it is not required to review the current project. TMAC Resources does not make use of the National Occupational Classification (NOC) system for employment and training planning purposes. Additionally, we note that the Government of Nunavut abandoned use of the NOC based Nunavut Community Skills Inventory System several years ago. A staffing level scenario is provided in TMAC's May 2015 Pre-Feasibility Study. These numbers are expected to change through the course of the next year as optimization of staffing needs occurs.

It is also an important input into project planning and a requirement of the recently negotiated IIBA that has been signed with the KIA. A copy of the IIBA is attached to this submission for reference purposes. As per the terms of the IIBA, TMAC will provide the IIBA Implementation Committee with information about the Project's projected labour requirements once available to. This information will help the IIBA Implementation Committee set Inuit training and employment targets as described in the 2015 IIBA (KIA & TMAC, 2015). TMAC submits that the information presented within the tables and associated discussion in the 2015 Amendment Application are adequate to perform the level of review associated with amendments to the Water License Application and Project Certificate."

21.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

As the chair of the regional Socio-Economic Monitoring Committee (SEMC) the GN confirms that between the two operating mines in Nunavut a common trend in staffing is apparent. The local labour force typically has little issue filling unskilled positions (level D); however, only a significant amount of effort by employers addresses vacancies in the semi-skilled positions (level C). Skill requirements can be a significant barrier to employment and to upward mobility in the workforce. In order to accurately understand the potential effects of the proposed amendment on employment levels in the region, aggregate planned employment levels, alone, are not sufficient.

With respect to the 2015 Amendment Application, the proposed increases in labour force requirements, although positive, are more significant and complex than they were originally proposed in the 2005 FEIS. In order to maximize the employment benefits available through the Doris North Project, a structural alignment of labour demand and labour supply must occur. This is not the sole responsibility of the Proponent, which is why this information should be shared with the GN and other Interveners.

21.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The GN respectfully disagrees with the Proponent's submission that "the information presented in the 2015 Amendment Application is adequate to perform the level of review associated with amendments to the Project Certificate." To clarify, there has only been one major Project Certificate Amendment process completed in Nunavut in the recent past and it was for Baffinland Iron Mines Corporation's (BIMC) Mary River Early Revenue Phase (ERP) proposal. In its Addendum to the Mary River FEIS, BIMC did in fact include skill level distinctions in their employment forecasts and local labour supply levels. The GN found this type of information critical to the overall evaluation of the ERP's potential net benefit for the same reasons it finds it necessary in this case. Without this information it is not possible to reasonably conclude the potential employment benefits of any proposal, nor does it allow for an effective planning and mitigation process.

In the Proponent's response it notes that the GN abandoned use of the NOC-based Nunavut Community Skills Inventory System several years ago as justification for not providing a comprehensive analysis of labour supply and demand. While the Nunavut Community Skills Inventory System is currently not in operation, the GN's Department of Family Services, through its Career Development division is currently in the process of collating and synthesizing labour market information to ensure that skills training and education are in line with the demand for work. As mining is one of the biggest sectors in Nunavut's economy, it is critical that the GN is aware of the available jobs and the skills required to adequately perform each in order to ensure that the local labour market is prepared to assume these positions. The NOC is the best way of categorizing available jobs and skills required as it is used throughout the country and is presently being used by Family Services' Career Development.

In the interest of producing accurate labour market information and reliable economic and employment forecasting for the current and future labour force, the GN requires the most up-to-date estimates of what types of employment will be available through the Project, and what skills are required for these jobs. Without the demand numbers by NOC coding, the GN cannot undertake accurate supply and demand modelling to inform labour market programming and related training. Essentially, this information is critical to ensuring an available labour force to maximize the available benefit of the Project.

Recommendation/ Request:

The GN reiterates its requests that the Proponent provide before the Final Hearing:

1. A supplementary table related to Section 6.4.1 to indicate planned project employment demand by skill category, consistent with the NOC coding system; this effort should extend to direct (on-site and off-site) and also mine contractor employment.

2. A supplementary table related to Section 6.4.1 to indicate the composition of the regional labour force by skill category, consistent with the NOC coding system.

3. An assessment of the information provided in the two tables mentioned above that gives consideration to proposed employment targets, gaps in education and training, and the adequacy of proposed mitigation measures.

21.6 TMAC RESPONSE

TMAC does not use the National Occupational Classification. We will require a multi-skilled workforce with skills that cannot be assigned to one classification. For example, our crane operator (NOC 7371) is also a heavy equipment trainer. TMAC has prepared a manpower plan of positions required at Hope Bay in 2016 and will be in a position to share this confidential document with the GN by the end of February 2016. To facilitate

review and use of the listing, TMAC will categorize the list of positions in relation to three levels of education required, specifically: post-secondary education required, high school required or on-the-job training.

In addition, TMAC will conduct a supplemental analysis of the labour demand and supply identifying the composition of the regional labour source, also by skill category consistent with the NOC coding system and an assessment that considers the labour force demand and supply as indicated by these estimates.

Direct Project employment estimates will be based on the preliminary workforce schedule developed based on the Prefeasibility Study. Regional labour supply data will be based on the 2011 National Household Survey (NHS), the most suitable data available. While the Canadian Labour Force Survey (LFS) collects data within the Kitikmeot Region, Statistics Canada has confirmed that it is unable to release the data as it is thought to be inaccurate and unreliable at this geographic level. (Reference: Vicky Wu, Data Dissemination Officer, Statistics Canada, pers. comm., January 12 2016)

The labour supply analysis will be conducted using an approach that is similar to the approach taken for the Mary River Project by Baffinland. The labour supply analysis will employ the following methodology:

1. Estimate the labour force requirements of the Project by NOC skill level using a peak year of employment and the required minimum education level for each position as an indicator of skill level.
2. Estimate the supply of available labour within the Kitikmeot Region using the 2011 NHS and Canadian LFS.
3. Provide an analysis of the requirements of the Project in relation to labour force capacity, to inform efforts to maximize local participation in Project employment.

21.7 ATTACHMENTS

Not applicable

22. ID# GN-2

22.1 SUBJECT

Training and Development

22.2 REFERENCE

GN IR #2 Training and Development

TMAC Resources Inc. Responses to IR Comments

22.3 SUMMARY

The Proponent writes:

"TMAC has worked with the KIA to review, mitigate, and enhance the opportunities and potential impacts of the Project, resulting in an Inuit Impact and Benefit Agreement (IIBA) (KIA & TMAC, 2015). The IIBA includes measures that are relevant to the Human Resources Plan as well as training and development.

Additionally, TMAC supports the preparation of the Kitikmeot labour force for mining related employment generally through participation in Socio-economic Monitoring Committees and as part of the Community Readiness Committees and other skills training initiatives as indicated in the 2015

Amendment Application. TMAC Resources participates in the Nunavut Mine Training Roundtable and continues to track progress made to establish a Nunavut Mine Training Center in Cambridge Bay.

TMAC's Human Resources requirements will be subject to optimization over the next year as we progress to gold production. TMAC Resources is required under Condition 32 of the existing Doris North Project Certificate to have relevant Human Resource plans in place prior to commencement of Production, which is scheduled for early 2017. TMAC does not feel providing this information to the Technical Meeting is necessary.

TMAC acknowledges that the Kitikmeot Region is progressing its Community Readiness for employment and will continue to participate in the Committees and education opportunities as available and meet IIBA commitments. Details of training and education programs will be managed as per the terms and conditions of these existing Committees and Agreements. TMAC submits that the detail provided in the 2015 Amendment Application is adequate to perform the level of review associated with amendments to a Water Licence Application and Project Certificate."

22.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Training and education are essential components of an effective Human Resources Plan. Without a well-developed and fully informed approach, the benefits associated with increased employment cannot be fully realized. This situation can occur when there is no upward transitioning in skill levels and the availability of lower skill level category positions are exhausted. It is in all Parties' best interest to begin discussions as early as possible on this topic. Furthermore, the general public will benefit from understanding what, if any, specific training and education plans are currently under consideration. The value of the potential feedback from the public must not be discounted.

22.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The GN appreciates the Proponent's response to GN IR#2 and its obligations to IIBA requirements, however, it is still not possible to discern what, if any, direct and specific plans are under consideration to train and develop its potential labour force. The commitments to remain engaged with the Kitikmeot Socio-Economic Monitoring Committee (SEMC), Community Readiness, and other skills training initiatives are important, but they are not a substitute for a meaningful discussion of the region's labour force characteristics and proposed training initiatives.

It is also worth noting that the Kitikmeot SEMC as well as the Kugluktuk and Cambridge Bay Community Readiness Initiatives (not a regional effort) are not skills training initiatives. While they do provide a forum to communicate the needs and capacity of communities and government departments and agencies, they are not action-based organizations. As such, the Proponent's continued involvement in those initiatives does not equate to support for training initiatives.

Given the repeated reference in the mitigation plans to partner with other training agencies in the region, further discussion is required to identify the extent to which the Proponent understands the programs and services that are available to support mine training initiatives. Through the GN alone the Proponent may find opportunity through the Departments of Education and Family Services (Career Development Division), as well as the Nunavut Arctic College.

Reviewer's Recommendation/Request(s):

The GN requests that the Proponent elaborate on the proposed 'Training and Development' content of the Human Resources Plan and consider more fully developing a draft version for review before the Final Hearing. Please specify where partnerships are planned with other training agencies and organizations.

22.6 TMAC RESPONSE

TMAC asserts that direct and specific training commitments are contained in the 2015 Hope Bay IIBA sufficient for environmental assessment purposes.

Schedule D (Training and Education) of the 2015 Hope Bay IIBA commits TMAC to a number of direct and specific tasks such as:

- Development of a Human Resource Strategy that addresses training and education,
- Specified areas of training,
- Career Development Plans for Inuit Employees,
- Inuit Training Targets that are subject to review and adjustment by the IIBA Implementation Committee,
- Community Information and Career Awareness Sessions in the Kitikmeot,
- Kitikmeot Secondary School achievement awards,
- Collaboration with KIA and government and other training organizations, and
- Information Sharing.

Schedule A of the IIBA commits the IIBA Implementation Committee to prepare an Annual Evaluation Report on the implementation of the IIBA, which would include details on the efficacy of Training and Education programs.

Additionally, Schedule A also requires the IIBA Implementation Committee to establish Inuit Training Targets on an annual basis. If TMAC is unable to achieve an Inuit Employment Target, Schedule E of the IIBA requires TMAC to pay into a Training and Education Fund. Monies in this fund must be used to Train and Educate Inuit.

Training and educational support is a shared responsibility between TMAC and the KIA as agreed in the 2015 IIBA TMAC cannot bind KIA to a specific course of action such as government engagement as part of a public environmental assessment process.

The development and implementation of Training and Education programs will be achieved in conjunction with our Human Resource strategy. As stated previously, TMAC will submit the Human Resource Strategy, which is considered analogous to the Human Resources Plan and Wellness Strategy, in September 2016.

TMAC notes that a previous project owner entered into a Mine Training MOU with regional training organizations, including Nunavut Arctic College and the then GN Department of Education in 2007 See Appendix B: GN-2 – 1 Kitikmeot Training Model MOU. Such an MOU would provide the venue to communicate and engage with the GN and other parties in an integrated fashion regarding student employment, and any

other training and employment matter specific to Doris mine operations. Mining is currently performed by a 3rd party contractor, and their participation in such an MOU is not wholly within TMAC's control, TMAC would welcome and support our mining contractor in engaging the GN, Nunavut Arctic College and other relevant parties in an updated and revised Mine Training MOU, subject to the willing participation of all stakeholders.

22.7 ATTACHMENTS

Appendix B: GN-2 – 1 Kitikmeot Training Model MOU

23. ID# GN-3

23.1 SUBJECT

Economy

23.2 REFERENCE

GN IR#4 Economy

TMAC Resources Inc. Responses to IR Comments

Amendment Application, Volume 4, Section 6.4, Pages 6-19 – 6-21

23.3 SUMMARY

The Proponent writes:

"TMAC acknowledges that an updated economic model may assist with local, regional and project planning. However, updated economic impact modelling is not expected to substantially alter conclusions about the effects of the Project as described in the 2015 Amendment Application. Moreover, updated baseline and economic impact modelling conform to a level of detail typically provided in more in-depth reviews, rather than the screening level of detail typically provided for licenses and certificate amendments. TMAC submits that the detail in the Amendment Application provided is adequate for the current level of review."

23.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The indirect and induced effects of employment and contracting are a major source of benefits with respect to major resource developments. Understanding that the relationship between direct and indirect/induced effects can be exponential, and the amendments to the Doris North project are significant, it is within the Proponent's best interest to provide an adequate forecast and discussion to demonstrate the net potential benefit of the amendments.

23.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The Proponent did not substantively address the GN's request for an updated economic analysis. The GN disagrees that the detail in the Amendment Application provided is adequate for the current level of review. Furthermore, it is generally at the NIRBs discretion to determine what level of detail is adequate when it is requested, not the Proponent. In this case the NIRB relayed GN IR#4 without any additional direction,

and the GN maintains a reasonable expectation that the original information request receive an adequate response.

Without the provision of indirect and induced employment and expenditure (income) figures, and a discussion of their effects on aggregate economic indicators, it is not possible to understand the true benefit of the proposed amendment. While the Proponent may be correct in aspsuming economic impact modeling may not change their own conclusions about the effects of the Project, the review process exists to share necessary information and analyses amongst relevant Interveners so that they may reach their own conclusions. The Proponent has not shared the necessary information and analyses to support their own conclusions, and further there is no basis to indicate the GN's request falls outside the level of detail typically required of a certificate amendment.

Reviewer's Recommendation/Request(s)

The GN requests that the Proponent provide the following:

1. A presentation and description of available baseline information for the local, regional, and territorial economies.

2. Additional projections for potential indirect and induced employment and income related to Sections 6.4.1 and 6.4.2.

3. An assessment of the proposed amendments overall economic effects considering increases in aggregate employment, government revenue, and GDP as well as influences on consumer price index (CPI) and economic diversification.

23.6 TMAC RESPONSE

1. Current available baseline information for the local, regional and territorial economies was presented and described as part of the Amendment Application (Document P4-1, Chapter 6 Socio-economic, Section 6.2 Existing Socio-economic Baseline for Hope Bay).

2. and 3. TMAC has addressed the reviewer's request for an updated economic analysis.

TMAC agrees to conduct additional economic impact analysis to quantify the predicted benefits and effects of the Project on the economy. Results of the model will be available in advance of the public hearing. Economic modelling will estimate the direct, indirect and induced employment and income effects within the Kitikmeot Region and for Nunavut and Canada as a whole. TMAC will subsequently conduct an assessment of the proposed amendment's overall economic effects considering increases in aggregate employment, GDP, and government revenue. Related

influences on consumer price index (CPI) and economic diversification will also be considered.

TMAC reiterates that the conclusions in the Amendment Application with respect to socio-economic benefits and effects remain valid.

23.7 ATTACHMENTS

Not applicable

24. ID# GN-4

24.1 SUBJECT

Anticipated Tax and Royalty Revenues

24.2 REFERENCE

GN IR#5 Fiscal and Infrastructure Impacts and Benefits

TMAC Resources Inc. Responses to IR Comments

24.3 SUMMARY

The Proponent writes:

The 2015 Amendment Application predicts minimal adverse effects on health care services, community well-being, and the delivery of social services, housing, and public safety and protection services as a result of a minor (or low) effect on in migration. This finding is supported by 1) the adoption of multiple point-of-hire (minimizing intra-regional migration), 2) the fly-in/fly-out operation of the Project and well- equipped camp facilities (minimizing the potential for in-migration to the region), and 3) the high unemployment rates within the Kitikmeot communities coupled with planned training partnerships and initiatives.

The minor in-migration predicted in the 2015 Amendment Application stems from the induced and indirect economic benefits of the Project including business growth in Cambridge Bay. Existing mitigation included in the 2005 FEIS (KIA & TMAC 2015) and the recent Inuit Impact and Benefits Agreement (IIBA) are expected to further reduce the predicted minor in-migration by supporting local residents in meeting this demand. As a result, the effects of the Project on community services due to in- migration to the region are anticipated to be minor (or low), as indicated in the 2015 Amendment Application.

Economic modeling is not expected to substantially alter conclusions about the effects of the Project as described in the 2015 Amendment Application (Document P4-1). TMAC submits that the detail provided as adequate to perform the level of review associated with amending the previously approved Water License Application and Project Certificate.

24.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The GN does not collect royalties and has limited tax revenues, however, it is the major program and service provider in the territory. Even though the Proponent predicts minimal adverse effects on community services and associated infrastructure, revenues accruing to governments and DIOs are still listed as a way to mitigate any excess costs incurred. Having a clear understanding of the potential royalty and tax revenues is important for Interveners and the general public for planning purposes. It also helps to create more realistic expectations with respect to the outcomes of mining projects.

24.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The Proponent did not address the GN's request for a detailed summary of anticipated revenues, by source, accruing to DIOs, AANDC, and the GN. It is not unusual to have anticipated revenues to governments and DIOs included in a certificate amendment application, nor is it overly arduous to collect and present the figures in the first place. The GN respectfully requests that the Proponent provide the requested information.

The GN disagrees that the detail provided in the 2015 Amendment Application is adequate to perform the level of review associated with amending the previously approved Project Certificate. Furthermore, it is generally at the NIRBs discretion to determine what level of detail is adequate when it is requested, not the Proponent. In this case the NIRB relayed GN IR#5 without any additional direction, and the GN maintains a reasonable expectation that the original information request receive an adequate response.

Reviewer's Recommendation/Request(s)

The GN requests that the Proponent provide a detailed summary of anticipated revenues, by source, accruing to the organizations mentioned above in a table format*. In the case of the GN, the only direct revenue sources to present are taxes and include: payroll tax, personal income tax, corporate tax, fuel tax, and property tax. In the associated discussions, it should be understood that there are limitations on the benefits increased tax revenues can have as they are collected into the general budget and are allocated across the territory and not to any single community or region.

*Where confidentiality agreements are in place the GN understands that detailed information cannot be included, however, it is desired that the Proponent indicate where this is the case.

24.6 TMAC RESPONSE

TMAC will provide an updated estimate of revenues to governments based on the result of economic modelling (see response to GN-3). The economic model generates data describing the predicted revenues according to government recipient - provincial, territorial, and federal. The output from the economic model reports total aggregate indirect and induced tax revenues (primarily from income taxes, corporate taxes, sales taxes), and some components of direct tax revenues (payroll taxes).

The economic model does not estimate direct tax revenues accruing to DIOs, the GN, INAC (AANDC) and/or Revenue Canada, which can include direct taxes on the profit of the Project, land taxes or rents, royalties for development on Inuit-owned land and Crown land, annual implementation payments, royalties and payments associated with the Inuit Impact and Benefit Agreement (IIBA), and Water and Wildlife Compensation Rates.

Estimated revenues from various direct tax payments will be provided by TMAC based on the Project's financial model developed for the Prefeasibility Study and assumptions based on provisions of the Framework Agreement and the IIBA with the KIA. Data will be supressed to comply with applicable confidentiality requirements. Combined with the results from the economic modelling, a comprehensive profile of tax revenues will be provided.

24.7 ATTACHMENTS

Not applicable

25. ID# GN-5

25.1 SUBJECT

Student hiring

25.2 REFERENCE

GN IR#6

TMAC Inc. Response to IR Comments

FEIS Guidelines, Section 4.21.4, p. 64

25.3 SUMMARY

The Proponent writes

"The information requested would contribute to local and regional education planning as well as a deeper understanding of successful approaches to education and training. TMAC does not interpret this as an information gap within the 2015 Amendment Application nor as relevant to the intent of the current review, which is to determine the adequacy of information provided in the 2015 Amendment Application. TMAC conducts socio-economic monitoring and reporting for the Project annually, and works with the KIA, AANDC, and GN to ensure that the ongoing monitoring program meets its objectives. TMAC also actively participates in school-based and regional 'career day' events (e.g. Kitikmeot Trade Show) as available to promote the opportunities within the construction and operation of a gold mine.

Student hiring was a common practice during the larger construction program. During the care and maintenance period of the last few years workforce reductions meant a reduction in student hiring opportunities. In addition, employment related age restrictions are in place for safety reasons and in compliance with the Nunavut Mining Regulations (2014).

Prior to project acquisition in 2013, TMAC understands that student employment at Hope Bay consisted of persons currently undertaking some form of post-secondary education, and being hired on for term, seasonal employment within the Hope Bay Environment Department. In 2013 and 2014, during which time TMAC Resources operated the project under Care and Maintenance, the Hope Bay workforce was significantly reduced overall, leading to commensurate declines in opportunities for student involvement.

As discussed in Section 6.2.3 of the Doris Amendment Application, there are a number of complex inter- related factors affecting primary and secondary education attainment in the Kitikmeot Region, the potential opportunity for wage employment at Doris being only one such factor. Given the prevalence of other factors; truancy at its causes, attractiveness of remote rotational work, it is not possible or practical at this level of assessment to assign changes in high school graduation in the Kitikmeot as a result of our project changes."

25.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The link between resource development and education has the potential to be positive and is of great importance to Nunavummiut. Student hiring offers a great opportunity for students to get professional work experience while developing their education. The significant decrease in student hiring while Doris North as in Care and Maintenance is understandable. However, it is important for the GN to better understand how the proponent plans to re-engage Kitikmeot communities and educational institutions to promote and implement future student hiring opportunities with the proposed extended mine life. As the geographic disbursement of the population in Nunavut is vast, communication strategies must be designed strategically in order to ensure all stakeholders are properly informed as the opportunities and benefits that external organizations are offering.

Adding to the importance of an updated education management strategy, the proponent claims that partnering with regional education and training institutions as a mitigation strategy to the potential housing impacts. Given the significant importance of housing in Nunavut, more information on the intended education and training partnerships is required to determine its potential effectiveness on mitigating the demand for housing.

25.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Guidelines for the original Doris North Project require the Proponent to "give special consideration to promoting Nunavummiut in Project employment and related business opportunities by addressing, for example: employment preferences to Nunavummiut, recruitment strategies to overcome entry barriers, education and training programs (e.g. partnerships with local schools and other educational institutions, on-the-job learning and apprenticeships)". An updated analysis of education and training programs does not appear in the EIS Addendum.

With a decrease in an overall workforce, it is understandable that the capacity for the proponent to hire students in temporary positions will also be reduced. The proponent has not, however, explained any mitigation strategies relating to how the expansion of the existing project's work can re-engage the community. In addition, the proponent has not discussed any new work place training programs or communication strategies

(to potential graduates on the early requirements need to participate in future work project, or similar communication to post-secondary, particularly trades school students, on future employment opportunities).

The GN supports the proponent's initial involvement in career ready/preparedness programming with K-12 students, noting that this demographic is Nunavut's future workforce and should have a significant interest in the potential benefits of future mining activities. As the project advances the Proponent is encouraged to take a similar approach to what Nunavut's more established mining companies have done, which is to partner with Regional School Operations to incorporate mining curriculum into the school program and to work with individual schools to host career planning sessions that are trades and mining specific.

Reviewer's Recommendation/Request(s)

The GN recommends that:

1. A comprehensive communication strategy be integrated into the content of the Human Resources Plan. This strategy should consider how and when communication occurs with various GN departments, particularly with the Department of Education, the Department of Family Services, and the Nunavut Arctic College on student opportunities, future employment opportunities, job requirements, and any training initiatives.

2. The GN Departments of Education, Family Services, and the Nunavut Arctic College be engaged as early as possible with respect to prospective collaborative education and training initiatives

3. The effectiveness of the communication strategy should be discussed in the annual socio-economic monitoring report.

25.6 TMAC RESPONSE

TMAC agrees that student employment offers opportunities for Kitikmeot youth to gain valuable work experience while still pursuing their academic career.

As a result, Schedule E, Section 16 of the 2015 Hope Bay IIBA commits TMAC to the development of an Inuit summer student program. Also in Section 3, Schedule D of the IIBA, TMAC and the KIA are to work together with government agencies and Kitikmeot communities in the areas of education and training. Further, Schedule A of the IIBA commits the IIBA Implementation Committee to prepare an Annual Evaluation Report on the implementation of the IIBA, which would include details on the efficacy of the Inuit summer student program.

Inuit summer student employment is a shared responsibility between TMAC and the KIA. TMAC cannot bind KIA to a specific course of action such as government engagement as part of a public environmental assessment process.

The development of a summer student program will be achieved in conjunction with setting our Human Resource strategy, which is synonymous with the Human Resource Plan and Wellness Strategy. As stated previously, TMAC commits to instituting this prior to commencement of Operations, with an expected submission date to the NIRB in September 2016.

TMAC notes that a previous project owner entered into a Mine Training MOU with regional training organizations, including Nunavut Arctic College and the then GN Department of Education in 2007. See Appendix B: GN-2 – 1 Kitikmeot Training Model MOU. Such an MOU would provide the venue to communicate and engage with the GN and other parties in an integrated fashion regarding student employment, and any other training and employment matter specific to Doris mine operations. Given that mining is currently performed by a 3rd party contractor, and their participation is not wholly within TMAC's control, TMAC would welcome and support our mining contractor in engaging the GN, Nunavut Arctic College and other relevant parties in an updated and revised Mine Training MOU, subject to the willing participation of all stakeholders.

25.7 ATTACHMENTS

Appendix B: GN-2 – 1 Kitikmeot Training Model MOU

26. ID# GN-6

26.1 SUBJECT

Short-term impacts of in-migration and impacts of training

26.2 REFERENCE

GN IR#7 Housing

TMAC Inc. Response to IR Comments

26.3 SUMMARY

The Proponent writes:

"TMAC included additional consideration for effects to housing in the 2015 Amendment Application and submits that the additional mitigation measures presented are adequate to address the predicted adverse effect on increased demand for housing and increased overcrowding. This effect is predicted to be minimal due to the small-scale nature of the Project and additional housing-related mitigations presented in the 2015 Amendment Application."

26.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

As acknowledged by the Proponent in the 2015 Amendment Application, an effects assessment on housing is warranted due to the potential in-migration caused by the Project. Given Nunavut's severe housing shortage and the serious health implications of living in overcrowded homes, the effects on housing caused by direct and induced economic growth from the Project are of great concern to individuals and families in Kitikmeot communities. The Proponent's proposed mitigation strategy will take time to develop and does not address the possibly immediate negative impacts that are likely to arise as a result of employment and training opportunities.

26.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The GN disagrees with the Proponent's conclusion to GN IR#7 that workforce training will adequately mitigate potential negative effects on housing in the Kitikmeot throughout the life of the Project. Although this approach is recognized to help alleviate some of the added pressures on housing in the Kitikmeot and Nunavut in the long term, it does not sufficiently address the immediate effects of in- migration on the housing situation. A more comprehensive mitigation strategy that includes the immediate

impacts on housing is required for reviewers to better understand how these potential effects will be managed.

Moreover, as workforce training is the only presented mitigation strategy, the GN requests a more dedicated plan on the different types and extent of training that will be offered by the Proponent. This should include, but is not limited to, a proposed training schedule, any pre-requisites for training programs, and in what communities will the training be offered. The Proponent is encouraged to consider the potential negative impacts of in-migration that could result from demographic movement within the Kitikmeot region to access specialized training programs.

Reviewer's Recommendation/Request(s)

The Nunavut Housing Corporation requests:

- Identification of more immediate proposed mitigation measures for the "Potential Effects" of increased demand for housing and increased conditions of overcrowding.

- More information on the intended training related to direct and indirect employment to determine its effects on the demand for housing in the affected community.

26.6 TMAC RESPONSE

It is expected that potential in-migration anticipated to be associated with the project would be for skilled workers, not locally available, that may be hired by Cambridge Bay business in response to induced growth.

TMAC believes it would be useful to describe how we see such a scenario at work. For example, businesses building and operating their own staff housing is a proven and successful Human Resources strategy in Cambridge Bay. In this case, the business would rely on privately owned staff housing, or build additional staffing units, with no impact on the existing public housing stock. The most recent examples of this activity are:

- Ellis Don CHARS construction camp;
- New Kitnuna Bunkhouse;
- Qillaq Innovations Lodge.

Further, data suggests that overcrowding and substandard housing in Cambridge Bay exists primarily within the public housing stock. The 2011 Housing Needs Survey Factsheet for Cambridge Bay (Appendix B: GN-6 – 1) indicates:

- 20% of the housing stock is staff housing,
- Staff Housing is of a higher quality than Public Housing,
- 33% of Cambridge Bay units housed temporary residents without a usual home elsewhere in the 12 months prior to the time of the survey, and
- 150 persons in Cambridge Bay were on the Cambridge Bay Public Housing waiting list.

A local business wishing to import a skilled worker would not rely on moving that individual to Cambridge Bay only to wait for an indeterminate time, for that potential employee to become eligible for public housing (thereby displacing a local family and exacerbating overcrowding).

A potential worker and business could not reasonably initiate a work contract in a new community without immediate consideration of shelter. Such a business would be much more likely to make use of existing good quality staff housing, or build new.

If the abovementioned skilled worker moved into Cambridge Bay by a business were a normal resident of another Nunavut community, that in-migration could also have the effect of freeing up public housing in another location, thereby mitigating the overall Nunavut Housing situation.

If the skilled worker moved into Cambridge Bay by a business were a normal resident of elsewhere, as described above, their move to Cambridge Bay would have no effect on public housing usage in that community.

TMAC reiterates that developing the regional workforce is an acceptable mitigation against any reasonably foreseen in migration induced by our project.

Training related to our project will be addressed in our Human Resource Strategy, which is considered synonymous with the Human Resources Plan and Wellness Strategy. As stated previously, TMAC commits to instituting this prior 90 days prior to commencement of Production, anticipated in January 2017.

26.7 ATTACHMENTS

Appendix B: GN-6 – 1 Nunavut Housing Needs Survey Fact Sheet – Cambridge Bay

27. ID# GN-7

27.1 SUBJECT

Socio-Economic Impacts Related to Mine Closure

27.2 REFERENCE

GN IR#8 Mine closure

TMAC Resources Inc. Responses to IR Comments

Amendment Application, Volume 4, Section 6.4.2 and 6.4.2, Page 6-19 – 6-22

FEIS Guidelines, Section 4.21.4, p. 55

27.3 SUMMARY

The Proponent writes:

"The 2015 Amendment Application considered the potential for the amendments to the Project to alter the unemployment following mine closure. The material nature of the effect remains consistent with the description provided in the 2005 FEIS and existing mitigation is considered adequate to address this effect. As indicated in the 2015 Amendment Application, the proposed amendments to the Project are not anticipated to result in any new effects and the potential effects as identified in the 2005 FEIS remain valid. In addition, under the existing Doris North Project certificate, TMAC is required to have relevant Human Resource plans in place prior to commencement of Production (Condition 32) and to monitor social and economic impact of the project on the local communities (Condition 28).

Furthermore, TMAC has entered into Inuit Impact and Benefit Agreement (IIBA) with the KIA and looks forwards to implementing the related mitigations contained within the IIBA, which are beyond that included in the 2005 Final EIS (KIA & TMAC, 2015). The 2015 IIBA is specifically relevant to temporary and final closure.

TMAC submits that the information presented in the Amendment Application is adequate to perform the level of review associated with amendments to the Water License Application and Project Certificate."

27.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

An explanation and assessment of the socio-economic impacts related to mine closure is of great interest to communities and impacted stakeholders of the Project. The extended mine life of the newly proposed amendments will likely increase the significance of impacts related to mine closure. It is important to understand how the Proponent evaluates the socio-economic impacts of mine closure including its perceived responsibility to the workforce and communities should operations shut down temporarily or permanently.

27.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The 2002 Environmental Assessment Guidelines for the Doris North Project require the Proponent to evaluate the effect that mine closure (temporary or final) would have on its workers and communities, and to discuss what measures the Proponent would put in place to mitigate the negative effects of mine closure. An updated assessment of management and mitigation measures has not been provided by the Proponent in the EIS Addendum.

The GN disagrees with the proponent's conclusion in it's response to GN IR #8 that the proposed amendments will not cause any additional effects in the event of permanent or temporary mine closure and that existing mitigation from the 2005 FEIS is adequate. An extended mine life and increased milling rate will create additional and prolonged employment and business opportunities. As such, the negative effects on the Project's workforce and nearby communities will likely be more significant than those originally anticipated in the event of temporary or permanent mine closure.

Table 6.4.1 and section 6.4.2 of the EIS Addendum indicate a significant decrease in employment and contracting expenditures, respectfully, in the years while the Project was in Care and Maintenance. A full examination of the impacts that have resulted from the Care and Maintenance phase could provide valuable insight into the effects that mine closure can have on communities and stakeholders. This discussion should contribute to an updated management plan that outlines the proponent's role in mitigating the effects that temporary or permanent mine closure has on its workforce and the local economy.

Reviewer's Recommendation/Request(s)

The Human Resources Management Plan should be updated to outline the proponent's role in mitigating the effects that temporary or permanent mine closure has on its workforce and the local economy.

27.6 TMAC RESPONSE

TMAC acknowledges that information on socio-economic conditions during the Construction and subsequent temporary Care and Maintenance phases of the Doris North Project, as well as conditions following the re-initiation of Construction activities, provides valuable information to help inform management of adverse effects on Kitikmeot communities.

TMAC has monitored the socio-economic effects of the Project as defined by the Doris North Socio-economic Monitoring Program (SEMP). The SEMP monitors the potential socio-economic effects of the Project and has been undertaken annually, including the previous period of Care and Maintenance.

The cause-effect relationships are complex and there are a number of factors that affect socio-economic conditions in the communities, in addition to changes in the Project. Identifying the reasons behind changes, and any additional mitigation that may be warranted, is best done through the existing Doris North Socio-economic Monitoring Committee (SEMC) and the Kitikmeot Region SEMC. In fact, this is the primary purpose and role of the SEMCs. TMAC is an active participant in these processes and will continue to use the SEMC as a venue to establish, with these parties, additional mitigation measures, if and where necessary, for any future temporary Care and Maintenance phase that may occur as well as for the final Closure phase.

As part of mitigation, TMAC's engagement strategy includes regular communications with key government agencies (e.g., the GN Department of Community Services) to help keep these service providers well-informed regarding changes in the Project for planning purposes.

TMAC commits to added mitigation in the form of a conceptual Workforce Transition Strategy that would be implemented at Project Closure. The Strategy will be provided to the NIRB as part of the Human Resource Strategy (synonymous with the Human Resource Plan and Wellness Strategy)and may be revisited from time to time during the Project to review and revised on an as needed basis. The main objective of the Strategy, based on adaptive management, is to support Project employees in their transition to new employment. Specific measures will reflect industry best practices and could include resources and support for employees to assess and characterize their skills and experience, identify new employment opportunities, and prepare for employment transition.

The Workforce Transition Strategy will form part of the overall Human Resource Strategy in September 2016.

27.7 ATTACHMENTS

Not applicable

28. ID# GN-8

28.1 SUBJECT

Doris North Socio-Economic Monitoring Committee

28.2 REFERENCE

Doris North Socio-Economic Monitoring Committee Terms of Reference

28.3 SUMMARY

Not applicable

28.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Effective project monitoring is required to assess the accuracy of predicted socio-economic effects of the Project, and to identify and mitigate any potential negative impacts early on before they become significant. In order to ensure that the proposed developments are captured in the current Doris North Socio-Economic Monitoring Program, a provision should be added to the Terms of Reference for the Doris North Socio-Economic Monitoring Committee.

28.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Specific mention of the Project Amendment should be included in the Doris North Socio-Economic Monitoring Committee Terms of Reference to ensure it is captured in the Doris North Socio-Economic Monitoring Program.

Reviewer's Recommendation/Request(s)

The GN requests that the proposed project amendment be captured in the Terms of Reference for the Doris North Socio-Economic Monitoring Committee by including the following provision under the "Scope" section:

"The monitoring program and this Terms of Reference shall apply to any project phase or development granted pursuant to Article 12, Part 8 of the Nunavut Land Claims Agreement and any additional Project Certificate Terms and Conditions established as a result."

28.6 TMAC RESPONSE

TMAC agrees that Project activities associated with the Doris Amendment will be subject to the existing Doris North Socio-economic Monitoring Program (SEMP). It is TMAC's intent to continue the Doris North SEMP as one program, considering all Project activities, and complementing existing monitoring and reporting.

TMAC agrees to revision of the Terms of Reference for the Doris North SEMP in consultation with the NIRB and the Doris North Socio-economic Monitoring Committee (SEMC), if and as necessary.

28.7 ATTACHMENTS

Not applicable

29. ID# GN-9

29.1 SUBJECT

Caribou Herds Interacting with the Project

29.2 REFERENCE

Package 4, Sections 3.3.3.1 and 3.4.3

29.3 SUMMARY

The Proponent states that 3 caribou herds have historically made use of habitat at or near the Project; namely the Bathurst, Dolphin and Union, and the Ahiak herds.

The Proponent states that no consistent zone of influence was found around the Project and "it was determined that Caribou numbers from recent years (2006 to 2012) are too low to detect a ZOI during the post-calving period, if one exists."

The Proponent concludes that impacts on caribou from the proposed amendments will be negative but mitigatable.

The Proponent indicates that Wildlife Mitigation and Monitoring Plan (WMMP) for the Project will be revised as and when needed. The WMMP has not been revised as part of the Project Amendment application.

29.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

29.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Detailed Technical Comment

Based on the analysis of long-term satellite telemetry data from collared caribou (Nagy et al. 2011), the GN recognizes 4 rather than 3 herds (Bathurst, Dolphin and Union, Ahiak, and Beverly) in the vicinity of the Project. Although caribou use of habitat near the Project is, at present, reduced relative to historical levels, shifts in range and range use have been documented for each of these herds and can be expected to occur again in future (Poole et al. 2010; Nagy et al. 2011). While the Dolphin and Union Herd presently interacts most with the Project, any and all of these herds has the potential to significantly interact with the Project in future. The Dolphin and Union herd is most likely

to interact with the Project during the winter and early spring, while caribou from the 3 other herds could interact during calving and post- calving periods.

The amendment Proposal includes plans for an increased Project footprint, increased mining and milling rates, increased camp personnel, prolonged mine life and a major change in tailings management. It seems intuitive that these amendments will result in increased impacts on caribou by mechanisms such as habitat loss or habitat modification and sensory disturbance. The Proponent's conclusion that these impacts will be negative but mitigatable seems to be based in part on the rationale that caribou abundance in the vicinity of the Project (and therefore the impact on caribou) has been relatively low in recent years and the assumption that it will remain so during the Project's life. However, this conclusion does not take into account the potential for caribou distribution to change such that one or more of the surrounding herds could increasingly interact with the Project. As such the assessment provided does not bracket the potential risks of the amended Project. Confidence in the Proponent's impact prediction for caribou is therefore deemed to be low.

Zones of Influence (ZOI) around mines sites in the Arctic have been documented for caribou (e.g. Boulanger et al. 2012). The potential for a ZOI to presently exist or become established around the Project is high. Amongst other things, the impact of this ZOI on herd status will depend in part on the proportion of the herd encountering this ZOI and the size of the ZOI relative to the available seasonal range; both parameters may change over time. Proposed Project amendments, in particular the change to subaerial storage of tailings (see GN comment 11 – Dust Effects on Wildlife) and the expected overall increase in work site activity increases the potential for creation of a ZOI around Project that could dampen or prevent future use of habitat within the ZOI by surrounding caribou herds.

In view of the precautionary principle, wildlife monitoring and mitigation activities associated with the Project should be based on the implicit assumption that a ZOI for caribou exists regardless of whether current data have sufficient power to detect it. The objective should be to minimize the spatial extent of the ZOI and the magnitude of impacts associated with it. In the absence of a known Project-specific ZOI, the monitoring design should be sufficient to detect the presence of caribou at distances equal to or greater than the ZOIs documented around other northern mines (e.g. Boulanger et al. 2012). Mitigation measures should be triggered when or before caribou enter the ZOI and should involve a graded response to the presence of caribou based on factors such as distance from the mine, season, number or density of caribou and group composition (see Golder Associates Ltd (2015) for a recent example of this approach).

It is the GN's view that the Proponent should have revised the Wildlife Mitigation and Monitoring Plan (WMMP) for the Project as part of the amendment application given the overall level of increased activity proposed at the site and some fundamental

changes in operations. Monitoring schemes in the current WMMP are limited to the area immediately around the Project footprint and do not provide a mechanism to detect and respond in real-time to the presence of caribou at distances further out but still within the potential ZOI. These schemes while somewhat applicable to a mine in care and maintenance are not adequate for the Project's operational phases. Similarly, mitigation measures within the current WMMP are too limited in scope, lacking in detail with respect to the criteria for triggering action and offer no mechanism to implement a graded response to the presence of caribou. The GN notes and supports the Proponent's plan to contribute to government-led monitoring of the Dolphin and Union herd as a means of tracking long-term herd status and movements. However, this regional level monitoring does not replace the need for the real-time monitoring within the Project's potential ZOI that is required to support day-to-day mitigation activities.

The limited capacity of the existing WMMP to mitigate impacts on caribou contributes to the GN's lack of confidence in the impact predictions for the amended Project.

References:

- Boulanger et al. (2012). Estimating the zone of influence of industrial developments on wildlife: A migratory caribou and diamond mine case study. Wildlife Biol. 18:164-179.

- Golder Associates Ltd (2015). Wildlife Road Mitigation Plan for the Jay Project.

- Nagy et al. (2011). Subpopulation structure of caribou in arctic and subarctic Canada. Ecol. App. 21: 2234-2348.

- Poole et al. (2010). Sea-ice and migration of the Dolphin and Union caribou herd in the Canadian Arctic: An uncertain future. Arctic 63:414-428.

Reviewer's Recommendation/Request(s)

The Proponent shall submit a revised Wildlife Monitoring and Mitigation (WMMP) plan for review and approval by NIRB prior to issuance of any Project Certificate amendment.

The revised plan shall be prepared in consultation with relevant Government agencies, Hunters' and Trappers' Organizations' and Inuit organizations.

The revised WMMP shall take into account future scenarios in which caribou use of the areas around the Project increases and shall include details of monitoring and mitigation mechanisms designed to minimize the ZOI around the project.

29.6 TMAC RESPONSE

TMAC notes that, with the encouragement of the NIRB, the Government of Nunavut, Department of Environment (GNDoE) and TMAC entered into an MOU whereby TMAC's annual monitoring for caribou was curtailed in favour of funding to GNDoE to carry out a regional collaring program in the Hope Bay Region. TMAC and GNDoE now rely on this collaring data to indicate caribou usage of the region and for input to TMAC's response to the large scale caribou usage of the area.

The Amendment effects determination for caribou (document P4-1) considered both current caribou usage, as well as usage observed over the past 20 years of monitoring in the area. This overlaps with a period of elevated caribou usage in the Regional Study Area in the 1990's. TMAC considers this an appropriate basis for assessment. For context, the completed Doris North Project will be less than 1/10th the size of the Ekati Project footprint.

Should the data from the collaring program under the MOU indicate an increase in usage to above levels observed within the past 20 years, or the Project area become part of a core calving or post-calving area, TMAC will work with the GNDoE to identify whether additional mitigation measures are warranted.

The Wildlife Mitigation and Monitoring Plan (WMMP) required under the existing Project Certificate is currently under routine revision. As a part of this revision process, the GN, along with the Hope Bay Project Inuit Environmental Advisory Committee (IEAC), Environment Canada, and the Kitikmeot Inuit Association (KIA) participated in a review of the proposed program changes in October of 2015. KIA direction on formal inclusion of HTO membership in the IEAC is currently pending. Further engagement on this WMMP program is underway, and a revised Plan will be submitted on April 30, 2016, with the NIRB Annual report.

The WMMP revision will include consideration of feedback from the October 2015 meeting, as well as comments received during this Amendment process and wildlife monitoring program findings. The current WMMP outlines various mitigation measures currently undertaken to protect wildlife, including caribou. The Amendment Application, and subsequently filed correspondence, has indicated additional mitigation and monitoring measures TMAC proposes undertaking to minimize possible effects of the change from subaqueous to subaerial tailings deposition. These combined measures serve to ensure any potential ZOI of the project is minimized to the extent possible, and allow real-time response where appropriate (such as providing wildlife the right-of-way and delaying blasting if pre-blast wildlife screenings indicate wildlife are in the area).

29.7 ATTACHMENTS

Not applicable

30. ID# GN-10

30.1 SUBJECT

Water inflow to mine and effects on vegetation

30.2 REFERENCE

Package 4, Section 2.5.3, page 2-25

Package 6-10 Site Wide Water and Load Balance

30.3 SUMMARY

"A revised water balance model for Doris Lake has predicted that the removal of water for domestic and process purposes combined with seepage from the lake into the underground mine would decrease the flow in the lake outflow and drop the surface water level of the lake (Section 2.5.2). However, it is anticipated that the drawdown of water from Doris Lake will not result in adverse effects on fish and fish habitat as natural variability in water level and ice thickness is similar to maximum predicted drawdown depth."

30.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

30.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

As a result of the amended Project, water is predicted to seep into the mine from several sources (Doris Lake and regional ground water) at a rate of up to 3000 m^3/day. This water will be removed and eventually discharged into the Roberts Bay marine environment.

A part of the amendment Proposal, the Proponent revised "the existing site wide water and load balance model to match the new requirements. The model was designed to evaluate water management needs and predict water quality at the Project and downstream receptors" (P6-10, section 1.2) but did not examine possible effects across the Doris-Roberts watershed as a whole; an area of 194 km^2 (Package 4, figure 2.3.1).

The amendment documents discuss the impacts of this water loss on Doris Lake levels and down-stream environments in terms of potential changes in habitat for fish and birds. However, there is no discussion about potential impacts on vegetation communities and terrestrial mammals in the watershed.

Given the predicted change in hydrology as a result of mine inflow, the potential consequences, if any, for the Doris-Roberts watershed are not known. Whether there will there be an overall net increase in withdrawal of water from the watershed that could lead to changes in soil moisture content and consequently the biomass or composition of vegetation communities across the watershed is not known either. Given the strong link between the demographics of species such as caribou and vegetation (Chen et al. 2014), the implications for the quality of habitat in the watershed should be addressed by the Proponent.

References:

• Chen et al. (2014) Assessing the impact of summer range on Bathurst caribou's productivity and abundance since 1985. Nat. Res. 5:130-145.

Reviewer's Recommendation/Request(s)

It is requested that the Proponent provide technical discussion on the potential effects of mine water inflow on vegetation across the Doris-Roberts watershed.

30.6 TMAC RESPONSE

Effects to groundwater in the Doris-Roberts watershed due to mine water inflow are expected to be confined to the Doris Lake area and are predicted to influence lake levels. The maximum predicted drawdown depth of Doris Lake levels is predicted to be up to 23 cm during the winter as a result of water withdrawal and infiltration into the underground workings. This change is predicted to be within the natural range of water level and ice thickness of Doris Lake and is not expected to result in significant adverse environmental effects. Appendix B: TMAC response to support Technical Comment DFO-3.2.1 includes the Doris Creek and Little Roberts Outflow Fisheries Assessment prepared by ERM Consultants Canada for TMAC Resources Inc.

Furthermore, the terrain around the lake is comprised of mostly bedrock controlled shorelines or wetlands that slope down to the lake, so flow from the lake to terrestrial ecosystems is limited. As a result, a change in lake level (23 cm), within natural variability is not predicted to have an anticipated effect to vegetation.

TMAC reiterates that the conclusions in the Amendment Application indicating no significant adverse environmental effects on the terrestrial environment remain valid.

30.7 ATTACHMENTS

Appendix B: DFO-3.2.1 Doris Creek and Little Roberts Outflow Fisheries Assessment Memorandum

31. ID# GN-11

31.1 SUBJECT

Dust effects on wildlife

31.2 REFERENCE

Package 4, section 3.4.2 Terrestrial ecosystems, p3-10

31.3 SUMMARY

"With the implementation of mitigation measures to reduce dust generated from the subaerial tailings and adaptive management incorporated into monitoring plans, no significant residual effects are anticipated to the terrestrial environment." (Package 4, section 3.4.2 Terrestrial ecosystems, p3-10)

31.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

31.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The Proponent's conclusions regarding the impacts of dust generated by activities linked to the Project amendments (namely the subaerial storage of tailings) are based on two related assumptions: 1) Dust effects on wildlife will be confined to a local area extending out from the Tailings Impoundment Area (TIA). 2) Dust control measures for the TIA will be effective enough to keep this area small thereby effectively mitigating impacts.

The Proponent delineates an area for the assessment of dust effects that consists of a zone extending up to 1 km from the TIA. Besides consideration of local wind conditions the assessment does not provide any technical information or literature citations to support the delineation of this dust effects assessment area. Estimates of dust generation or dust-fall modelling are not presented for the reader to evaluate. Assumptions about the level of effectiveness (and seasonal variation) of dust suppression measures are not presented. It is therefore unclear how the assessment conclusion was derived.

It is the GN's view that the assessment of potential dust effects on wildlife and wildlife habitat resulting from the subaerial storage of tailings is inadequate and does not capture the range of possible outcomes and resultant risk of this tailings management strategy. The success of this strategy appears to hinge on the assumed effectiveness of

an as yet unproven dust control strategy (see GN comment 12 – Dust Mitigation and Wildlife). In addition, the Project amendments include increased mining and milling rates, increased personnel, increased shipping and movement of materials and an extended mine life. Taken as a whole, one can reasonably assume that there will be some increase in dust generation besides that associated with the TIA.

To more fully capture the uncertainty and risks, the Proponent should assess other scenarios in which dust control is less effective. In this regard, it is noted that Boulanger et al. (2012) demonstrated a Zone of Influence for caribou of approximately 14 km around two northern mines. Deposition of fine particulate dust at levels as low as 23 kg/ha/yr (TSP) was postulated to be a potential mechanism responsible for this behavioral response. Adopting a similar ZOI around the TIA and other mine infrastructure would provide a reasonable alternative assessment scenario for the amended Project and provide a more balanced assessment.

Reviewer's Recommendation/Request(s)

The Proponent should revise the effects assessment to consider a range of dust control and dust effects scenarios relating to wildlife and wildlife habitat.

31.6 TMAC RESPONSE

To demonstrate and confirm the conclusions in the Amendment Application, TMAC has carried out dustfall modelling, considered dust control mitigation measures and included additional wildlife monitoring considerations. Therefore, TMAC reiterates that the conclusion in the Amendment Application of no significant adverse environmental effects to the terrestrial environment remains valid.

Details of the dustfall modelling work (Appendix B GN-11 dustfall modelling memo), dust control mitigation measures (TMAC response to GN-12) and additional monitoring considerations as part of the Wildlife Monitoring and Mitigation Plan (TMAC response to KIA-2) are presented below.

Dustfall Modelling

TMAC has carried out supplemental modelling to further quantify the potential dustfall and distribution as a result of the subaerial tailings deposition as a means to validate the conclusions of the effects assessment. The AERMOD air dispersion modelling system was chosen for the modelling study for its capability to handle the effects of wind erosion on dust settling and dispersion.

Based on conservative assumptions and methodology, emissions calculations and modeling of TSP potentially released from the Doris North TIA, indicate that the guidelines for dust fall are met (except a small localized area)_within the watershed basin of the TIA without the application of dust suppression methods.

Refer to Appendix B: GN-11 dustfall modelling assessment, results and conclusions, as requested by the reviewer.

Dust Control Measures

As outlined in Document P6-13 in the Amendment Application, dust suppressions mitigation measures will be applied, if necessary. TMAC will monitor air quality and dustfall in accordance with the updated Air Quality Management Plan and will implement dust control measures in accordance with this plan.

Wildlife Monitoring and Mitigation Plan

Furthermore, TMAC will monitor dustfall from the TIA as part of the Air Quality Management Plan. In conjunction with the Wildlife Monitoring and Mitigation Plan, TMAC is committed to addressing any potential attraction of wildlife to the TIA and will conduct monitoring and adaptive management described in the following steps (refer to TMAC's response to KIA-2):

1) TMAC will design and implement a monitoring program as part of the Wildlife Mitigation and Monitoring Plan (WMMP) to investigate if wildlife are using the site as a salt/mineral lick and will also include TIA dustfall monitoring as part of the Air Quality Monitoring Program (AQMP).

2) If the outcome from the monitoring program indicates that wildlife are found to be consistently and in large numbers, using the site as a salt/mineral lick, or significant quantities of TIA dust are found to be deposited in the area, TMAC will conduct a risk analysis to determine if the ingestion of tailings or surrounding vegetation could produce health effects for large mammals.

3) If the analysis indicates a health hazard, TMAC will implement deterrent measures for caribou during the operations phase, which will be informed by discussions with the Inuit Environmental Advisory Committee (IEAC).

In summary, given the dustfall modelling results, dust suppression control measures, and additional wildlife monitoring measures, TMAC reiterates that the conclusions of the amendment of no significant residual effect to the terrestrial environment associated with dust are valid.

Citing Boulanger et al. (2012) Publication:

With regard to the review's comment citing the Boulanger et al. (2012) publication, for comparative purposes, TMAC would like to point out that the completed Doris North

Project will be less than 1/10th the size of the Ekati Project footprint as used in the Boulanger et al. (2012) publication. As such, it is anticipated than a Zone of Influence (ZOI) surrounding the Doris North Project will be less than that of the one detected around the Ekati and Diavik mines. Processing is also much greater at these two mines with Ekati averaging 11,000 tonnes per day and Diavik 6,000 tonnes per day (Cunning et al. 2011, Rescan 2011). In comparison, Doris North will have an initial mining rate of 1,000 tonnes per day with a subsequent increase to 2,000 tonnes per day once the second mill stage is installed.

References:

Cunning, J., A. Isidoro, C. Apaz, and C. Kinakin. 2011. *Deposition Planning at the Diavik Diamond Mine*. Paper presented at Proceedings Tailings and Mine Waste, Vancouver, BC.

Rescan. 2011. *EKATI Diamond Mine: 2008 Air Quality Monitoring Program*. Prepared for BHP Billiton Canada Inc. by Rescan Environmental Services Ltd.: Yellowknife, Northwest Territories.

31.7 ATTACHMENTS

Appendix B: GN-11 - 1 Memorandum on the Potential Dustfall Associated with Subaerial Tailings Deposition at TMAC Doris North Project, Nunavut.

32. ID# GN-12

32.1 SUBJECT

Dust mitigation and wildlife

32.2 REFERENCE

Package 4, section 3.4.2 Terrestrial ecosystems, p3-10

32.3 SUMMARY

"With the implementation of mitigation measures to reduce dust generated from the subaerial tailings and adaptive management incorporated into monitoring plans, no significant residual effects are anticipated to the terrestrial environment." (Package 4, section 3.4.2 Terrestrial ecosystems, p3-10)

"Emissions from the proposed sub-aerial tailings will be mitigated as described in the Application Amendment Document P6-13 Appendix I. After mitigation, the expected dust emissions are expected to be very low to none." (Proponent response to GN IR #11)

The Proponent's dust mitigation strategy for the subaerial tailings is summarized in the amendment documents as follows:

- "The primary dust control measures of the Project site TIA will be the use of environmentally suitable chemical dust suppressants. The application of these suppressants will be reviewed on an ongoing basis to ensure that any areas that may be at risk will be adequately covered. Generally, annual application of chemical suppressants will be applied; however it is recognized that more frequent applications may be required as discharge locations are changed throughout any year. In addition to chemical dust suppressants, natural dust control in the form of packed snow when available will be used as far as practical. Again, the effectiveness will vary on a year by year basis depending on how deposition points vary for any given winter season. Finally, if for any reason, any of the above dust control methods prove to be temporally ineffective, a suitable water cannon will be available to allow for dust suppression in the form of spraying of the areas of concern." (Package 6-16, Appendix I, Tailings Impoundment Area Dust Control Strategy, Section 4.0 Dust Control Procedures for TIA.)

- "Water or chemical additive (e.g., Soil Sement®) sprays compatible with the ambient air temperatures are utilized to suppress dust generation from tailings in the TIA, when ambient air temperatures permit, and as approved by the GN-DOE." (Package 5-1, Air Quality Management Plan, Section 2.2 Mitigation Measures)

32.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

32.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

With respect to this dust mitigation strategy the following concerns are noted:

- Section 2.2 of the Tailings Impoundment Area Dust Control Strategy states that "Aeolian dust is defined as particles that are transported as suspended load due to wind action on a surface. Although tailings are discharged wet, the surface eventually dries out as a result of evaporation or freezing of the tailings surface. As a result, at any given time, large areas of the tailings surface would expose dry tailings. The Project site is prone to high winds and with the moderate topography, aeolian tailings dust is expected."

- Given ambient temperatures at the Project, it is assumed that there will be an extended period (months) when use of chemical dust suppressants and water cannons is impractical. During these periods, fresh floatation tailings will be deposited in the TIA and use of compacted snow cover will be the only available means to control Aeolian and fugitive dust generation. Deposition of tailings will occur throughout these frozen months. If at any point in time available snow cover is insufficient to meet dust control needs, significant generation of dust could occur.

- Currently, three dust suppression products are approved under GN guidelines, none of which are suitable for the Project's needs. The Proponent has indicated that an environmentally friendly chemical suppressant will be used but has not provided details on the product selected, quantities to be used and frequency of application. Furthermore, review of the MSDS and certifications for some of these products (such as Soil Sement) suggest that the efficacy and safety of these products is based on tests conducted under conditions that may differ substantially from those encountered at the Project site in terms of climate, frequency and volume of application. Given these uncertainties about the chemical dust suppression product, it is unclear to the reader how effective these products will be in controlling dust during the periods of the year they can be used.

In light of these concerns, the Proponent's conclusion that "after mitigation, the expected dust emissions are expected to be very low to none" may be overly optimistic and does not reflect the uncertainties of the proposed dust control strategy. As such, impacts of dust on the terrestrial environment may be underestimated in the current assessment.

Reviewer's Recommendation/Request(s)

See GN comment 11 – Dust Effects on Wildlife (The Proponent should revise the effects assessment to consider a range of dust control and dust effects scenarios relating to wildlife and wildlife habitat).

32.6 TMAC RESPONSE

TMAC has carried out dustfall modelling estimation (Appendix B GN-11 -1 dustfall modelling memo), committed to dust control mitigation measures, as needed (Document P6-13, Appendix I) and will implement additional monitoring considerations as part of the Air Management Plan and Wildlife Mitigation and Monitoring Plan (TMAC response to KIA-2).

Details of the dustfall modelling work are included in the response to the technical comment GN-11. Based on conservative assumptions and methodology, emissions calculations and modeling of TSP potentially released from the Doris North TIA, indicate that the guidelines for dust fall are met (except a small localized area)_within the watershed basin of the TIA without the application of dust suppression methods.

. TMAC acknowledges predictive modelling can simplify complex natural systems and is committed to monitoring dustfall to ensure objectives are being met and, when exceedances are noted, implementing adaptive management actions to reduce the dust source. To monitor and assess the environmental effects from dustfall, TMAC will revise the Wildlife Mitigation and Monitoring Plan to address any potential attraction of wildlife to the TIA and, if needed, conduct a risk analysis to determine if the ingestion of tailings or surrounding vegetation could produce health effects for large mammals.

Adaptive management of the TIA includes use of proven dust suppression methods and TMAC will work with the GN DOE to identify these acceptable products and methods. As indicated within the response to Information Response GN#12 TMAC has identified that chemical suppressants may be required to mitigate the generation of dust from the TIA, however, at this stage in planning, the product (or products) that will be used have not been identified. Products will be evaluated on an "as required" basis and will be incorporated into the Air Quality Management Plan and/or Tailings Impoundment Area Operation, Maintenance and Surveillance Manual (Tailings Management Plan) accordingly.

32.7 ATTACHMENTS

Appendix B: GN-11 - 1 Memorandum on the Potential Dustfall Associated with Subaerial Tailings Deposition at TMAC Doris North Project, Nunavut

33. ID# GN-13

33.1 SUBJECT

Dust monitoring

33.2 REFERENCE

Package 5-1 Air Quality Monitoring Plan (AQMP)

33.3 SUMMARY

"Air quality monitoring programs for the Tailings Impoundment Area (TIA) will be revised to take into account the change in tailings management strategy."

33.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

33.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

The Air Quality Monitoring Plan (AQMP) included with the amendment application indicates that snow core and dust-fall monitoring programs will be developed for the TIA but specifics such as the number, distribution and type of monitoring stations were not provided. This lack of detail makes it hard to assess whether these programs will be sufficient to monitor the effectiveness of dust control measures and mitigate potential dust effects on the terrestrial environment.

Reviewer's Recommendation/Request(s)

The Proponent should provide additional details of snow core and dust-fall monitoring programs.

33.6 TMAC RESPONSE

TMAC has conducted further assessment of the potential dustfall changes resulting from subaerial tailings deposition, and results are included in the Appendix B: GN-11. This assessment concluded that TIA-generated dustfall is expected to remain localized in close proximity to the TIA. Dustfall is estimated to meet the objectives within a local area of the TIA without the application of dust suppression measures.

Should guidelines for dustfall be exceeded, TMAC will implement dust management mitigation measures.

Additionally, TMAC proposes monitoring of dustfall at a location near, and downwind from, the TIA to confirm dustfall is not exceeding the Alberta guidelines (in the absence of Nunavut dustfall guidelines). As described in the Air Quality Management Plan (Document P5-1), dustfall is sampled in accordance with the methodology from ASTM D1739-98 (Reapproved 2010) *Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter)*. Samples are then shipped to an accredited laboratory for analysis of particulates, specific anions and nutrients, and metals. This is the same methodology that is currently used for the Doris North compliance program. This monitoring consists of duplicate dustfall collection canisters, which will operate outside of the snow cover/snow-core collection period.

Dustfall over the snow-cover period will be quantified through the use of snow-core chemistry sampling in April or early May. The proposed sampling procedure will be the same as that used by Environment Canada's Canadian Air and Precipitation Monitoring Network (CAPMoN) and the United States Environmental Protection Agency (US EPA). This methodology is the same that employed at other northern mine sites, including Ekati and Diavik. Snow coring locations would coincide with the dustfall canister locations, consisting of a composite of three cores collected within 100 m of the dustfall canister locations. Snow cores will be extracted using a non-contamination snow sampling tube designed for water quality analysis. Samples will then be melted and processed on-site and then shipped to ALS Environmental laboratories for analysis.

The Air Quality Management Plan (AQMP) will be revised to include these sampling details, and in consideration of the Amendment Application review process outcomes, operational needs, and based on monitoring program findings. A revised AQMP will be submitted on or before September 15, 2016, as committed to in TMAC's Nov 12th, 2015 letter to the Nunavut Water Board and Nunavut Impact Review Board.

33.7 ATTACHMENTS

Appendix B: GN-11 -1 Potential Dustfall Associated with Subaerial Tailings Deposition at TMAC Doris North Project, Nunavut Memorandum

34. ID# GN-14

34.1 SUBJECT

Human-Wildlife Conflict

34.2 REFERENCE

Package 4, section 3.4.3

34.3 SUMMARY

"…..the primary effect of developments on bears is through visual and auditory disturbances. Since these disturbances are unchanged at the Project site, no new effects are predicted for grizzly bears."

"While the footprint of the Laydown Area will increase, the activities that will be carried out are not planned to change. Hence, the same level of disturbance from lights, noise and human presence and movement is expected. The primary effects of the Project on wildlife are expected to stem from disturbance. Since the level of disturbance is expected to remain constant, despite the footprint expansion, and this disturbance will be constrained to the same Laydown Area and shallow pan in which it is located, no additional effects on wildlife are anticipated."

34.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

34.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

In the assessment of Project amendments the Proponent maintains that levels of auditory and visual disturbance of wildlife at the Project site will remain unchanged despite significant increases in personnel levels, the shipping, movement and storage of materials, storage of ore, milling and mining rates, mine infrastructure and mine life. This assessment seems uncertain since most of the proposed amendments involve an increase in the spatial extent, duration or intensity of visual and auditory stimuli above current project certificate conditions.

Among other concerns (for example GN comment 9 – Caribou Herds Interacting with the Project) is the potential for increased conflict between people and grizzly bears in the region leading to heightened risks to public safety and probability of bear mortality. The current wildlife mitigation and monitoring plan (WMMP) contains some information

regarding human-bear conflict mitigation but does not contain a detailed bear safety and response plan.

Reviewer's Recommendation/Request(s)

Given the potential for an increase in human-bear encounters as a result of the Project amendments, the WMMP should be revised to include a stand-alone bear safety and response plan. This plan should contain details of protocols for taking deterrent action including the potential for relocation or destruction of bears. The plan should also contain a threshold for the acceptable level of project-related grizzly bear mortality (a 5-year mean annual mortality) that is established with reference to current knowledge of grizzly bear population demography and existing sources of human caused mortalities (i.e. subsistence harvest, problem kills at other industrial sites). Exceedance of this threshold would trigger additional mitigation requirements. The Proponent should also consider the employment of dedicated wildlife monitors during seasons when bear encounters are most likely to occur in-order to detect bears that are approaching camp infrastructure as early as possible.

34.6 TMAC RESPONSE

Existing bear safety and bear interaction mitigation procedures include:

- training for staff in bear safety;
- a Wildlife Response Team with specialized training in bear response;
- training in, and use of, bear safety kits by field personnel and those working remotely during bear season;
- use of bear monitors for those working remotely and in an areas of high bear interaction potential (based on season, location, bear foraging suitability and field activity);
- exemplary waste management practices which minimize bear interest in the Project;
- annual audits of the site for bear attractants, entrapment concerns, and other potential bear (and other wildlife) hazards;
- a no-harvesting policy for site staff while on work rotation at the site;
- Standard operating procedures related to bear notification and response appropriate for all staff as well as by the Wildlife Response Team; and
- monitoring programs aimed at verifying success of mitigation measures and bear interaction with the Project.

The current project mitigation and monitoring measures are also appropriate for the amendment project, which will not significantly alter the way in which the Project interacts with bears.

TMAC is of the view that the acceptable number of project-related bear kills is zero. Should a bear be killed, or staff be harmed by a bear, TMAC will re-assess all bear-related mitigation measures and, if additional measures are indicated, they will be applied.

34.7 ATTACHMENTS

Not applicable

35. ID# INAC-1

35.1 SUBJECT

Confirmation of Doris Lake Outlet Sill Elevation

35.2 REFERENCE

Rescan, Doris North Gold Mine 2012 Hydrology Compliance Report, Appendix C, Figure C-1. Doris TL-2 (Doris lake Outflow) Stage-Discharge Rating Curve (to assumed datum).

TMAC Resources Inc., June 2015, Revisions to TMAC Resources Inc. Amendment Application No.1 of Project Certificate No. 003 and Water, Package 4 Identification of Potential Environmental Effects and Proposed Mitigation, Section 2.5.2, Hydrology, Pages 2-20 and 2-21.

SRK Consulting, June 2015. Doris North Project – Water and Load Balance, Section 6.2.2, Page 37, Doris Lake.

TMAC response to AANDC-NIRB #1; Equation 2.5-1 in Document P4-1 (Effects Assessment)

35.3 SUMMARY

TMAC predicts that winter leakage from Doris Lake into the underground mine will reduce the lake level and cause impacts which include but are not limited to a delayed seasonal onset of Doris Lake outflow each year. These impacts occur because the lake is drawn down to below a critical elevation at which lake outflow occurs. In the project documentation, this critical elevation is called the lake outlet channel invert elevation and also the lake outlet sill elevation[1].

INAC requested a confirmation of the invert elevation of the Doris Lake outlet sill, comments on the year-to-year stability of the local assumed benchmark[2], an estimate

[1] "Lake outlet channel invert elevation" and "lake outlet sill elevation" are interchangeable terms that both refer to a critical lake level below which no outflow occurs.
[2] Benchmark is a physical reference point such as a paint mark on a rock or a nail in a tree.

of the Doris Lake water surface elevation and an elaboration on the datum[3] and accuracy of the LiDAR[4] results.

TMAC responded that:

- the stage (water level) at Station TL-2 is not representative of the Doris Lake water level, but that discharge at TL-2 can be correlated to Doris Lake levels;
- the reported elevations are comparable between years, assuming that the same benchmarks are used each year;
- the mean water surface of Doris Lake for August 2006 was 21.225 m[55], and
- the LiDAR data was acquired in 2007 and was used to generate a DEM with 0.5 m contour intervals.

The responses also established that the Doris Creek invert elevation of 21.5 m as stated in SRK (2015), is in fact the lake water surface elevation at the time of data collection, without an adjustment for the outlet water level depth.

35.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The project could cause the winter water levels to be drawn down below the sill level, with resultant impacts including but not limited to, a delayed onset of spring outflows to the downstream channel.

35.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: There are unresolved questions regarding the elevation of the Doris Lake outlet sill and the benchmark used to determine this elevation.

Disagreement with amendment proposal conclusions:

After review of the available information, INAC found that the elevation of the sill at the outlet of Doris Lake, and the datum or benchmark that this is referenced to is not clearly established.

[3] Datum is an elevation reference system that assigns numeric elevation values to benchmark and other features such as channel bottom elevation and lake water surface elevation.
[4] LiDAR is an acronym for Light Detection and Ranging which is an advanced method of collecting high-resolution topographic data
[5] Max = 21.159 m, Min = 21.286 m, local datum = 22.593 m.

Reasons for disagreement with amendment proposal conclusions: TMAC's confirmation of the invert elevation of the Doris Lake outlet sill refers to a multi-part equation which was used to compute lake outlet discharge Q as a function of "H", which is defined as "lake water surface elevation above the invert (m)." This provides no insight into where or how "H" is determined, or the elevation of the invert.

For the comments requested by INAC on the year-to-year stability of the local assumed benchmark, TMAC stated that elevations are comparable between years so long as the same benchmarks are used, as has been done since 2009, and that it would be difficult to compare data that were collected using independent benchmarks. This statement does not address the core question of the actual year-to-year stability of the local assumed benchmark(s), particularly for data collected prior to 2009.

INAC questions whether the datum used for lake bathymetric surveys (by Golder) in 2006 is consistent with the local datum and benchmark(s) established in 2009.

Similarly, INAC requests confirmation of the datum that is associated with the LiDAR results. The question is whether the datum used for collection of LiDAR-derived surface topography data in 2007 is consistent with the local datum and benchmark(s) established in 2009.

The project documentation presently available does not adequately identify the elevation of the Doris Lake outlet sill, which controls water flow from the lake to the downstream channel. Without a clear definition of the elevation of the outlet sill, it will be difficult or impossible to assess future actual impacts relative to those predicted by the project documentation.

Provision of this information will allow future confirmation of actual project impacts resulting from winter drawdown (leakage) of water from Doris Lake into the talik/underground mine, compared to current TMAC predictions for the magnitude of project-induced delayed seasonal onset of Doris Lake outflows.

Recommendation/Request:

1.1 INAC requests that TMAC confirm the invert elevation of the Doris Lake outlet sill, and provide a detailed description of the datum and benchmark(s), and methods upon which this elevation is based.

1.2 INAC also requests that TMAC provide an assessment of elevation adjustments, if any, that should be applied so that Doris Lake bathymetry collected in 2006, and vicinity LiDAR data collected in 2007, are aligned with the current datum(s) and benchmark(s) that were established for Doris Lake in 2009.

Conclusion: The project documentation presently available still does not state the elevation of the Doris Lake outlet sill. INAC is unable to fully assess future actual impacts relative to those predicted by the project documentation.

35.6 TMAC RESPONSE

The Doris Lake outlet sill is not a bedrock formation; rather it is a soft, predominately sandy section at the outlet of Doris Lake into Doris Creek. As such, its elevation is not considered a fixed value as it may change between years due to freeze/thaw and permafrost conditions.

The water elevation of Doris Lake is comparable between years because it is measured against the same local datum. Similarly, downstream of the outlet sill at TL-2, the flow which is determined from water level, is comparable between years as it is based on its own local datum.

A consistent relationship, with strong correlation, was found between daily water surface elevations at Doris Lake and daily streamflow at TL-2 (Equation 2.5-1, Document P4-1); therefore; water level elevation differences over the outlet sill are appropriate for comparison of potential effects on lake level due to lake drawdown rather than absolute elevations.

The Golder bathymetry (2006) and the SRK LiDAR 2007 are both referenced horizontally with UTM NAD 83 Zone 13 datum and vertically to the mine site control datum, so no adjustment should be needed.

The Doris Lake benchmarks established in 2009, are local datum and have not been surveyed to the mine site. The only exception for TL-2, in 2015, which had the primary benchmark tied to the mine site benchmark.

35.7 ATTACHMENTS

No attachments

36. ID# INAC-2

36.1 SUBJECT

Management of Groundwater, Site Water Management Plan

36.2 REFERENCE

Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003, Package 2: Project Description, Page 9, Paragraph 5.

Package 5: Management and Other Plans, P5-3 Water Management Plan, Page 5, Paragraph 4.

TMAC response to AANDC-NIRB #2.

36.3 SUMMARY

INAC has concerns relating to the potential for large volumes of groundwater reporting to the underground mine and how that water will be managed on site.

More specifically, INAC has asked TMAC to define the criteria for what the proponent describes as "substantial flows", to outline a program that will be used to identify the location of the source/s of these "substantial flows" and to estimate the volume of water that may be encountered in the underground mine.

TMAC has responded by stating that "substantial flows" are defined as rates that exceed 3,000 m^3/day and have provided a reference to a document that explains the rational for this value. TMAC has stated that if these flows are exceeded, mining will cease and (further) measures will be put into place to mitigate the flow. The proposed mitigation is a program of pressure grouting in the affected area. The proponent has further clarified that as mining advances forward, exploration drilling will be carried out and that this exploration drilling is the method that will be used to identify the location and sources of "substantial flows".

36.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The location and volumes of groundwater produced will influence the water management strategy for the entire mine, including above-ground facilities. Larger than expected volumes of groundwater may influence the performance of the tailings impoundment area, the marine outfall system and the quality and quantity of water being discharged to the marine environment. If not managed correctly, the discharge of mine contact water could create environmental degradation in the marine

receiving environment which could potentially affect the health of fish and marine mammals.

36.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Location and volume of groundwater expected to report to the underground mine are unknown and plans to manage large volumes of groundwater have not been adequately described.

Disagreement with amendment proposal conclusions: The setting of a design value, in this case, 3,000 m^3/day, does not appear to be appropriate. It is INAC's view that mitigation measures should be put in place based on an adaptive management plan.

Reasons for disagreement with amendment proposal conclusions: Groundwater entering the mine will vary over time, as will the groundwater quality. The available storage on surface, and the quality of water contained will also vary. INAC believes that underground water management and mitigation should be implemented based on a holistic view of site wide water management and permitted discharge quantities and qualities. Particular emphasis should be made to implementing underground water management and mitigation methods based on the existing water storage capacity and quality of groundwater at any given time. For instance, mitigation methods may need to be put in place at lower groundwater flux rates if inadequate surface storage is available in the short term.

Recommendation/Request:

2.1 INAC requests that TMAC update the groundwater management plan to recognize that groundwater volumes (quantity) and quality will vary over time and that existing predictions may be invalid. The plan should recognize that water management decisions must be made on a site-wide manner to ensure that sufficient storage is available, quality is monitored, and that decisions will be made to ensure compliance with the future amended water licence. An adaptive, integrated, site wide water management plan is requested.

Conclusion: Future options for managing and mitigating potentially greater groundwater inflows into the mine need to be fully described in the updated groundwater management plan.

36.6 TMAC RESPONSE

TMAC has committed to submitting a Groundwater Management Plan 90 days prior to the start of operations. This plan will include mitigation measures for managing groundwater inflows greater than those predicted. The response to technical comment KIA-10 discusses some approaches to mitigation.

36.7 ATTACHMENTS

Not applicable

37. ID# INAC-3

37.1 SUBJECT

Groundwater Inflow and Quality Model Calibration

37.2 REFERENCE

Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003, Package 6: Engineering and Design Documents, P6-3 Groundwater Inflow and Quality Model, Page 19.

TMAC response to AANDC-NIRB #4.

37.3 SUMMARY

When mining moves into the through talik zone underlying Doris Lake groundwater will enter the underground mine. It has been indicated that the sources of this water will be both Doris Lake and the existing groundwater in the talik.

INAC requested the rationale for not calibrating the model or comparing the base case heads to measured heads, or to otherwise provide an updated groundwater inflow and quality model with the suggested calibrations.

TMAC responded that the suitable calibration data is not available because the mine has not been developed and that details pertaining to the engineering judgement and benchmarking was done in lieu of calibration. Also, data used in the analysis is extensive and includes a Westbay well in the vicinity of the proposed workings.

37.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

When the mining activities progress into the through talik, unexpectedly high quantities of inflow into the mine may risk operational viability, worker safety and environmental stability. The model's predictions need to be adequately assessed in order to develop the appropriate management strategies for the groundwater.

37.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The groundwater model is not calibrated and therefore does not provide sufficient confidence in the models predictions.

Disagreement with amendment proposal conclusions: Data is available to verify that the model is representative of pre-mining conditions. This includes piezometric levels

from hydraulic testing, piezometric levels from the Westbay installations, and estimates of groundwater flux rates into Doris Lake. There is not as much data available as could be expected on other projects, but available data could be used for the calibration of the predictive model. The model could have been calibrated, or otherwise verified, using existing pre-mining conditions.

Reasons for disagreement with amendment proposal conclusions: Typically baseline groundwater models are calibrated to observed head levels in piezometers and measured flux rates to surface water bodies. The model should be shown to be representative of pre-mining conditions before it is used to simulate mining.

Testing of the model could have been conducted to ensure that the model pre-mining head levels and hydraulic gradients in the Westbay well correlate with currently observed head levels. Head levels and gradients could also have been checked for the pre-mining hydraulic testing. Further, the model could have been checked against the likely flux rates from the through talik into the base of Doris Lake as a verification check. It is accepted that a calibrated model is not necessarily a representative model; however, these additional steps could have provided additional confidence in the model's predictions.

Calibration of the groundwater inflow and quality model will enhance confidence in the reliability of model predictions and provide assurances to the reviewers that the model and conceptualization is representative of pre-mining conditions. If the model is shown to be representative of pre- mining conditions, then its predictions of mining conditions can be more readily accepted. This is particularly important as considerable volumes of water are predicted to flow into the underground mine area from beneath Doris Lake which could compromise the operational viability, worker safety and the environment. The groundwater will need to be effectively managed.

Recommendation/Request:

3.1 INAC requests that TMAC calibrate the model with the available data to improve confidence in the prediction of underground water inflow and quality that it is representative of pre-mining conditions.

Conclusion: In the opinion of INAC more confidence in the predictions made by the groundwater inflow and quality model could be achieved if the model was calibrated using data obtained from the Westbay well and the other in situ testing data.

37.6 TMAC RESPONSE

An earlier simplified version of the groundwater model was prepared in 2011 using the available pumping test data and the Westbay wells. This simplified model was subsequently revised to better reflect actual geological conditions as part of this Amendment Application. The selection of material properties for the model was

fundamentally based on the results of the calibrated model. A formal calibration report of the final model as presented in Document P6-3 was not included in the Amendment Application. TMAC recognizes that this information will be valuable to reviewers and it will be documented and presented at the Technical Meeting in Cambridge Bay in January 2016.

37.7 ATTACHMENTS

Not applicable

38. ID# INAC-4

38.1 SUBJECT

Validation of Groundwater Quantity and Quality Predictions

38.2 REFERENCE

Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003, Package 6: Engineering and Design Documents, P6-3 Groundwater Inflow and Quality Model, Page 28, Table 8.

TMAC response to AANDC-NIRB #5.

38.3 SUMMARY

Several other existing northern mines have encountered unexpected challenges in relation to managing underground water. INAC requested that TMAC provide a comparison with existing northern Canadian mines and academic studies to show that the predicted range for groundwater quantity and quality is reasonable. As well, INAC would like the proponent to demonstrate that the mine water management plan is capable of managing the worst case scenario.

TMAC responded by stating that they would provide a review of comparable information prior to the Technical Meeting but to date this information has not been provided.

38.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Encountering unanticipated water management issues risks operational viability, worker safety and environmental compliance.

38.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The groundwater model predicts an inflow rate of up to 2,650 m^3/day. Potential mine water quality issues include, but are not limited to, elevated metals, nutrients, and suspended solids. Appropriate management methodologies are required to be put in place to ensure that all potential scenarios can be effectively managed.

Disagreement with amendment proposal conclusions: The amendment proposal does not put the groundwater quantity and quality predictions into context relative to other northern Canadian mines.

Reasons for disagreement with amendment proposal conclusions: Literature is available for sub-permafrost chemistry and for other northern Canadian underground mines. The existing study does not compare literature values with the predicted water quantities and quality. This would aid INAC in identifying where the Doris North project is predicted to be in relation to previously observed water quantities and qualities in these other mines. Available information concerning groundwater quantity and quality of relevant active northern Canadian mines should be used to validate model predictions and evaluate the functionality of the mine site water management plan in preventing potentially negative environmental effects to the receiving environment (Roberts Bay) as well as mine operation considerations.

Recommendation/ Request:

4.1 INAC has requested that TMAC provide a comparison with existing northern Canadian mines and academic studies and that the submission include groundwater flow and quality, and reference to how this has varied at other projects over time. The predictions for the Doris project should be compared to what has been observed at similar sites and the predicted versus actual quantity and quality values for other projects should be provided where available.

Conclusion: TMAC has yet to provide the requested review of comparable groundwater quantity and quality from similar northern mines.

38.6 TMAC RESPONSE

The requested review of comparable groundwater quantity and quality from similar northern mines can be found in Appendix B: INAC-4 - 1 Validation of Groundwater Quality Predictions.

38.7 ATTACHMENTS

Appendix B: INAC-4 - 1 Validation of Groundwater Quality Predictions

39. ID# INAC-5

39.1 SUBJECT

Groundwater Inflow and Quality Model Sensitivity Analysis

39.2 REFERENCE

Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003, Package 6: Engineering and Design Documents, P6-3 Groundwater Inflow and Quality Model, Page 35, Table 11.

TMAC response to AANDC-NIRB #6.

39.3 SUMMARY

The model predictions for inflow into the underground mine are highly sensitive to the hydraulic properties of the geological materials applied to the model. The hydraulic parameters applied, as well as the sensitivity analysis may not be representative of in situ conditions. Higher conductivity values in the model and the sensitivity analysis should have been used in the prediction of underground water inflow.

INAC requested a rational for the water management options if the inflow of groundwater is higher than predicted by the model.

TMAC responded that should flows exceed those values modelled, and specifically should they exceed inflows of 3,000 m^3/day, mining in the area affected will cease and measures put into place to mitigate the inflow.

39.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

In the event that the hydraulic conductivity values are greater than applied to the model, the groundwater inflow rate will be higher. This could have a significant impact on the mine operational viability, site wide water management and potentially impacts on Doris Lake's aquatic resources.

39.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The existing model may not be predicting the full range of potential groundwater inflow rates given the hydraulic parameters applied to the base case and the sensitivity analysis.

Disagreement with amendment proposal conclusions:

The hydraulic conductivities applied to the model, and the modelling method may not be truly representative of in situ conditions.

Reasons for disagreement with amendment proposal conclusions: The base case hydraulic conductivity values appear to have been derived primarily from the short duration packer testing. The long duration testing, which will be representative of a larger aquifer area, have a higher conductivity value by up to approximately one order of magnitude. A higher hydraulic conductivity value would lead to more flow to the underground mine in the through talik zone. Further, only two tests were performed in the diabase dyke[6]. The diabase dyke was given a very low conductivity value; in the sensitivity analysis this parameter could have been varied more.

The validity of applying an equivalent porous media model approach in a fractured rock system is also questionable. The equivalent porous media approach applies the hydraulic properties throughout the rock mass. In reality water would tend to rush into the underground from interconnected high hydraulic conductivity zones. These are very difficult to characterize in the field in fractured rock aquifer systems.

Further, the use of a MODFLOW finite difference model and equivalent porous media approach in a fractured media has limitations in being representative of the actual flow mechanisms (i.e. flow through interconnected fracture zones).

Recommendation/Request:

5.1 INAC requests that TMAC reconsider the hydraulic parameters applied to the base case and sensitivity analysis, of the groundwater inflow and quality model, to address potentially higher groundwater inflows to the underground mine works.

Conclusion: At the moment, the groundwater inflow and quality model and the sensitivity analysis do not use the full range of possible hydraulic parameters. INAC could have a greater confidence in the results of the model and the analysis with the use of a wider range of parameters showing the range of possible real world scenarios.

39.6 TMAC RESPONSE

The approach towards the sensitivity analysis presented in Package 6-3, Table 1, p. 35 was not to present the full range of mine water inflow for all possible ranges of material properties. Rather, as explained in Package 6-3, Section 4.4, p. 34, the approach was to

[6] A diabase dyke is a mafic igneous rock that is sub-intrusive. It has the same mineral composition as basalt and gabbro.

quantify the change relative to baseline conditions for key input parameters, acknowledging that any groundwater model has inherent uncertainty. Sensitivity analysis should be used to facilitate understanding of the modelled processes rather than the numeric values of input parameters.

The sensitivity analysis determined that the water level of Doris Lake and the hydraulic conductivity of the diabase dike has no material influence on the model outcome. The single biggest parameter that influences the model outcome is the hydraulic conductivity of the lake bed sediments, resulting in tripling of the inflow from Doris Lake when the hydraulic conductivity is increased by one order of magnitude, and almost doubling inflow from the host rock. The second most significant parameter is the hydraulic conductivity of the volcanic rock; increasing the hydraulic conductivity by one order of magnitude results in almost doubling of the inflow from the host rock, although it has no material impact on the inflow resulting from Doris Lake.

Since almost 70% of the total mine inflow is from Doris Lake, the sensitivity analysis demonstrates that the only parameter that would materially influence the overall mine inflow is the lake sediments. As explained in the response to technical comment # INAC-6, TMAC is of the opinion that the basis for selection of the base case hydraulic conductivity values for lake bed sediments are appropriate.

In any event, TMAC believes that the model-projected volume of water that will enter the Doris Mine is at, or near the volume that can be economically and safely tolerated. Groundwater flows above this level would have significant operational effects including curtailment of work in some headings and possible shut down of portions of the mine.

39.7 ATTACHMENTS

Not applicable

40. ID# INAC-6

40.1 SUBJECT

Doris Lake Sediment Hydraulic Conductivity Values

40.2 REFERENCE

Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003,

Package 6: Engineering and Design Documents, P6-3 Groundwater Inflow and Quality Model, Appendix B.

TMAC response to AANDC-NIRB #7.

Hope Bay Gold Project: Stage 2 Overburden Characterization Report. September 2009. Prepared by SRK Consulting (Canada) Inc.

40.3 SUMMARY

One of the key elements in determining the anticipated magnitude of groundwater flow into the underground mine will be the hydraulic properties of the Doris Lake bottom sediments. In the event the hydraulic conductivity[7] of the sediments is higher than anticipated then more water could report to the mine than currently predicted.

As a result, INAC requested TMAC provide the locations of the Cone Penetrometer Test[8] (CPT) holes and an inferred bottom sediment thickness, with associated hydraulic properties, for the mapped Doris Lake-bottom sediments, along with an isopleth map, which would be useful for reviewers.

TMAC responded by referring to an SRK report prepared in 2009 and provided the report for review.

[7] The hydraulic conductivity of a geological material is a coefficient which represents the ease with which water will flow through the pore space of fractures

[8] The cone penetrometer test (CPT) is a method used to determine the geotechnical engineering properties of soils and delineating soil stratigraphy

40.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

In the event the lake bottom sediments are discontinuous (vary in thickness and/or have a higher hydraulic conductivity than anticipated) then there is the possibility that greater than anticipated groundwater flow rates could enter the underground mine. This could subsequently lead to environmental, operational, and safety concerns.

40.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The hydraulic properties of the lake bottom sediments may be different from those used to model groundwater flow into the mine.

Disagreement with amendment proposal conclusions: The hydraulic conductivity values for the Doris Lake sediments may be higher than applied in the model. This could result in more flow to the underground workings of the mine than predicted.

Reasons for disagreement with amendment proposal conclusions: The hydraulic conductivity values applied to the groundwater model vary from $1x10^{-8}$ (Soft sediments) to $4x10^{-10}$ m/s (Indurated, or hardened, sediments). The 2009 Overburden Characterization Report (pg. 35) indicates the sediments at the base of Doris Lake grade from sensitive fines, through clayey silt, to silty sand/sand. These materials have the potential to have higher hydraulic conductivity values than were applied to the model.

TMAC has indicated that they are able to manage any water quantity flowing into the underground. A water management plan which acknowledges that the groundwater inflow rates may be much greater than expected is required prior to the commencement of operations. The management plan must acknowledge that the groundwater is required to be managed in conjunction with the rest of the site water to meet the overall requirements of the anticipated amended Water Licence.

Recommendation/Request:

6.1 INAC recommends that TMAC update the groundwater inflow and quality model by considering higher hydraulic conductivity values than were applied to the model to better represent the range of possible site conditions.

Conclusion: A water management plan which acknowledges that the groundwater inflow rates may be much greater than expected is required.

40.6 TMAC RESPONSE

TMAC agrees with INAC and has acknowledged in Document P6-3, Groundwater Inflow and Quality Model that the lake sediments hydraulic conductivity has the single

biggest influence on the modeled groundwater inflow number. This has been demonstrated in the sensitivity analysis (Document P6-3, Table 1, p. 35).

TMAC however remain confident that given the dataset of lake bed sediment data (Document P6-3, Section 2.3.3.1, p. 8) that the assumed baseline model properties for lake sediments are appropriate and representative. The dataset includes 28 individual tests for the soft lake bed sediments and two laboratory consolidation tests for the indurated lake bed sediments. This dataset covers three different areas on the property showing significant consistency which provides confidence in the selection of values.

TMAC has committed to submitting a Groundwater Management Plan 90 days prior to the start of operations. This plan will include mitigation measures for managing groundwater inflows greater than those predicted. The response to technical comment KIA-10 discusses some approaches to mitigation.

40.7 ATTACHMENTS

Not applicable

41. ID# INAC-7

41.1 SUBJECT

Marine Water Quality - Winter Conditions

41.2 REFERENCE

Package 6 Engineering and Design Docs, P6-10, Section 6.3.2 Roberts Bay Outfall, page 43;

Rescan (2013) Roberts Bay Report – A Supporting Document for the Project Certificate No 003 Amendment Package, November 2013;

SRK (2011). Groundwater Inflows and Inflow Water Quality Used for the Revised Doris North Project Certificate No 003 Amendment Package. Table 4: 75th Percentile of Doris Central Sample Results, SRK, November 2011.

TMAC response to AANDC-NIRB #8

Doc P4-7, Sections 4.5.2.2 and 4.5.2.3.

41.3 SUMMARY

Concentrations of certain parameters (e.g. Cadmium and Mercury) exceeding Council of Ministers of the Environment (CCME) guidelines for the protection of marine life are present in the proposed winter effluent. Detailed plume modelling results covering the range of potential plume behaviour should be used to enhance the assessment of potential effects on the marine receiving environment. TMAC refers only to a buoyant plume behaviour trapped in a 20-metre deep portion of the water column, and provides a schematic description of diffuser and plume performance that does not encompass the full range of potential mixing dynamics.

Based on these concerns, INAC requested information on the range of behaviour of the effluent plume under the various environmental conditions experienced during the year, in particular the winter condition. Without detailed modelling, or more information on the modelling already conducted, it is not possible to fully assess potential risks to the receiving environment.

41.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The potential zone of influence of the proposed TIA effluent and underground mine water discharge, particularly during ice-covered conditions is information to consider when assessing potential impacts to the marine environment.

41.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The box modelling methods/results provided by TMAC to date are not sufficient to fully evaluate plume behaviour, mixing zones and features such as re-circulation.

Disagreement with amendment proposal conclusions: INAC agrees with TMAC's response that plume behaviour, mixing zones, and general circulation cannot be addressed with a box model but only with 3- dimensional hydrodynamic modelling.

Certain conditions in the marine receiving environment could potentially reduce diffuser performance well below the "dilution of approximately 300:1."

Most of the conclusions regarding marine water quality result from use of a time-stepping box model, described in Rescan (2013). The box model cannot resolve the physical behaviour of the plume and circulation over time, but assumes that the effluent is evenly distributed in a box "20 m thick" but of undefined volume. There is not enough information to determine whether the time stepping box model produces conservative results.

Reasons for disagreement with amendment proposal conclusions: Environmental conditions, including weak circulation in and out of Roberts Bay under ice or during ice-free periods of calm winds and/or weak tidal currents, could reduce diffuser performance.

The plume's behaviour during times when the effluent flows are lower than the 120 L/s (10,360 m^3/day) referenced in Section 2.2.4 of the 2013 Roberts Bay Report are not defined, and no plume modelling covering behaviour of the estimated 3,000 m^3/day of only saline and dense effluent is provided.

Recommendation/Request:

7.1 INAC requests a complete report containing detailed plume modelling methods and results, addressing variable effluent flow rates and composition, variable environmental conditions, plume behaviour, recirculation, and consideration of year-to-year variability in under-ice circulation. INAC also requested that TMAC provide a description of the numerical modelling methods and results behind the representative schematics and diagrams.

Conclusion: The modelling methods/results provided by TMAC to date are not sufficient to fully evaluate plume behaviour, mixing zones and features such as re-circulation. The potential impacts to the marine environment of the proposed TIA effluent and underground mine water discharge, particularly during ice-covered conditions cannot be adequately assessed.

41.6 TMAC RESPONSE

TMAC commits to carrying out three-dimensional hydrodynamic water quality modelling (using DHI's MIKE3 software) to predict water quality concentrations in Roberts Bay in response to Tailings Impoundment Area (TIA) and/or groundwater discharge. In this exercise, water quality concentrations will be predicted within Roberts Bay during the operation (6 years) and post closure of the Discharge System, for parameters with current CCME guidelines, with MMER discharge limits, and those proposed parameters with MMER limits. Modelling will consider Roberts Bay water quality, bathymetry, riverine inputs, winds, tides, ice cover, stratification, and other physical inputs as well as effluent discharge and chemistry.

The predictions will be evaluated against marine CCME guidelines and baseline conditions. Time series at spatially relevant sites in Roberts Bay will be presented for important water quality parameters as will 2D and 3D instantaneous figures that will display plume evolution over the course of the marine discharge (including open-water and under-ice scenarios) and identify the spatial extent of mixing zones. TMAC will present modelling methods prior to the Technical Meeting and preliminary results at the Technical Meeting. All modelling results and methodologies will be summarized in a final modelling report following the Technical Meetings and provided to Parties prior to the public hearings.

41.7 ATTACHMENTS

Not applicable

42. ID# INAC-8

42.1 SUBJECT

Marine Water Quality – Bathymetric Data Gaps

42.2 REFERENCE

Rescan (2013) Roberts Bay Report - A Supporting Document for the Project Certificate No 003 Amendment Package. November 2013, page 4-9.

Package 4 Identification of Potential Environmental Effects & Proposed Mitigation, Section 4.5.2 Water Quality page 4-53.

Documents referred to in TMACs response to AANDC-NIRB #9:

- Rescan. 2013. Doris North Gold Mine Project: 2012 Roberts Bay Bathymetry Monitoring Report. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Ltd.

- Rescan. 2009. Doris North Project: 2009 Roberts Bay Jetty Fisheries Authorization Monitoring Report. Prepared for Hope Bay Mining Ltd., North Vancouver, BC by Rescan Environmental Services Ltd., Vancouver, BC.

Rescan. 2010. Doris North Gold Mine Project: 2010 Roberts Bay Jetty Fisheries Authorization Monitoring Report. Prepared for Hope Bay Mining Ltd., North Vancouver, BC by Rescan Environmental Services Ltd., Vancouver, BC.

- Rescan 2010. Hope Bay Belt Project: 2009 Marine Fish and Fish Habitat Baseline Report, Hope Bay Belt Project. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. March 2010.

- Rescan 2011. Hope Bay Belt Project: 2010 Marine Fish and Fish Habitat Baseline Report, Hope Bay Belt Project. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. April 2011.

The previous sediment monitoring reports:

- Golder. 2008. 2008 Roberts Bay Fisheries Authorization Monitoring Report. Prepared for Hope Bay Mining Ltd., North Vancouver, BC by Golder Associates Ltd., Edmonton, AB.

42.3 SUMMARY

The fate of the effluent into the marine receiving environment has not been adequately determined with respect to Roberts Bay bathymetry.

During the winter, exchange between Roberts Bay and Melville Sound is extremely low and effluent from the Tailings Impoundment Area (TIA) and groundwater is expected to "pool" during this period (Package 4). Pooling of effluent denser than seawater within Roberts Bay could occur in bathymetric depressions.

Rescan (2013) states "All site-specific bathymetric information is included in Figure 4.2-7". The contours for depths greater than 50 m do not appear on the figure, yet it is concluded that there is no sill at the mouth of Roberts Bay. Some figures, e.g. 4.2-9, appear to show a bowl-shaped depression within Roberts Bay.

As a result, INAC requested that TMAC provide the bathymetric survey data, including point measurements, survey methodology, and area of coverage, to support the estimates regarding the pooling behaviour of negatively buoyant effluent.

TMAC responded to INAC's request by referring the reviewer to a series of reports.

42.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Localized pooling of saline groundwater effluent in a small volume of water could result in poor dilution and therefore could cause some exceedances of the CCME guideline criteria (e.g. Cadmium and Mercury) for the protection of marine life, especially in slow moving water conditions under the ice. This information is needed to fully understand the potential zone of influence of the proposed underground mine water discharge into the marine environment during the winter ice-covered conditions.

42.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Data at depths below the diffuser is necessary to properly evaluate the anticipated dilution dynamics within Roberts Bay.

Disagreement with amendment proposal conclusions: Figure 1.1 from Rescan's November 2013 Roberts Bay Report omits the bathymetric contours below 50 m south of the Roberts Bay/Melville Sound interface line. The same report claims "Roberts Bay is directly connected with Melville Sound, as there is no sill present at the mouth of Roberts Bay. This was verified by depth soundings in April 2011."

Reasons for disagreement with amendment proposal conclusions:

The long reference list of baseline reports do not provide the requested information.

The 2010 Roberts Bay Jetty Fisheries Authorization Monitoring Report provides detailed near-shore bathymetry but none in the region of the diffuser or interface with Melville Sound.

The 2012 Roberts Bay Bathymetry Monitoring Report could not be found by searching the NIRB Public Registry.

Recommendation/Request:

8.1 INAC requests that TMAC provide the April 2011 bathymetric data collected in Roberts Bay below the 50 m contours, specifically near the mouth of Roberts Bay to support the conclusion that there is no sill or potential effluent collection point within the Bay.

Conclusion: The report cannot conclude that there is no sill at the mouth of Roberts Bay with the data presented to date. Confirmation of the statement that there is no sill at the mouth of Roberts Bay remains important.

42.6 TMAC RESPONSE

Roberts Bay bathymetric data have obtained from the following sources:

- Canadian Hydrographic Service Chart#7790 (digitized);
- Intensive bathymetric survey conducted in southern Roberts Bay by Frontier Geosciences Inc. for SRK to support jetty construction (See Appendix A: Figure INAC-8 – 1, Bathymetry Contour Plan, September 2003);
- April 2011 survey where spot lead-line measurements were taken within a 24-site grid at the mouth of Roberts Bay (Roberts Bay/Melville Sound interface) to determine if a sill was present (Appendix A: Figure INAC-8 – 2, 2011 Bathymetry Sampling Sites, Doris North Project);
- Near-shore bathymetric surveys specific to measuring potential sedimentation effects from jetty construction (e.g., Rescan 2013) and to assess fish habitat (e.g., Rescan 2010a, 2011a); and
- Deep-water physical profiling during 2009-2011 marine sampling surveys (Rescan 2010b, 2011b, 2012).

No sill is indicated on CHS charts and this was confirmed from the April 2011 discrete bathymetry measurements at the mouth of Roberts Bay. The Acoustic Doppler Current Profiler (ADCP) placed at 82 m depth at the mouth of Roberts Bay showed year-long horizontal currents and consistently high concentrations of dissolved oxygen at depth indicating deep waters move freely into Roberts Bay (Rescan 2012).

Results of the bathymetry measurements at the mouth of Roberts Bay are provided in Table INAC-8 -1 and in Appendix A: Figure INAC-8 – 2, 2011 Bathymetry Sampling Sites, Doris North Project).

Table INAC-8 - 1. Bathymetric sampling sites, coordinates (13W), and depths at the mouth of Roberts Bay

Sample Site	Easting	Northing	Depth (m)
B12	431478	7569200	86.5
B13	431878	7569200	83.5
B14	432278	7569200	55
B15	432678	7569200	24.5
B21	430978	7569700	66
B22	431478	7569700	90
B23	431878	7569700	80.5
B24	432278	7569700	49
B25	432678	7569700	15
B31	430978	7570200	76
B32	431478	7570200	86
B33	431878	7570200	62
B34	432278	7570200	36
B35	432678	7570200	39
B41	430978	7570700	72
B42	431478	7570700	86
B43	431878	7570700	66
B44	432278	7570700	54
B45	432678	7570700	52
B51	430978	7571200	79
B52	431478	7571200	85
B53	431878	7571200	71
B54	432278	7571200	61
B55	432678	7571200	45
B64	432202	7571694	69
B74	432329	7572179	66

References:

Rescan 2010a. *Hope Bay Belt Project: 2009 Marine Fish and Fish Habitat Baseline Report, Hope Bay Belt Project*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. March 2010.

Rescan 2010b. *Hope Bay Belt Project: 2009 Marine Baseline Report, Hope Bay Belt Project*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. March 2010.

Rescan 2011a. *Hope Bay Belt Project: 2010 Marine Fish and Fish Habitat Baseline Report, Hope Bay Belt Project*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. April 2011.

Rescan 2011b. *Hope Bay Belt Project: 2010 Marine Baseline Report, Hope Bay Belt Project*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. April 2011.

Rescan 2012. *Doris North Gold Mine Project: 2011 Roberts Bay Physical Oceanography Baseline Report*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Limited. April 2012.

Rescan. 2013. *Doris North Gold Mine Project: 2012 Roberts Bay Bathymetry Monitoring Report*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Ltd.

42.7 ATTACHMENTS

Appendix A: Figure INAC-8 -1 Bathymetry Contour Plan, September 2003

Appendix A: Figure INAC-8 -2 2011 Bathymetry Sampling Sites, Doris North Project

43. ID# INAC-9

43.1 SUBJECT

Marine Water Quality – Time Stepping Box Model Description

43.2 REFERENCE

Package 4 Identification of Potential Environmental Effects & Proposed Mitigation, Section 4.5.2 Water Quality pages 4-52 to 4-58;

Rescan (2013) Roberts Bay Report - A Supporting Document for the Project Certificate No 003 Amendment Package. November 2013. TMAC response to AANDC-NIRB #10.

43.3 SUMMARY

The time stepping box model is used to demonstrate the ability of the receiving environment to dilute the plume below CCME guidelines for the protection of marine life. The model description does not state the volume of the assumed mixing zone, only the exchange rates between Roberts Bay and Melville Sound.

INAC requested technical details on the receiving water time stepping box model, including seasonal differences in water column properties and plume behaviour, along with representative maps of the areas and depths of the receiving water body affected. In addition, TMAC was requested to provide estimates of the degree of background buildup and effluent inhomogeneity in the receiving marine environment.

TMAC responded that the technical details are available in the documentation provided and that effluent inhomogeneity, plume behaviour, mixing zones, and general circulation cannot be addressed with a box model; only with 3-dimensional hydrodynamic modelling. The box model applied a trapping layer of a particular volume with baseline metal concentrations and then allowed effluent of particular concentrations to accumulate with flushing during the open-water season such that the CCME guidelines were met during the last year of the proposed discharge. This gave a water quality target for each CCME WQ parameter.

43.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The potential zone of influence of the proposed TIA effluent and underground mine water discharge, particularly during ice-covered conditions is especially important to consider when assessing potential impacts to the marine environment.

43.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The method presented by TMAC in the application documentation for estimating marine water quality over time does not consider a variety of effluent behaviours.

Disagreement with amendment proposal conclusions: There is not enough information provided to determine whether the time stepping box model produces conservative results.

As stated by TMAC, three-dimensional modelling was conducted, but it was not subsequently used to complete detailed, time-varying plume modelling.

Reasons for disagreement with amendment proposal conclusions:

The model description does not state the volume of the assumed mixing zone, only the exchange rates between Roberts Bay and Melville Sound. As volumes of the receiving water winter 'pool' is identical to the summer volume, it is not clear whether the box model appropriately and conservatively represents receiving water conditions given the seasonal variations of the volume in which a plume would be trapped and mix.

An essential detail of the box model includes numerically stating the "particular volume" of the box. Picking a large volume as the mixing box results in optimistically large instantaneous dilution. The coarse temporal resolution of the box model obscures potential effluent recirculation behaviour. For example, during weak estuarine circulation, it appears currents would flow along the axis of the multiport diffuser, reducing the effective dilution. Tidal currents superimposed on the estuarine circulation could 're-dose' the same water with effluent, potentially leading to significant accumulation.

The box model also assumes instantaneous mixing throughout the receiving water volume. In any outfall system there is the potential for concentration of effluent on tidal timescales, especially during calm periods. No estimate of the reduction of effective dilution due to buildup of effluent was provided.

Environmental conditions, including weak circulation in and out of Roberts Bay under ice or during ice-free periods of calm winds and/or weak tidal currents, could reduce diffuser performance.

The plume's behaviour during times when the effluent flows are lower than the 120 L/s (10,360 m^3/day) referenced in Section 2.2.4 of the 2013 Roberts Bay Report are not defined, and no plume modelling covering behaviour of the estimated 3,000 m^3/day of only saline and more dense effluent is provided.

Recommendation/Request

Additional information regarding the variables and inputs into modelling of the effluent discharge into Roberts Bay is needed to support the claims regarding receiving environment concentrations, and should help to address any ongoing public concerns with marine discharge of the TIA and groundwater effluent into Roberts Bay.

Plume modelling, informed by complete three-dimensional hydrodynamic modelling, would provide confidence that potential issues such as recirculation and effluent inhomogeneity are properly addressed.

9.1 INAC requests the technical details and validations of a three- dimensional hydrodynamic modelling, as well as methods and time- varying results for any plume modelling conducted that supported the box modelling approach.

Conclusion: The modelling methods/results provided by TMAC to date are not sufficient to fully evaluate plume behaviour, mixing zones and features such as re-circulation. The potential impacts to the marine environment of the proposed TIA effluent and underground mine water discharge, particularly during ice-covered conditions, cannot be fully assessed.

43.6 TMAC RESPONSE

TMAC has committed to performing 3D hydrodynamic modelling of Roberts Bay with respect to TIA and groundwater discharge. See response to INAC-7.

43.7 ATTACHMENTS

Not applicable

44. ID# INAC-10

44.1 SUBJECT

Marine Water Quality – Diffuser HAZID (Hazard Identification)

44.2 REFERENCE

Package 4 Identification of Potential Environmental Effects & Proposed

Mitigation, Section 4.5.2 Water Quality page 4-49;

Package 6 Engineering and Design Docs, P6-10, Section 6.3.2 Roberts Bay Outfall.

Initial TMAC response to AANDC-NIRB #11 and follow-up response prepared by SRK dated December 2, 2015.

44.3 SUMMARY

During the IR stage of the review process INAC determined that the hazards and risks associated with construction and operation of a marine outfall did not appear to be addressed.

As a result, INAC requested TMAC to advise whether a HAZID (hazard identification) was conducted for the outfall system. TMAC's initial response to AANDC-NIRB #11 was that a formal HAZID had not been completed to date and is typically undertaken as part of the detailed engineering phase of a project.

Subsequently, TMAC submitted an additional response (Tech Memo) prepared by SRK, dated December 2, 2015, which elaborated on the environmental stressors considered in the design of the marine outfall and presented a summary hazard Identification (HAZID).

44.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Any failure in the outfall system would have operational consequences for the Project and could change current environmental impact predictions.

44.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Detailed Review Comment

Issue: Hazards and risks associated with the construction and operation of a marine outfall do not appear to be fully addressed.

Disagreement with amendment proposal conclusions: INAC's review of the HAZID provided has assisted in meeting our concerns. In particular, the mechanical protection is appropriate, but will need to be refined in the regulatory review / detailed design phase of the Project. However, leak detection methodology seems inadequate and the issues of scaling and other forms of deposit in the discharge pipe have not been addressed, which should be assessed during an environmental assessment due to the potential for environmental impacts.

Reasons for disagreement with amendment proposal conclusion.

The proposed leak detection appears to be inadequate, partly because the location of the "remote" sensor is not defined.

Another issue, with respect to long term operation, is the issue of scaling or other deposition in the pipe, and the consequent increase in head requirements. The possibility of scaling/deposition should be identified in the HAZID, and the likelihood and consequences should be addressed.

Recommendation/Request

10.1 INAC requests that TMAC provide a more comprehensive conceptual level description of the leak detection system. INAC also requests that information on the potential for scaling be provided.

Conclusion: Provision of the detailed design of the outfall pipeline (including the finalized HAZID) for review and approval in the regulatory review phase of the Project prior to construction will address this concern, if the Proponent provides the requested comprehensive conceptual level description for the current environmental assessment.

44.6 TMAC RESPONSE

TMAC is committed to completing detailed engineering of the marine outfall pipeline design prior to its construction. The work has been commissioned and is underway, but will only be completed by the end of March 2016. As part of this design all the previously mentioned issues as discussed in the response to Information Requests AANDC-NIRB #11, AANDC-NIRB #12, AANDC-NIRB #27 and KIA-30 will be addressed. Although not specifically mentioned in the aforementioned response, TMAC acknowledges and agrees that scaling and other deposition within the pipeline also needs to be considered.

As presented in the HAZID prepared as part of the response to Information Response AANDC-11, TMAC is planning on using remote pressure monitoring along the pipeline as

a mitigation strategy to facilitate leak detection. This method of leak detection is standard practice for pipeline systems; accordingly TMAC's proposed approach is considered proven and tested. This method is suitable for the system since the pumping rate along the pipeline is fixed while operating at a steady rate (i.e. either 3,000, 4,000 or 7,000 m^3/day). It is however also standard practice to establish the location and type of pressure sensors as part of the detailed design stage of a pipeline when all the necessary hydrotechnical and thermodynamic assessments are being carried out to ensure selection of the appropriate technology and locations of pressure sensors. As such, TMAC will identify these locations during the detailed design phase, prior to construction. At a conceptual level, a series of sensors would be installed to allow pressure differentials between pipeline sections of variable length to be identified such that the zone within which a leak is detected can be readily identified for subsequent physical inspection.

44.7 ATTACHMENTS

Not applicable

45. ID# INAC-11

45.1 SUBJECT

Marine Water Quality - Outfall System Hydraulics

45.2 REFERENCE

Package 6 Engineering and Design Docs, P6-10, Section 6.3.2 Roberts Bay Outfall.

TMAC response to AANDC-NIRB #12 including Docs P6-6, P6-7, and P6-8 in the Application.

45.3 SUMMARY

The hydraulics of the diffuser, the delivery pipe and the de-aeration tank in the plant are crucial to meeting the stated performance of the marine outfall, and to its continuous operation as designed.

INAC requested a number of technical details such as the surface area of the de-aeration tank (needed to avoid air bubbles in the outfall pipe), the head requirement of the diffuser and outfall pipe, planed operation during emergency and planned shut downs, provision for potential scaling in the pipe and design of the pipe.

TMAC responded that a preliminary engineering assessment on the overall feasibility of the outfall serves as the basis of the information contained in the Application and indicated that detailed design of the outfall will be provided in the regulatory review phase prior to construction.

45.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Any failure in the outfall system would have operational consequences for the Project, particularly a surplus of water on site above available storage capacity, and trigger changes to current environmental impact predictions (e.g. a need to temporarily discharge excess stored effluent to a freshwater stream).

45.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Technical details on the design and operational procedure of the marine outfall system design are needed for INAC to better assess the feasibility of the current hydraulic design of the proposed outfall.

Disagreement with amendment proposal conclusions:

INAC acknowledges that a preliminary engineering assessment on the overall feasibility of the outfall serves as the basis of the information contained in the proponent's application and that engineering planning has been completed at a level consistent with the expectations for Water Licencing purposes.

INAC is concerned that there may be overly optimistic calculations in the hydraulic design. INAC remains concerned as to whether the outfall system will perform effectively over the entire seasonal range of effluent flows and chemistry and variable environmental conditions, in particular during the ice-covered period.

Reasons for disagreement with amendment proposal conclusions:

INAC appreciates TMAC's partial response to this initial Information request but is of the opinion that additional technical information is needed to better assess the feasibility of the current hydraulic design of the proposed outfall.

For example, we note that the Roberts Bay Discharge System is a pressurized hydraulic system, with fluid velocities ranging between 1.0 m/s and 2.4 m/s. These velocities would result in a ratio of head requirements between the high and low flow cases of 5.96. The project application indicates a range in head of 10 masl to 37 masl, a ratio of 3.7. This discrepancy seems large, leading to concern that pumping requirements, and the potential for partial full pipe flow and associated air management issues may not have been adequately considered. These are fundamental considerations, and should be addressed in any document seeking regulatory approval.

Recommendation/Request:

11.1 In order to fully assess the hydraulic design of the proposed outfall, INAC requests that TMAC provide at a minimum the following additional information:

a. What are the head requirements of the diffuser and outfall pipe?

b. How was the surface area of the de-aeration tank determined?

c. Will the mixture of the TIA supernatant and the mine groundwater lead to either generation of gas bubbles when combined, or scaling in the pipe?

d. Is there provision for potential scaling in the pipe, or other processes that would increase its roughness?

e. How will planned and emergency shut-downs be handled, especially to avoid freezing of the pipe when flow is not maintained?

Conclusion: This additional information is needed by INAC to complete the EA-level technical appraisal of the proposed marine outfall system.

45.6 TMAC RESPONSE

TMAC is committed to completing detailed engineering of the marine outfall pipeline design prior to its construction. The work has been commissioned and is underway, but will only be completed by the end of March 2016. At this time TMAC is not in a position to provide more information regarding the marine outfall pipeline design than presented in the Amendment Application.

45.7 ATTACHMENTS

Not applicable

46. ID# INAC-12

46.1 SUBJECT

Marine Water Quality – Public Concerns

46.2 REFERENCE

Package 2 Project Description, Section 4.3.5 2014 Public Consultation, page 31.

Appendix 4 Supporting Document, Section 3 Public Consultation, page 3-2.

Package 4 Identification of Potential Environmental Effects & Proposed Mitigation, Section 4.5.2 Water Quality page 4-49; Package 6 Engineering and Design Docs, P6-10, Section 6.3.2 Roberts Bay Outfall, page 43.

TMAC's response to AANDC-NIRB #13.

46.3 SUMMARY

INAC has noted that members of the public had expressed concern about the discharge of TIA and underground mine water into the marine environment, the potential contamination of the sea and possible negative effects on marine life.

TMAC has stated that the TIA and mine groundwater effluent will meet the legally-required MMER limits within the pipeline prior to discharge via the multiport diffuser in the marine environment and that CCME guidelines for the protection of marine life will be met within Roberts Bay for the duration of mine groundwater and TIA discharge. However, supporting document P6-10 indicates that concentrations of cadmium and mercury in the effluent prior to discharge are predicted to exceed the marine CCME guidelines on occasion both during operation and post-closure dewatering. During the winter period the more saline groundwater is predicted to pool on or near the seafloor, presumably with limited mixing.

As a result, INAC requested updated information on TMAC's efforts to consult with the local communities regarding their plan to discharge the TIA and mine groundwater to the marine environment and any associated receiving environment water quality and impact predictions to community members in plain, accessible language. INAC requested that more recent consultation records be provided for the public record.

TMAC responded by stating that they do not anticipate water quality exceedances in the marine environment, that effluent is predicted to meet MMER end of pipe limits and that water quality is not predicted to exceed CCME guidelines in Roberts Bay at the extent of the mixing zone, which is within meters of the diffuser.

In addition TMAC advised that between September 28th and October 2nd, 2015, the company undertook a Kitikmeot community consultation tour which focused on the Doris Amendment application. During this tour it was reported that community questions focussed on marine discharge, tailings management and employment and training. TMAC has stated that a summary document is currently being prepared of these proceedings and that no Kitikmeot resident encountered spoke out against the amendment application.

46.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

This additional information will help to demonstrate that any possible ongoing public concerns with the marine discharge of the TIA and mine groundwater effluent into Roberts Bay via the proposed marine diffuser outfall have been discussed with the communities and effectively addressed.

46.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Effective consultations with local communities with regards to TMAC's plan to discharge TIA and mine groundwater effluent via a marine diffuser into Roberts Bay.

Disagreement with amendment proposal conclusions: No disagreement as the proponent has conducted additional community consultation on the amendment application.

Reasons for disagreement with amendment proposal conclusions:

INAC is pleased to note that TMAC has undertaken further, more recent community consultations focussing on the Doris Amendment application, including the marine discharge component, and looks forward to receiving the summary document of these proceedings as per TMAC's commitment.

Recommendation/Request:

12.1 INAC recommends that a summary document of community consultations focussing on the Doris Amendment application, including the marine discharge component be provided for review.

Conclusion: This TRC can be considered to be resolved upon receipt and review of the community consultation proceedings summary document.

46.6 TMAC RESPONSE

TMAC appreciates the need to fully summarize community consultation on this significant project component and herewith provides a 2011-2015 community consultation summary for review.

46.7 ATTACHMENTS

Appendix B: INAC-12 -1 Doris Amendment Application Consultation Record

47. ID# INAC-13

47.1 SUBJECT

North Dam Spillway Effects on Permafrost

47.2 REFERENCE

Package 6 Engineering and Design Docs, P6-11, Section 4.5 and

Attachment 2 (Stability Analysis, Table 1).

TMAC response to AANDC-NIRB #14.

SRK (2007) [Design of the Tailings Containment Area Doris North Project, Hope Bay, Nunavut, Canada - report prepared for Miramar Hope Bay Ltd., Project 1CM01008.165, March 2007].

47.3 SUMMARY

Reference is made to a proposed "North Dam Spillway", the location and design drawings of which are not included in the application. This spillway could thermally alter the permafrost boundary condition in the vicinity of the North Dam, which is a frozen core dam, or possibly negatively affect the surrounding permafrost ground conditions.

INAC requested the location, design and the anticipated impact of this proposed North Dam Spillway.

TMAC responded that the North Dam Spillway has already been reviewed and approved by the NWB as part of the existing Water Licence.

47.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The proposed "North Dam Spillway" is a structure that may cut into and negatively impact the local permafrost condition in the vicinity of the North Dam.

47.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The design of the "North Dam Spillway" was undertaken before the proposed amendment, therefore it could not have taken into account the amendment design and operational parameters.

Disagreement with amendment proposal conclusions: It is unclear whether the "North Dam Spillway" is to be utilised in the proposed amendment, and if so, whether the previously approved design is still applicable to the proposed changes.

Reasons for disagreement with amendment proposal conclusions: The amendment application may have different design and operational parameters to those originally reported in 2007 for the North Dam Spillway.

However, it is understood that with implementation of the proposed direct discharge of underground mine water to the marine environment, rather than to the TIA, that a North Dam Spillway may no longer be required.

Recommendation/Request:

13.1 INAC requests that TMAC confirm whether a North Dam Spillway is still required, and if so, indicate whether the currently approved design is fit for purpose and meets the design intent for the conditions expected for the amendment application.

47.6 TMAC RESPONSE

The same rationale for including the Spillway in the original dam design in the 2007 TIA design (SRK 2007) was that although the Water and Load Balance Modelling at that time suggested that the TIA would not reach Full Supply Level (FSL) during either the operational or closure period, a spillway would be the prudent best practice mitigation measure to ensure that the dam does not overtop in the event that unforeseen conditions led to a requirement to retain water for an extended period of many years.

In accordance with the current Project Water and Load Balance Package 6-10, there is no time during the Project life, or the closure period prior to breaching the North Dam that the TIA will come close to the FSL as the TIA is actively managed through annual discharge to the ocean at a rate of 4,000 m^3/day during the open water season.

Accordingly, TMAC does not believe that the North Dam Spillway will be required, TMAC does not intend to construct it, yet TMAC has chosen to retain the optionality of constructing the Spillway should it ever be required.

In a response to ECCC-10, TMAC has illustrated the conservatism built into the system by determining the timeline to reach FSL under different scenarios where no discharge is allowed.

Notwithstanding, the fact that the North Dam Spillway is not expected to be required, the design criteria for the Spillway as presented in the 2007 design (SRK 2007) remain valid, as the North Dam design and functionality remain unchanged. The only factor that is different and could affect the Spillway design is the inclusion of a section of subaerial tailings within the catchment that would affect the volume of runoff, due to

the fact that the runoff coefficient of natural tundra, tailings and open water is different. However, the North Dam Spillway was sized to pass 100% of the 1:500 year, 24-hour duration storm event, assuming zero attenuation. Since the overall TIA catchment remains unchanged and a 100% runoff factor was assumed (which ignores the differences between tundra, tailings or open water), the Spillway design remains valid.

References:

SRK (2007) [Design of the Tailings Containment Area Doris North Project, Hope Bay, Nunavut, Canada - report prepared for Miramar Hope Bay Ltd., Project 1CM01008.165, March 2007].

47.7 ATTACHMENTS

Not applicable

48. ID# INAC-14

48.1 SUBJECT

Frozen Soil Design Parameters

48.2 REFERENCE

Package 6 Engineering and Design Docs, P6-11, Section 4.5 and Attachment 2 (Stability Analysis, Table 1).

TMAC response to AANDC-NIRB #15.

SRK TCA Design of the Tailings Containment Area Report dated March 2007.

48.3 SUMMARY

INAC has determined that the frozen soil parameters used in stability analyses of Pad U Ore Stockpile may not be the most appropriate.

In particular, the frozen soil parameters used for the foundation soils to determine stability are not typical. These parameters were utilized to evaluate the stability of the pile. Ice-rich frozen soils are typically modelled as material with a friction angle of 0 degrees (Ø= 0°) because confining stress has no effect on material strength. The relatively high friction angle may over estimate stability. An apparent cohesion much higher than noted in the proponent's analysis is often the method utilized to simply model the strength of the frozen soil.

In addition the stockpile may generate creep deformation in the foundation soils depending on the length of time that the ore is stockpiled on the pad.

As a result, TMAC was requested to provide information that will confirm the suitability of the material property parameters for the frozen soil forming the foundation of Pad U stockpile.

In addition, TMAC was requested to provide information on the expected time that ore would be stockpiled on the pad to enable the potential for creep deformation to be considered.

TMAC's response to technical comment #AANDC IR #15 was to state that frozen material properties are consistent with material properties adopted for the creep deformation analysis carried out for the North and South Dams as documented during the original Water licence Application in 2007. They provided a reference to a

supporting document (SRK TCA Design of the Tailings Containment Area Report dated March 2007 located on the NWB ftp site). TMAC also stated that the ore stockpile will be dynamic in nature as it serves as the feed to the process plant. An initial stockpile will be developed in advance of plant commissioning and it is expected that storage time could be up to 16 months. During normal operations, storage time will be more in the order of 6 months in duration.

48.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Inadequate design of the Ore Stockpile Pad may lead to localized ore slope failures/slumping, which may pose personnel safety and operational issues.

48.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: There may be some potential for safety issues arising and also potential movement of ore in an uncontrolled manner onto the natural ground surface

Disagreement with amendment proposal conclusions: The stability analysis conducted used variables that are appropriate for the long term storage of ore. The amendment application refers to short term storage of ore; therefore, variables more appropriate to short term storage of ore should be used in the stability analysis.

Reasons for disagreement with amendment proposal conclusions:

INAC reviewed the 2007 SRK report and noted that the stability analysis carried out for the evaluation of the dams utilized Ø= 0° and a cohesion of 40 kPa for the ice-rich overburden soils. These material properties would also be appropriate for determining the long term stability of the pile.

However, short term stability would be much more appropriately evaluated with a stability analysis using Ø= 0° but a higher cohesion which is reflective of the much higher short term strength of the frozen foundation soils.

Long term deformation from creep may not be of concern due to the relatively temporary nature of the ore storage.

Failures, if they were to occur, would not be expected to be catastrophic or cause significant environmental damage. Rather there is potential for interruption to the supply of ore to the plant and the potential to require cleanup of ore from outside the area of the stockpile pad. There may be some potential for safety issues arising and also potential movement of ore in an uncontrolled manner onto the natural ground surface.

Recommendation/Request:

14.1 INAC recommends that TMAC consider alternate justifiable material properties for the ice-rich overburden to be used for the foundation of the Pad U stockpile, and a complimentary revaluation of the short term stability. Suggested conservative material properties for the ice- rich saline foundation soils (based on extensive testing carried on similar saline soils) would be Ø= 0° and an apparent cohesion on the order of 100 to 200 kPa.

Conclusion: The application of the most appropriate material properties for the ice-rich overburden to be used for the Pad U stockpile foundation will more accurately identify the potential for localized ore slope failures/slumping, which may pose personnel safety and operational issues.

48.6 TMAC RESPONSE

The stability analysis of the Pad U Ore Stockpile used an effective friction angle of φ= 26° and a cohesion of c'= 112 kPa as frozen shear parameters for the marine silt and clay at the foundation of the pile (Documen P6-11, Table 1). These parameters are based on laboratory tests from the 2004 and 2005 geotechnical investigations (SRK 2004, 2005). The modeled saturation and porosity values are generally low compared to the lab results, which results in conservative frozen strength parameters. Plasticity index tests (typically 17-22%) were used to confirm that the friction angle of 30^0 is representative using empirical data presented in Figure 11.64 of Mitchell and Soga (2005).

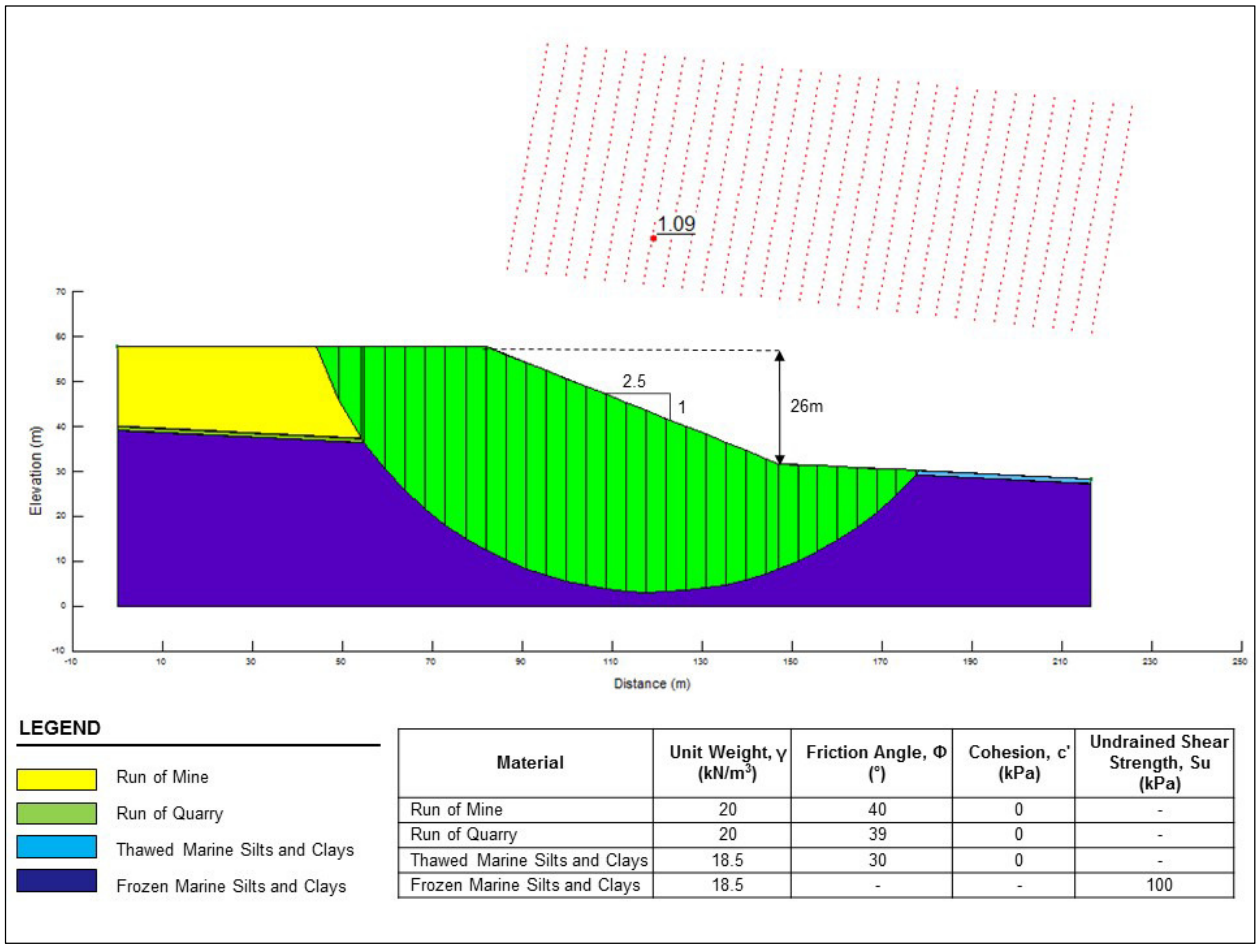
The frozen strength parameters for the marine silt and clay were estimated based on the model presented by Nater *et al*. (2008). The model is dependent on the volumetric ice content and soil temperature and is based on laboratory tests on undisturbed samples of permafrost soils. For this analysis, a ground temperature of -2^0C and an ice content equal to the volumetric water content was assumed.

With these parameters, the calculated factor of safety (FOS) was 2.0 for a 26 m height free standing stockpile with a slope angle of 2.5H:1H. The critical failure surface was very shallow in the stockpile body. The analysis considered a pile built on 1 m thick run of quarry material with similar shear properties as the pile, placed on the native ice-rich overburden.

Based on the mechanical consideration that frozen materials do not behaves as frictional materials, INAC has questioned the type and values of shear parameters for the frozen soils at the foundation of the Pad U stockpile. Instead of using effective shear parameters, INAC recommend the use of shear parameters with a friction angle (φ) of 0 and an apparent cohesion of (i.e., c≠0), and higher than 112 kPa, for the marine silt and clay, i.e., the use of a constant shear strength (S_U) for the frozen marine silt and clay. Additionally, INAC, recommends to re-evaluate the short term ore stockpile stability with a S_U value between 100 and 200 kPa.

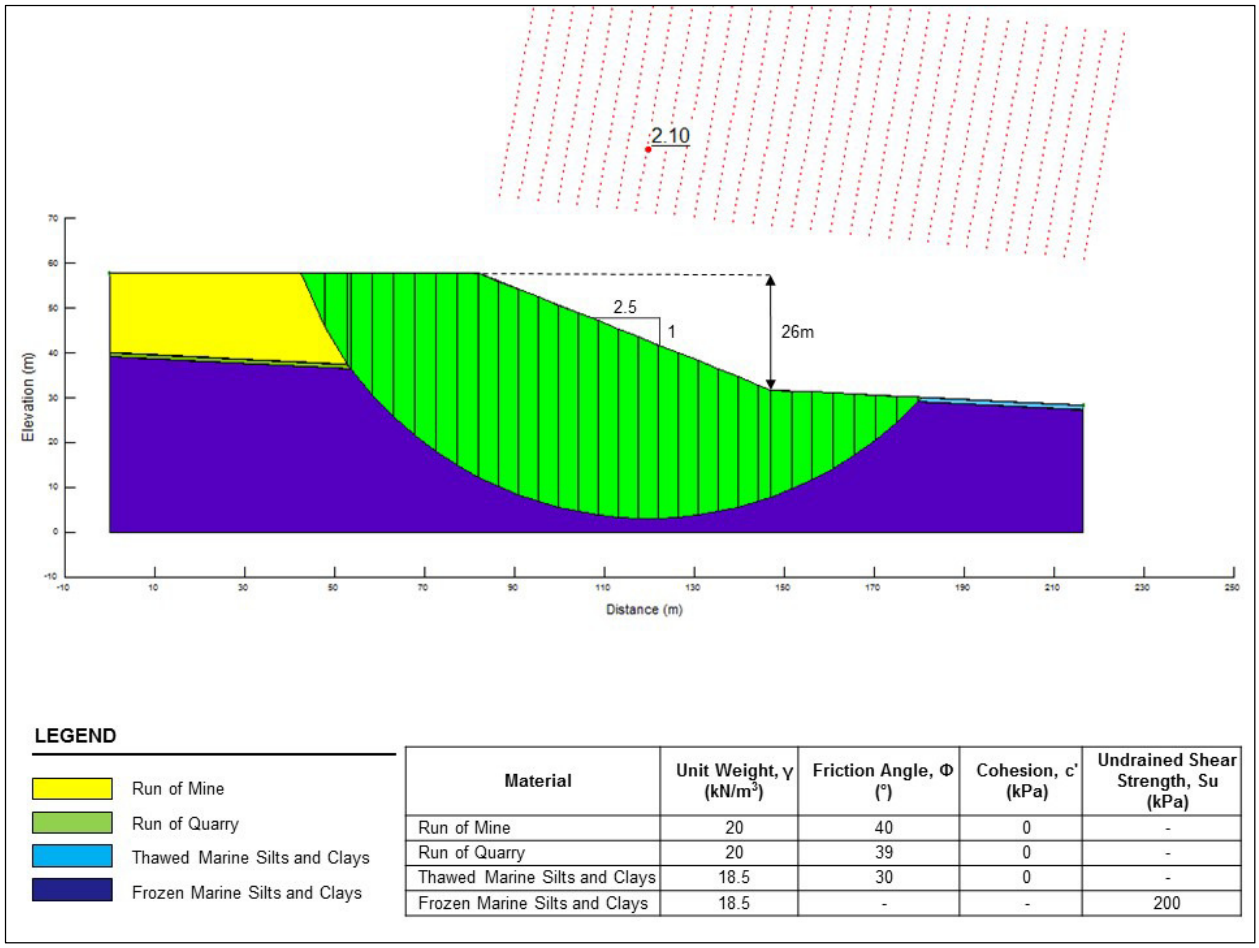
SRK completed a re-evaluation of the ore stockpile stability for the same geometrical configuration as presented in the application with the suggested (S_U) values proposed by INAC. FOS's of 1.1 and 2.1 were obtained for a S_U = 100 kPa and S_U = 200 kPa respectively as illustrated in Figures INAC-14 - 1 and INAC-14 - 2 below. In both these scenarios the FOS is acceptable.

TMAC however remain confident that the parameters adopted in the Amendment Application as presented in Document P6-11 remain valid and is suitable and applicable as an evaluation of ore stockpile stability.



Material	Unit Weight, γ (kN/m³)	Friction Angle, Φ (°)	Cohesion, c' (kPa)	Undrained Shear Strength, Su (kPa)
Run of Mine	20	40	0	-
Run of Quarry	20	39	0	-
Thawed Marine Silts and Clays	18.5	30	0	-
Frozen Marine Silts and Clays	18.5	-	-	100

Figure INAC-14 – 1. Factor of Safety Assuming S_U = 100 kPa for Marine Silt and Clay Foundation



Material	Unit Weight, γ (kN/m³)	Friction Angle, Φ (°)	Cohesion, c' (kPa)	Undrained Shear Strength, Su (kPa)
Run of Mine	20	40	0	-
Run of Quarry	20	39	0	-
Thawed Marine Silts and Clays	18.5	30	0	-
Frozen Marine Silts and Clays	18.5	-	-	200

Figure INAC-14 – 2. Factor of Safety Assuming Su = 200 kPa for Marine Silt and Clay Foundation

References:

Mitchell, J.K., Soga, K., 2005. *Fundamentals of Soil Behaviour*. 3rd Edition, John Wiley & Sons, Inc.

Nater, P., Arenson, L.U., and Springman, S.M.., 2008. "Choosing Geotechnical Parameters for Slope Stability Assessments in Alpine Permafrost Soils", In *Proceedings of 9th International Conference on Permafrost*. 1261-1266.

SRK Consulting, Inc. 2004. *Summer 2004 Geotechnical Field Investigation at Tail Lake, Doris North Project, Nunavut, Canada*. Prepared for Miramar Hope Bay Limited, April, 2005.

SRK Consulting, Inc. 2005. *Winter 2005 Geotechnical Field Investigation at Tail Lake, Doris North Project, Nunavut, Canada*. Prepared for Miramar Hope Bay Limited, October, 2005.

48.7 ATTACHMENTS

Not applicable

49. ID# INAC-15

49.1 SUBJECT

Capacity of Proposed Underground Backfilling Space

49.2 REFERENCE

Project Description Table 3, and text p. 9; Project Description Section 3.5; Waste Rock and Ore Management Plan, Section 4. Contingencies; Waste Rock and Ore Management Plan, Table A1, p. A7; P6-12 Tailings Geochemistry, Technical Summary second paragraph.

TMAC response to AANDC-NIRB #20.

49.3 SUMMARY

The project description states that backfill requirements for the mine were calculated at 1,500,000 tonnes, based on volumes of planned stopes. It is also stated that all of the mineralized waste rock will be placed underground, all of the detoxified tailings (unspecified volume) will be placed underground, and any potentially acid generating (PAG) material encountered in quarries (unspecified volume) will be placed underground. It is stated that all of the surface waste rock storage is temporary during mining and that at closure it is anticipated that all remaining Non-PAG waste rock on surface will be placed underground.

The concern is whether or not the underground space has capacity to accommodate the total volume of materials planned for backfill.

As a result, INAC requested that TMAC provide a comprehensive tally of mine waste materials planned for underground disposal during operations and at closure, details of how tonnage is converted into volumes and a tally of available underground space for storage, including anticipated stope space.

Table A1 in the Waste Rock and Ore Management Plan presents volume of waste rock at 1,523,000 tonnes. It is understood that an unspecified amount of Non-PAG waste rock is proposed for use during construction; however, the concern is whether or not the underground space has capacity to accommodate the total volume of materials planned for backfill.

a. Provide a comprehensive tally of mine waste materials planned for underground disposal during operations and at closure (including but not limited to waste rock, detoxified tailings, and projected PAG from quarries).

b. Include details of how tonnage is converted into volumes, (i.e. swell factor considerations).

c. Provide a tally of available underground space for storage, including anticipated stope space (i.e. volume of space at the top of each stope evaluated as unusable for backfill storage, due to logistics of filling up all the way to the back of a stope).

49.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Adequacy of space available underground to accommodate the total amount of mine waste materials proposed for underground disposal is an important consideration. This could have a significant impact on the mine operational viability.

A large component of the plans to manage potentially acid generating or metal leaching mine waste materials from the project relies upon placing materials as backfill in the underground workings which will be flooded at closure, and thus limiting potential leaching of acid and metals to the receiving environment mitigating impacts to surface and groundwater quality during closure.

49.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Amount of space available for underground storage of ARD or ML waste rock and tailings is not demonstrated to be sufficient.

Disagreement with amendment proposal conclusions: The amount of usable space presented as being available for underground storage of waste rock and tailings in TMAC's project proposal is considered unrealistic. The calculations of how much space is needed is based on values of compaction that cannot reasonably be achieved in an underground environment.

Reasons for disagreement with amendment proposal conclusions: The amount of usable space presented as being available for underground disposal of waste rock and tailings in TMAC's project proposal is 100% of the excavation space created from underground development and mining. This is considered unrealistic as some of the void space created during mining will be impossible to fill, and some of the access space created during development will be needed for the full life of mine. The calculations of how much space is needed for the waste rock and tailings are based on unrealistic values of compaction that cannot reasonably be achieved in an underground environment. Please see attached Appendix A for a more detailed explanation and sample calculations.

Recommendation/ Request:

INAC requests that TMAC clarify:

15.1 What percentage of total mined out open stope space was assumed to be able to be backfilled? Does this account for not reasonably being able to place materials into the upper reaches of the stopes, and the limitations imposed by no man entry to mined-out stopes?

15.2 Is the void space created from waste rock development assumed to be available for backfilling include ramp and access drifts, and is it reasonable to assume that backfilling can be achieved in these areas? If so, what percentages of the areas are assumed to be able to be filled? Does this take into account that some access areas and ramps will be required for use during the full LOM?

15.3 How does TMAC propose to achieve compaction in the underground environment, specifically within an open stope or in an access drift?

15.4 Also, if there is insufficient space underground to accommodate all of the mine waste materials produced during the life of the mine, an evaluation of contingency permanent surface storage options for mine waste materials is needed, as well as assessment of related potential negative environmental effects.

Conclusion: The project description does not currently provide adequate detail on how TMAC calculated available underground space for the deposition of waste materials.

49.6 TMAC RESPONSE

It is common in underground mines to excavate access portals, ramps and drifts in non-ore formations ("waste") and excavate specific access to the orebody for efficient ore removal. The Doris ore bodies, Doris North, Doris Connector and Doris Central, are generally linear in nature, oriented in a north-south direction. This linearity has provided mining engineers with the opportunity to minimize waste excavations by starting at the north end of the deposits and progressively mining southward. In doing so access can be gained by "development in ore", that is, using access through mined out areas that once contained ore. In this way, development in non-ore formations is minimized as is waste rock generation, resulting in less waste rock temporarily on surface. The net result of this is that all waste rock hauled to surface will need to be returned to backfill stopes and some unneeded access tunnels.

Based on the values provided in Table A1 of document P5-4 (Waste Rock and Ore Management Plan), consider the following Table INAC-15-1:

Table INAC-15-1. Capacity of Proposed Underground Backfilling Space

Ore mined:	2,314,000	Tonnes
Waste rock mined:	1,523,000	Tonnes
Total mined:	3,837,000	Tonnes
In situ density:	2.7	Tonnes/m^3
Total mined void volume:	1,421,000	m^3
Backfill in place density (Swell = 0.7):	1.89	Tonnes/m^3
Placed fill volume, including waste rock and tailings (0.7 original density):	806,000	m^3
Percent of mined void filled:	57%	

Based on this, it is clear that the entire volume of waste rock can be placed underground as the mined volume is greater than the placed fill volume.

TMAC also intends to place detoxified cyanide leach tailings underground. This amount, 8% of the ore mass, if assumed to be placed at the same density of the waste rock, increases the volume filled from 57% to 61%. It is expected that the tailings will fill the interstices among the waste rock particles, providing somewhat less over total fill volume.

49.7 ATTACHMENTS

Not applicable

50. ID# INAC-16

50.1 SUBJECT

TIA Interim Dike – Filtering Requirements

50.2 REFERENCE

Package 6 Engineering and Design Documents, P6-13 Tailings Management System: Section 1.1 Paragraph 4 "The remaining portion of the TIA between the Interim Dike and the existing North Dam [completed in 2012, SRK (2012)] will not contain any tailings, and will act as a Reclaim Pond."

P6-13 Tailings Management System: Section 4.2 Paragraph 1 "Tailings will be retained between the South Dam and the Interim Dike"; P6-13 Tailings Management System: Section 4.4.2 Paragraph 1; P6-13 Tailings Management System: Appendix A, Drawing DN-TIA-04.

TMAC response to AANDC-NIRB #22.

SRK Consulting (Canada) Inc, Memo : Response to AANDC-NIRB IR#22: TIA Interim Dike – Filtering Requirements , Emma Helmers, EIT, Arcesio Lizcano, PhD, December 4th 2015.

50.3 SUMMARY

The purpose of the Interim Dike is to impound tailings between the South Dam and the Interim Dike. Therefore, it is inferred that the Interim Dike is actually a filter dike; retaining the tailings on the upstream side while allowing the supernatant water to flow through the dike to the downstream reclaim pond.

INAC requested additional information on the design process, calculation and proposed mitigation strategy.

TMAC's response confirmed that a filter will be required on the upstream face of the Interim Dike. This will be comprised of either a graded rock filter or a geotextile.

50.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

In terms of tailings solids and water management within the TIA, it is important that the TIA Interim Dike act as a filter to prevent tailings solids from migrating northwards through the Interim Dike to the Reclaim Pond. Maintaining the Reclaim Pond free of suspended tailings solids is important for the discharge of water from this facility.

50.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The filtering requirements of the TIA Interim Dike to enable water to be discharged from the downstream Reclaim Pond are not clearly defined.

Disagreement with amendment proposal conclusions:

TMAC's drawings show the Interim Dike to be mainly constructed with Run of Quarry material. The concern is whether the Run of Quarry material will be a suitable filter material to retain the tailings upstream of the Interim Dike while allowing the water to filter through to the downstream reclaim pond.

Reasons for disagreement with amendment proposal conclusions:

TMAC state that the upstream face of the Interim Dike will, if required, be clad with a layer of graded rock that would act as a filter to ensure tailings solids do not migrate through the Dike. Also that, alternately, the upstream slope will be clad with a geotextile to serve this filtering function. However, these mitigations may not be practical to employ if the Run of Quarry design does not work, since the tailings facility will already be in operation, and could have tailings and turbid supernatant water encroaching on the upstream face of the Dike.

Given the importance of the Interim Dike, it is prudent to implement best practice, and design and construct the Dike in a way that does not require post-construction retrofitting from the onset. If the run of Run of Quarry material does not act as a filter it may result in reclaim water turbidity and silting up of the downstream reclaim pond.

It is important that the Interim Dike function effectively to retain tailings on the upstream side of the TIA while allowing filtered tailings water to flow through the dike to the downstream reclaim pond for the proposed TIA to function properly and avoid TIA effluent quality exceedances, which would then be directed to the marine outfall mixing box prior to discharge to the marine environment.

Recommendation/Request:

16.1 INAC requests that TMAC clarify when and how the Interim Dike filter will be constructed/installed in the overall construction schedule.

Conclusion: The project description does not currently provide adequate detail on how TMAC plans to construct/install the Interim Dike filter in the overall construction schedule.

50.6 TMAC RESPONSE

In TMAC's response to Information Request AANDC-22, it was confirmed that an upstream filter would be required for the Interim Dike, and it was confirmed that it would comprise of either a suitable geotextile or a manufactured graded rock as specified. This filter needs to be in place before tailings are placed against the Interim Dike. In accordance with the tailings deposition plan described in Document P6-13 tailings will only reach the Interim Dike at the end of Year 3 of mine production, which means the filter only has to be in place by that time.

TMAC intends to construct the bulk of the structure, i.e., the Run-of-Quarry (ROQ) structure at the end of the 2016 open water season, around September 2016 (i.e., before tailings production starts). This will be the first stage of the structure, i.e., the in-water section as described in TMAC's response to AANDC- 23. This section of the Interim Dike will be left in place to allow the underlying sediments to consolidate and the structure to settle until the end of 2017 open water season when the TIA water level is at its lowest. At that time the upstream filter will be constructed (September 2017), there will be less than 1 year of tailings deposition in the TIA.

Subsequent raises of the Interim Dike will be above water construction and the filter will be constructed immediately after each bulk ROQ lift has been constructed.

50.7 ATTACHMENTS

Not applicable

51. ID# INAC-17

51.1 SUBJECT

TIA Interim Dike – Underwater Slopes

51.2 REFERENCE

P6-13, drawing DN-T1A-06,

P6-12, Section 4.6.2.

TMAC response to AANDC-NIRB #23.

SRK (Dec. 2015) Memo re AANDC-NIRB #23: TIA Interim Dyke – Underwater Slopes.

51.3 SUMMARY

INAC requested that TMAC provide a description of how the upstream and downstream slopes of the Interim Dike will be constructed to slopes of 3H:1V and if desired to improve the stability, to the flatter slope of 5H:1V discussed in P6-12 Section 4.6.2.

Given that the Dike will be constructed "in the wet" it is not clear if it is feasible to construct a 3H:1V slope considering the material available and the depth of the water at this location. If, due to water depth, the Dike cannot be constructed with these slopes, potential related effects on stability and more importantly the filtering capacity of the Dike have not been described. INAC requires the rationale for using the slopes as designed, along with a description of how they will be constructed given the project-specific circumstances.

This information is needed to confirm the current design parameters or to modify the design of the Interim Dike to ensure constructability.

TMAC responded to INAC's IR by stating that the Interim Dike construction will be carried out without draining the TIA, requiring in-water construction through a water depth of 2 - 3 m. TMAC indicated that construction will be done in stages, as opposed to the full height from the start, with the first lift construction to an elevation of about 1 m above the TIA water level. They have indicated that the overall dike height during construction would be a maximum height of 3 - 4 m during this first stage, which is the only in-water construction stage. They have also stated that with a target side slope of 3H:1V, it will require a reach of between 9 and 12 m for an excavator when working

from the crest of the dike. TMAC has indicated that they have a CAT 330 excavator on site, which has an operating reach of just under 12 m (11.7 m).

51.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

This information is needed to confirm the current design parameters or to modify the design of the Interim Dike to ensure constructability. This could have a significant impact on the mine operational viability.

51.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Constructability of 3H:1V underwater slopes of the Interim Dike within the TIA and potential negative effects on stability and filtering capacity.

Disagreement with amendment proposal conclusions: INAC is satisfied with the partial response given; however, we are of the opinion that it is incomplete since not all components of the request have been answered.

Reasons for disagreement with amendment proposal conclusions: With respect to TMAC's response, INAC understands the proposed construction plan. However, given that the above INAC Technical Comment #16 states that a filter will be required on the upstream face of the Interim Dike, INAC requests that the construction plan include a description of the filter installation for both the graded rock and the geotextile filter options.

Recommendation/Request

17.1 INAC requests that TMAC provide an Interim Dike construction plan that includes the placement of the tailings filter options: these being both the graded rock filter and the geotextile filter. In addition to the written construction plan, INAC requests that the construction plan also include a short series of drawings to help in the full understanding of the proposed construction process.

Conclusion: This issue is considered unresolved until TMAC provide an Interim Dike construction plan that includes the placement of the tailings filter options. The construction plan should also include a short series of drawings to help in the full understanding of the proposed construction process.

51.6 TMAC RESPONSE

A decision on whether the Interim Dike filter will consist of a geotextile or manufactured graded rock as specified in Information Request AANDC-22 will be made during the detailed engineering design stage of the Interim Dike following an appropriate trade-of study as described in the response to Information Request AANDC-22. The construction

procedures for installation of these different filters are common practice and are described below:

Geotextile Filter (see attached Figure INAC-17 - 1):

1. An as-built survey of the completed upstream face of the Interim Dike is carried out. For the in-water section of the Interim Dike, this compromises a bathymetric survey.
2. This survey is used to develop a template for the geotextile panels that are cut and stitched together to cover the upstream face.
3. The specified geotextile filter is cut in panels spanning from the crest to the toe with 1 m overlap, with each panel numbered in accordance with the template.
4. The panels are laid out on the crest of the Interim Dike and stitched together (not heat-bonded) to create one continuous panel.
5. The completed continuous panel is flaked and moved to the upstream edge of the crest with the top 1.5 m of the continuous panel laid out on the crest. This overlap is covered using crushed rock to act as ballast weight to anchor the continuous panel.
6. The toe edge of the continuous panel is attached to lines and the flaked continuous panel is dragged out over the water using a boat.
7. Sand bags and/or anchor rocks are lowered onto the panel to submerge the filter panel to conform to the upstream slope of the Interim Dike.
8. Finally a proper toe ballast is placed from the crest of the Interim Dike using an excavator.

Manufactured Graded Rock Filter (see attached Figure INAC-17 - 2):

1. An as-built survey of the completed upstream face of the Interim Dike is carried out. For the in-water section of the Interim Dike, this compromises a bathymetric survey.
2. The survey is used to develop a placement plan for the manufactured graded rock filter.
3. Using the excavator, the graded rock filter material is put in place along the upstream face of the Interim Dike.
4. Placement is done from the toe of the structure, moving up-slope.
4. An as-built survey of the placed filter layer is conducted to confirm that it meets the specified thickness criteria.

51.7 ATTACHMENTS

Appendix A:

Figure INAC-17 - 1 Idealized Construction Procedure for Geotextile Filter for the Interim Dike

Figure INAC-17 – 2 Idealized Construction Procedure for Manufactured Graded Rock Filter for the Interim Dike

52. ID# INAC-18

52.1 SUBJECT

TIA South Dam – Downstream Slope Steepness

52.2 REFERENCE

P6-13, Section 4.2, page 16 and Section 4.7, page 20 drawing DN-T1A-06.

SRK (2007) [Design of the Tailings Containment Area Doris North Project, Hope Bay, Nunavut, Canada - report prepared for Miramar Hope Bay Ltd., Project 1CM01008.165, March 2007].

TMAC response to AANDC-NIRB #25.

EBA Engineering Consultants Ltd., 2006. Thermal Design of Tailings Dams, Doris North Project NU. Report Prepared for Miramar and SRK Consulting (Canada) Inc. Project Number 1100126.

52.3 SUMMARY

The steepness of the TIA South Dam Downstream Slope is of concern. The South Dam is founded on very ice-rich saline silt that is expected to creep considerably over time. Earlier analyses of the North Dam by EBA for Miramar identified the potential for considerable deformation of that Dam during its operating life, and as a result the slopes were flattened significantly (6H:1V) to reduce potential deformation.

INAC requested an analysis result showing the evaluation of potential creep deformation of the downstream slope of the South Dam.

TMAC responded that the analysis evaluating the potential creep deformation of the downstream slope of the South Dam and the potential for environmental impacts was previously provided.

52.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

There is a potential for excessive creep deformation of the downstream slope of the dam which is founded on very ice-rich foundation soils. This issue needs to be addressed to ensure the long term integrity of the TIA South Dam. This could subsequently lead to environmental, operational, and safety concerns.

52.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: INAC still has concerns regarding the design of the TIA South Dam; specify related to the potential for excessive creep deformation of the downstream slope of the dam, which is founded on very ice-rich foundation soils.

Disagreement with amendment proposal conclusions: Although the South Dam might not fail due to creep during its life, it is possible the creep deformation could lead to the formation of substantial bulging of the downstream slope and cracking through the crest of the dam in the long term. This may raise concerns during dam inspections, potentially leading to a need to undertake some form of remedial repairs. TMAC has suggested that the slope could be flattened to a minimum of 4H:1V if monitoring shows excessive movement but identifies it is not expected due to the results of the thermal analysis. It remains unclear to INAC how the thermal analysis would lead to the conclusion that the South Dam might not fail due to creep during its life as the thermal analysis does not show extensively cooler foundation soils which would reduce creep rates.

Reasons for disagreement with amendment proposal conclusions:

The 2007 SRK Design report was reviewed by INAC and it was noted that the design of the original South Dam had a 6H:1V downstream slope specifically to limit the amount of creep deformation occurring in the foundation and hence settlement of the dam crest. The creep analysis documented in the report clearly showed the potential for significant creep movement even with the very flat side slopes.

The current design of the south dam now has a 2H:1V downstream slope and therefore there is potential for an even more significant deformation than identified for the dam in the 2007 design report.

Although the deformations are anticipated to occur over a period of time, increased creep deformation above that accounted for in the original design could perhaps compromise the geosynthetic clay liner (GCL) that is now the primary impermeable boundary in the new South Dam. Similarly, although there will be tailings on the upstream face of the dam there is therefore the potential for water in the tailings to escape through a compromised GCL liner system. As previously noted, these deformations could also raise concerns about dam stability during dam monitoring.

Recommendation/Request

18.1 INAC recommends flattening the downstream slope to at least 4H:1V to lessen predicted creep displacements to address this concern.

Conclusion: INAC concludes that the current design of a 2H:1V downstream slope is too steep and is likely to trigger creep displacement which would compromise the liber system.

52.6 TMAC RESPONSE

TMAC respectfully disagrees with INAC's conclusion.

TMAC agrees and has acknowledged that the foundation conditions at the South Dam are susceptible to creep, and as a result any structure that is constructed on this material is susceptible to deformation as a result of creep. However, the design of the South Dam as proposed in Document P6-13 is substantially different than the SRK (2007) design and therefore the susceptibility to creep deformation is different and the consequences of deformation is different.

A rigorous assessment of creep deformation was carried out for the North and South Dams as part of the original TIA design as documented in SRK (2007). For that design, both the North and South dams were designed as full water retaining structures with a design life of 20 years. The design analysis assumed a full head of water against the dam for the entire duration of the design life. The dams were designed as frozen core dams with a GCL secondary liner system. The design criteria specified that the dams must retain water for their entire design life and as a result deformation should be limited such that the core would not crack and overtopping would not occur. The subsequent deformation analysis under these extreme conditions subsequently provided the basis for recommending upstream and downstream slopes of 6H:1V for the South Dam. The reason the creep deformation is so significant under these design conditions is because there is a constant heat source in the form of a head of 4^{o}C water immediately against the upstream slope of the dam. This results in a slow but continuous warming of the foundation permafrost.

The function and design intent of the South Dam as proposed in the Amendment Application has however changed as described Document P6-13. This dam is no longer a water retaining structure, but will retain tailings solids which though thermal analysis has been demonstrated to freeze back in less than 10 years (note this analysis is conservative in that it assumes freeze back only starts once all tailings are placed as opposed to acknowledging actual seasonal freeze back). The GCL has been in the design as a matter of best practice to ensure that during the first year of operations, while the tailings beach is being developed and unfrozen tailings are against the South Dam, that there is primary containment against any seepage. Once the design beach has developed, seepage analysis as presented in Document P6-13 clearly demonstrate that there is no hydraulic head capable of mobilizing tailings, even under the unrealistic scenario of assuming zero freeze back. Therefore, should over time, foundation creep result in deformation of the South Dam to the point of resulting in separation of the GCL liner, there will be no risk of losing containment of the tailings solids to the environment.

The revised design as presented in the Amendment Application ensures that South Dam no longer has a constant heat source against it in the form of a head of water, but rather a tailings beach, which at closure is over 1.5 km long. This is a substantial change from the 2007 design which ensures that the dam foundation remain essentially unchanged and as a result the structure is less susceptible to creep deformation.

TMAC will be installing instrumentation into the South Dam to monitor thermal, settlement and deformation response of the South Dam as described in Package 6-13. This instrumentation will provide the necessary information to confirm that creep deformation is not a process of concern, but if required, TMAC remain committed to add additional downstream material as required to flatten the slope.

For the reasons described TMAC does not believe that creep deformation of the South Dam is a concern and therefore does not believe that flattening of the downstream slope is warranted. Notwithstanding this conclusion, as described above, TMAC will be monitoring the South Dam performance and is will make any necessary changes to the downstream slope should findings to the contrary be observed.

References:

SRK (2007) [Design of the Tailings Containment Area Doris North Project, Hope Bay, Nunavut, Canada - report prepared for Miramar Hope Bay Ltd., Project 1CM01008.165, March 2007].

52.7 ATTACHMENTS

Not applicable

53. ID# INAC-19

53.1 SUBJECT

Supernatant Pond Extent and Elevation

53.2 REFERENCE

P6-13 Tailings Management System: Appendix C: Figs 05, 06 and 07. TMAC response to AANDC-NIRB #26.

53.3 SUMMARY

The proposed tailings deposition plan drawings are missing the extent and elevation of the tailings supernatant pond.

The management of a tailings storage facility requires both the volume of solids (tailings) and the volume of water (supernatant water) to be managed in tandem within the facility.

TMAC responded to INAC's information request by stating that they acknowledged the reviewer's request and that revised drawings from the application document P6-13 (Tailings Management System) are provided in Appendix 3.1 - Figures 05, 06 and 07 and that these documents have been included to show the maximum level of the supernatant pond during operations and at closure.

53.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

The management of a tailings storage facility requires both the volume of solids (tailings) and the volume of water (supernatant water) to be managed in tandem within the facility. INAC requires this information to complete its technical review of the Project.

53.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The location and extent of the supernatant water remains important for the TIA review.

Disagreement with amendment proposal conclusions: INAC is satisfied with a portion of the response given; however, we are of the opinion that it is incomplete since not all components of the request have been answered.

Reasons for disagreement with amendment proposal conclusions: TMAC has committed to providing the requested additional information but has yet to do so.

Recommendation/Request:

19.1 INAC requests that TMAC provide the revised drawings from the application document P6-13 (Tailings Management System) provided in Appendix 3.1 – Figures 05, 06 and 07, as requested in IR#26.

Conclusion: TMAC's response to IR #26 is incomplete until the requested information is provided.

53.6 TMAC RESPONSE

TMAC acknowledges that an error was made in referencing the location of the revised drawings provided in response to Information Request AANDC 26 in the submission made on October 8, 2015. Please see Appendix A for revised drawings Figure INAC-19 – 1, INAC-19 – 2 and INAC-19 – 3. TMAC apologizes for any confusion this may have caused.

53.7 ATTACHMENTS

Attachment A:

Figure INAC-19 – 1 Tailings Deposition Plan (Years 1 &2)

Figure INAC-19 – 2 Tailings Deposition Plan (Years 3 & 4)

Figure INAC-19 – 3 Tailings Deposition Plan (Complete at Year 4 + 5 Months

54. ID# INAC-20

54.1 SUBJECT

Public Consultation Record

54.2 REFERENCE

EIS Addendum, Section 4.3

TMAC Response to INAC NIRB #28

54.3 SUMMARY

INAC requested that a comprehensive consultation summary, including the most recent consultations undertaken to date, be provided. This should include concerns raised regarding project changes and how the Proponent has considered these in their project design as well as mitigation and management measures.

In response, the Proponent reiterated that a summary of public consultation undertaken to date was provided with the amendment application. TMAC also indicated that community consultations were undertaken regarding the Doris North amendment application in September/ October.

54.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Providing a comprehensive consultation record as well as an overview of how the Proponent plans to address community concerns enables reviewers to ensure the Project is being undertaken in a manner that is acceptable to communities and incorporates their views and concerns.

54.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: A comprehensive consultation record and an overview of how the Proponent intends to address community concerns, has not been made available

Disagreement with amendment proposal conclusions: The brief summary on community consultation provided does not provide enough detail to determine if appropriate consultation was carried out.

Reasons for disagreement with amendment proposal conclusions:

In order to determine if appropriate consultation was carried out, a comprehensive consultation record, including a summary of what project aspects have been communicated, a detailed record of concerns raised, as well as how the Proponent plans to address these concerns in project design and mitigation/management measures is required. This level of detail at this stage of review is important as it will ensure reviewers have a full understanding of community views and concerns with regards to the project changes included within the amendment application. This summary should include the specific concerns raised regarding marine discharge, tailings management and employment and training, as noted in the response to Information Request INAC-NIRB #28.

Recommendation/Request

20.1 INAC requests that the Proponent provide a comprehensive consultation summary, including the most recent consultations undertaken. This should include concerns raised regarding project changes and how the Proponent has considered these in their project design as well as mitigation and management measures.

Conclusion: A comprehensive report on all consultation activities related to the proposed amendment is required to determine if consultations have been carried out appropriately.

54.6 TMAC RESPONSE

TMAC appreciates the need to fully summarize community consultation on the Doris Amendment and herewith provides a 2011-2015 community consultation summary for review.

54.7 ATTACHMENTS

Appendix B: INAC-12 -1 Doris Amendment Application Consultation Record

55. ID# INAC-21

55.1 SUBJECT

Labour Force Projections and Analysis

55.2 REFERENCE

EIS Addendum, Section 6.4.1,

TMAC Response to AANDC-NIRB #29, TMAC Response to AANDC-NIRB #30

55.3 SUMMARY

The application provides information on the projected project employment and a break down per year of number of project employees anticipated. However, the type of job and the skill level needed is not specified in the documentation.

INAC requested that the Proponent provide a labour market analysis based on up to date information regarding labour supply and demand for the affected Kitikmeot communities. The analysis should also include a breakdown of the number and type of employment opportunities expected to be available by project phase.

As a response, TMAC provided little additional information regarding employment projections, types of positions and skill level requirements and indicated that this information would not provide value at this stage of the review.

55.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Understanding the socio-economic benefits of the updated project as a result of employment is important for reviewers. Having a solid understanding of the types of jobs available and their skill requirements will enable parties to plan ahead and allow for the maximum socio- economic benefit possible should the project proceed.

55.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: A comprehensive labour market analysis and outline of employment projections has not been provided.

Disagreement with amendment proposal conclusions:

Considering the project changes in terms of scope, length and design, INAC disagrees with the statement that the information requested would not provide value at this stage

of the review. A comprehensive labour market analysis and outline of employment projections has been provided at this stage for other assessments in Nunavut at the same review stage.

Reasons for disagreement with amendment proposal conclusions:

INAC reiterates that having a comprehensive understanding of the type, number and skill level of positions is important for reviewers to understand the scale of benefits the project will provide, in addition to providing valuable information for local and regional planning.

Recommendation/Request

21.1 INAC recommends that the Proponent provide an updated labour force analysis and employment impact assessment using the skills requirements and number of jobs available by project phase (labour demand), and the skills profile of the Kitikmeot region (labour supply), in order to provide a clear picture of the impacts the project will have on the local labour market. Also, INAC requests that the Proponent provide a labour market analysis based on up to date information regarding labour supply and demand for the affected Kitikmeot communities. The analysis should also include a breakdown of the number and type of employment opportunities expected to be available by project phase.

55.6 TMAC RESPONSE

The reviewer is requested to refer to the response to technical comment GN-1 of this document for a response. TMAC has addressed the reviewer's comment and will conduct a supplemental analysis of the labour demand and supply.

55.7 ATTACHMENTS

Not applicable

56. ID# INAC-22

56.1 SUBJECT

Complete Assessment of Economic Effects of the Project Including Induced and Indirect Effects

56.2 REFERENCE

EIS Guidelines, Section 6.21.4, EIS Addendum, Section 6.4.2, TMAC Response to INAC-NIRB #31

56.3 SUMMARY

The economic effects analysis including indirect and induced effects of the project application give little information on what impact the project will have on local and regional economic conditions. This is important in order to understand the economic impact the updated and lengthened project may have on local and regional economies.

INAC is of the opinion that an updated economic effects analysis including indirect and induced effects is required to assist in evaluating economic impacts of the amendment.

INAC requested an updated economic effects analysis, to which the Proponent responded that this would not add value to the review at this stage.

56.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Having a complete understanding of the economic effects of the updated project is important for reviewers to assess the overall economic benefit of the project on the local and regional economies.

56.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: An updated economic effects analysis to reflect the proposed project amendments has not been provided.

Disagreement with amendment proposal conclusions: INAC disagrees with the Proponent's conclusion that there would be no added value from an updated economic effects analysis.

Reasons for disagreement with amendment proposal conclusions:

An updated economic effects analysis provides a more robust understanding of the economic effects of the updated project. If this information is not provided, the reviewers may not have a proper understanding of how the amendments to the project will interact with local and regional economies, both positively and negatively.

INAC disagrees with this assessment and notes that considering the project changes outlined in the amendment application, an updated economic effects analysis, including consideration of indirect and induced effects would allow reviewers to fully assess the economic effects of the project, as required by the EIS guidelines. The amendment application as submitted does not currently conform to the requirements of Guidelines Section 6.21.4. Due to the lengthened nature of the project, it is anticipated the effects will differ from those originally proposed, and having an understanding of economic impacts of the project would enable more comprehensive regional and local planning.

Recommendation/Request

22.1 INAC requests that the Proponent provide an updated economic effects analysis to include consideration of the indirect and induced economic effects of the proposed lengthened development in accordance with the EIS guidelines.

Conclusion: An updated economic effects analysis is required in order to increase reviewers' confidence in the proposed economic impacts of the updated project.

56.6 TMAC RESPONSE

As described in response to GN-3, TMAC agrees to conduct additional economic impact analysis to quantify the predicted benefits and effects of the Project on the economy. Economic modelling will estimate the direct, indirect and induced employment and income effects within the Kitikmeot Region and for Nunavut and Canada as a whole. TMAC will subsequently conduct an assessment of the proposed amendment's overall economic effects considering increases in aggregate employment, GDP, and government revenue.

56.7 ATTACHMENTS

Not applicable

57. ID# INAC-23

57.1 SUBJECT

Employment Mitigation Measures Including Education and Training

57.2 REFERENCE

EIS Addendum, Section 6.5.1

TMAC Response to AANDC-NIRB #32

57.3 SUMMARY

A more comprehensive Training and Education plan that reflects the amendment application is requested.

The proponent made the commitment to collaborate with training agencies in order to increase training opportunities for Nunavummiut. The application, however, does not include a comprehensive Training and Education plan.

INAC requested a more comprehensive Training and Education plan be added to the EIS. This plan would include more detail on the training collaborations, an overview of the anticipated training and education programming and how those training and education opportunities will enable Nunavummiut to fully participate in the development of this mining project.

In response, TMAC provided few additional details on its plan for training and education and how these components will facilitate a skilled local workforce being available for the project.

57.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Training and education is a key benefit of a major resource development project of this length and magnitude and having a clear understanding of what is being proposed by the Proponent in this regard is important for reviewers.

57.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The training and education plan includes limited information.

Disagreement with amendment proposal conclusions: Given the project changes being proposed, INAC is not of the opinion that the level of detail provided in the application is comprehensive enough to enable reviewers to have a solid understanding of the training and development measures under consideration.

Reasons for disagreement with amendment proposal conclusions: Given that the project scope and length is proposed to increase, INAC reiterates the request that the Proponent demonstrate that they have a comprehensive training and education plan in place, to maximize local participation in the project. This should include further detail on the proposed training collaborations, in addition to an overview of anticipated training and education programming, including specifics on how the training and education will enable Nunavummiut to participate more fully in the lengthened and updated project. Reviewers would benefit from understanding more details around the 'collaborative' training planned, including a high level overview of what courses are anticipated to be offered, and how the training program will enable Nunavummiut to participate more fully in the updated project.

Recommendation/Request:

23.1 It is recommended that the Proponent add a more comprehensive

'Training and Education' plan to their EIS Addendum. This should include further detail on the proposed training collaborations, in addition to an overview of anticipated training and education programming, including specifics on how the training and education will enable Nunavummiut to participate more fully in the lengthened and updated project.

57.6 TMAC RESPONSE

TMAC agrees that training and education offers benefits for Nunavummiut as part of our development.

As a result, Schedule D (Training and Education) of the 2015 Hope Bay IIBA commits TMAC to a number of tasks such as:

- Development of a Human Resource Strategy that addresses training and education,
- Specified areas of training,
- Career Development Plans for Inuit Employees,
- Inuit Training Targets that are subject to review and adjustment by the IIBA Implementation Committee,
- Community Information and Career Awareness Sessions in the Kitikmeot,
- Kitikmeot Secondary School achievement awards,

- Collaboration with KIA and government and other training organizations, and
- Information Sharing.

Further, Schedule A of the IIBA commits the IIBA Implementation Committee to prepare an Annual Evaluation Report on the implementation of the IIBA, which would include details on the efficacy of Training and Education programs.

Training and Educational support is a shared responsibility between TMAC and the KIA as agreed in the 2015 IIBA. TMAC cannot bind KIA to a specific course of action such as government engagement as part of a public environmental assessment process.

The development and implementation of Training and Education programs will be achieved in conjunction with the setting our Human Resource strategy, which will be provided in September 2016.

57.7 ATTACHMENTS

Not applicable

58. ID# INAC-24

58.1 SUBJECT

Socio-Economic Impact Assessment of Closure Effects

58.2 REFERENCE

EIS Guidelines, Section 4.21.4, TMAC Response to INAC-NIRB #33

58.3 SUMMARY

Guidelines for the original Doris North project require the Proponent to "evaluate how the temporary or final closure of the mine would affect workers and communities," as well as to provide an overview of what measures the Proponent would put in place to reduce the socio-economic impacts of temporary or final closure. An updated version of this analysis and overview of management measures does not appear in the EIS Addendum.

INAC requested that this information be provided. In response, the Proponent outlines that the effects of the original assessment and existing mitigation is considered adequate to address this effect.

58.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Responding to the socio-economic impacts of a temporary or final closure is an issue of concern to Nunavummiut and communities. Given that the newly proposed development has a lengthened timeframe, these impacts may be greater than originally anticipated. Understanding how the Proponent evaluates these impacts, as well as having an understanding of proposed mitigation measures and management responses will enable reviewers to have a better understanding of how these impacts will be managed.

58.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: The Proponent did not provide an updated socio-economic assessment of the amended closure plan.

Disagreement with amendment proposal conclusions: INAC disagrees that the effects of the original assessment is sufficient to cover the proposed amendments, given that the Proponent now has experience and additional information from which to draw from.

Reasons for disagreement with amendment proposal conclusions:

INAC is of the opinion that an examination of the effects that may occur as a result of the changes to the Care and Maintenance phase within the proposed amendment (i.e. project employment went from an average of 282 in 2011 to 48 in 2013) is required. This information would be valuable in illustrating effects that mine closure can have on communities and could be used by the Proponent to update their management and mitigation plan in the event of a temporary or premature closure.

Given the increased length of the project being proposed, it is presumed that the socio-economic impacts of final closure would be greater than those originally anticipated, and thus would require a more robust plan and response.

If the socio-economic impacts of a temporary or final closure are not properly evaluated, and proper measures and management plans are not developed, there is a greater likelihood for negative socio-economic impacts arising from temporary or premature closure.

Recommendation/Request:

24.1 INAC requests that the Proponent include a section on the anticipated socio-economic impacts and effects of a temporary or final closure for the newly proposed development, including consideration of its lengthened timeframe. Furthermore, the Proponent should outline potential mitigation and management responses to a temporary or final closure based upon their own experiences and the experience of other nearby projects.

Conclusion: In the opinion of INAC, more confidence in the socio- economic effects analysis relating to the proposed changes to temporary and final closure is required.

58.6 TMAC RESPONSE

The effects assessment as it relates the anticipated socio-economic impacts of a temporary closure (e.g., Care and Maintenance) and final Closure phase of the Project will be reviewed in consideration of the results of the revised economic impact analysis (see GN-3 and INAC-22).

As part of mitigation, TMAC's engagement strategy includes regular communications with key government agencies (e.g., the GN Department of Community Services) to help keep these service providers well-informed regarding changes in the Project for planning purposes. In addition, TMAC's mitigation will include a Workforce Transition Strategy that would be implemented at Project Closure. The Strategy will be provided to the NIRB at a conceptual level prior to Project Operations and may be revisited at times during the Project to review and revised on an as needed basis. The main objective of the Strategy, based on adaptive management, is to support Project

employees in their transition to new employment upon closure of the facility. Measures will reflect industry best practices and may include: resources and support for employees to assess and characterize their skills and experience, identify new employment opportunities, and prepare for employment transition.

58.7 ATTACHMENTS

Not applicable

59. ID# INAC-25

59.1 SUBJECT

Inclusion of project amendment in the Doris North Socio-Economic Monitoring Committee

59.2 REFERENCE

Doris North Socio-Economic Monitoring Committee Terms of Reference

59.3 SUMMARY

In order to ensure that the amendment provisions are included in the socio-economic monitoring program pertaining to the project, INAC requests that specific reference to the amendment be included in the Terms of Reference for the Doris North Socio-Economic Monitoring Committee.

59.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Demonstrating adequate project monitoring is important for reviewers to ensure that project effects will be monitored and mitigated where necessary.

59.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue: Collaborative socio-economic monitoring of the updated project is important for monitoring, management and mitigation plans.

Disagreement with amendment proposal conclusions:

While the Proponent has outlined that the project will be subject to the existing Doris North Socio-Economic Monitoring Program, INAC requests that the Terms of Reference for the Doris North Socio-Economic Monitoring Committee be amended to include the proposal.

Reasons for disagreement with amendment proposal conclusions: Including the project amendment in the Terms of Reference for the Doris North Socio-Economic Monitoring Committee will give reviewers confidence that socio-economic monitoring will occur for the project that can be used for management and mitigation planning.

Recommendation/Request:

25.1 INAC requests that the project amendment be included in the Terms of Reference for the Doris North Socio-Economic Monitoring Committee. Specifically under "Scope" it is recommended that the following wording be added to the Doris North Socio-Economic Monitoring Committee Terms of Reference: "The monitoring program and this Terms of Reference shall apply to any project phase or development granted pursuant to Article 12, Part 8 of the Nunavut Land Claims Agreement and any additional Project Certificate Terms and Conditions established as a result."

59.6 TMAC RESPONSE

TMAC agrees that as the Doris North project changes by means of this Amendment, these changes should be reflected in the scope of our Socio-Economic Monitoring Program.

TMAC commits to drafting changes to the Terms of Reference for the Doris North Socio-Economic Monitoring Committee, widening the scope of the Monitoring Program for consideration of the Committee prior to the next meeting of the Committee.

59.7 ATTACHMENTS

Not applicable

60. ID# KIA-1

60.1 SUBJECT

TIA Expansion Capacity

60.2 REFERENCE

Package 1, Section 1.7.1; Package 6-13, Appendix B

60.3 SUMMARY

TMAC states "The Doris North Project and the Madrid/Boston (Phase 2) Hope Bay Belt Project are separate but related neighboring projects...To minimize overall project footprint and potential for impact, and to maximize the existing investment TMAC has designed the Madrid/Boston project to use facilities that already exist at Doris to the extent possible. However, it is important to note that the revisions to Doris facilities listed in this Amendment Application are in support of the Doris Mine itself. Additional changes will later be required to support the Madrid/Boston project, but any such changes will be outlined and permitted separately as part of the Part 5 review of the Madrid/Boston (Phase 2) Hope Bay Belt Project."

The current Tailings Impoundment Area (TIA) plan has been re-scoped in the amendment to use sub-aerial deposition designed to accommodate a greater volume of tailings than the originally permitted sub-aqueous deposition would have been able to hold within the current project footprint. It is unclear if this new shift to sub-aerial deposition would eventually require an even larger project footprint at the time of the Madrid and Boston (phase 2) project permitting. Does proceeding with this updated deposition strategy allow for the accommodation of the tailings generated from the expanded project? For example, alternative #5 presented in the Tailings Management Strategies Alternatives Assessment has the reported benefit of permitting a larger volume of tailings within a smaller footprint, [generating] an overall more stable landform unit. A smaller footprint would provide more space for future expansion.

60.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

60.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

KIA Request: Will the proposed sub-aerial TIA need further expansion if TMAC proceeds with phase 2? Can TMAC provide a discussion on the TIA's capacity to handle additional tailings from Doris North (if additional resources are discovered), and the

other proposed projects in the Hope Bay Belt (Madrid and Boston)? What will this expansion, if built, eventually mean to the final build out of the tailings disposal facility? Does it enhance or jeopardize the need for any further expansion?

TMAC Response: While the Doris facilities have the capacity to support use by future development in the Hope Bay Belt, the scope of the Amendment Application is limited to the Doris Mine. Consideration of future developments in the Hope Bay Belt and their associated impacts should be considered as either a separate application or a future amendment to existing licences, as appropriate. Accordingly, TMAC respectfully requests that the consideration of the use of Doris infrastructure in the Madrid, Boston and Phase 2 projects be considered in their respective regulatory processes.

Recommendation/Request:

We are concerned with the proponent's response. Consideration of future development in the Hope Bay Belt and their associated impacts should be included as part of the cumulative effects assessment for this application.

The NIRB defines a "regional study area" as: "The area within which there is the potential for indirect or cumulative biophysical and socio-economic effects" (Nunavut Impact Review Board. 2011. Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project (NIRB File No. 09MN003).) NIRB's requires that the significance of a project's interaction with the environment must consider "the potential for cumulative adverse effects given past, present and future relevant events" (Nunavut Impact Review Board. 2007. Guide to Terminology and Definitions).

The Madrid/Boston projects are separate but related neighbouring projects and would meet the NIRB definition of "future relevant events", as TMAC plans to develop the resources in the Belt in a series of phases, continuously producing mines over time. Approval of the TIA for this project may predetermine, to some extent, the location of future tailings management areas and it is reasonable to consider the cumulative foot print and land uses associated with the future expansion.

While Doris Mine is operating, TMAC plans to commence the permitting and development of the Madrid/Boston project (Project Description, Section 1.7.1). It is therefore reasonable, and a requirement under the NIRB's environmental impact statement framework, for TMAC to include the cumulative effects from all projects in this application.

60.6 TMAC RESPONSE

As per TMAC's KIA-9 response, TMAC remains of the view that the Phase 2 Project is the appropriate mechanism to fully consider the combined effects from Project components and activities at Doris, Madrid/and Boston. The use of the Tailings Impoundment Area (TIA) and discharge to Roberts Bay is one of several alternatives that will be presented. The Phase 2 DEIS will include a detailed assessment of the potential effects to Roberts Bay for this alternative.

TIA expansion capacity has and continues to be studied as part of a potential Belt-wide development. The TIA can readily accommodate additional belt wide tailings, far in excess of the currently permitted volumes. As part of the original tailings alternatives assessment for the project (SRK 2006; available on the NIRB and the NWB public registries), the TIA was recognized to have sufficient capacity to store the belt wide tailings, which at the time was assessed to be about 38 million tonnes.

References:

SRK Consulting (Canada) Inc. 2006. *Evaluation of Tailings Management Alternatives, Doris North project, Hope Bay, Nunavut, Canada*. Report submitted to Miramar Hope bay limited. Project number 1CM014.007. August.

60.7 ATTACHMENTS

Not Applicable

61. ID# KIA-2

61.1 SUBJECT

TIA Wildlife Attraction and Deterrence

61.2 REFERENCE

"Engineering Design Plans: Pk 6-Pt 7;

Section 6.3.1,Table 6-2, Page 41; Predicted Water Quality in the TIA;

Appendix A; Page A-1,Table A-1; WQ levels@ TL-1(located at the TIA discharge pump); and Appendix B; Figure B-1

61.3 SUMMARY

TMAC has changed the way in which tailings will be handled, and some tailings (floatation tailings) will be spread sub-aerially between the south Dam and a new Interim Dike, confining tailings to the southern limit of the TIA. Some water will cover a portion of the TIA to the north of this area;

Mean monthly background water quality concentrations of chloride at TL-1, measured at the TIA discharge pump, are estimated between 33 and 57 mg/L between June to October;

From 2015 to approximately 2022, chloride levels in the TIA are predicted to be above background water quality levels, reaching peak levels of> 100 to 200 mg/L (Figure B-1);

From 2023 to 2035, chloride in TIA will fluctuate above the background water quality levels, with peak levels above 100 mg/L (Figure B-1);

Chloride can combine with other molecules to form salts, including sodium chloride, calcium chloride, or potassium chloride, which may attractant northern herbivores such as caribou and muskox; and

We could not find estimates of salt levels in dry floatation tailings to be deposited sub-aerially. However, elevated salts in those tailings could also attract northern herbivores if above levels in the surrounding environment, and this problem could persist post-closure.

61.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Moderate:

Caribou and muskoxen may be attracted to the TIA water (or solid tailings and vegetation or soils dusted with solid tails), if mineral and salt levels are higher than ambient. This prediction is based on observations of previous researchers observing ungulate behaviours around other mines;

Attraction of caribou to this site could be problematic to caribou if it causes them to be exposed to higher metal loads (see KIA-2 for a discussion of metal exposure of wildlife from tail leaching). Attraction to the area could also be problematic if the tailings act as ""quicksand material"" to wildlife;

If caribou and muskoxen are attracted to the area, they may also increase their exposure to noxious stimuli associated with the mine while it is operational; and

More likely, issues may occur post-closure, when there is less mine activity to cause wildlife to avoid the area. After closure, caribou may dig at the 0.3 m of cover material to access tails, or they may access tailings materials where boils form through cover material, if the floatation tailings contain minerals that attract them. Feeding on sub-aerially deposited flotation tailings intentionally or unintentionally (e.g., if tailings spread and are dusted on plants and soils, or if leachates are taken up by vegetation), could lead to an increased exposure of wildlife to metals (see KIA-2).

61.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

1. Gap/Issue: In general, a consideration of the sub-aerial floatation tailings and tailings water as a potential attractant for caribou, muskoxen, and other salt- limited northern herbivores is warranted but absent from the application. Contingency measures for wildlife deterrence during operation and post-closure phases may be needed as part of the updated WMMP. A clear answer about chloride and mineral levels in floatation tailing to be sub-aerially deposited should also be provided (it was requested of TMAC during this technical review period).

2. Disagreement with amendment conclusion: It is difficult to accept that this change in tailings management will not potentially pose issues over the long term for wildlife, without first having in place a contingency plan for wildlife deterrence or other suitable mitigation around the TIA during all mine phases, in the case that wildlife is attracted to the area.

3. Reason for disagreement with proposal conclusion: Wildlife (particularly ungulates) are known to be attracted to areas with elevated chloride, as seen in other areas impacted by mining. Caribou in the Arctic have been observed to intentionally consume soil (geophagy), and water, snow, ice and tails with elevated salts due to their

need for minerals. Mineral/salt limitations often occur in spring due to reproductive demands combined with low-mineral foods being available in the winter. In the NWT, Heard and Williams (1990) reported the use of ice and mineral licks during the winter by caribou at four lakes where caribou were observed licking and gnawing on the ice. Other researchers have reported caribou behaving similarly around tailings facilities, where they may be attracted to higher levels of salt in tailings water and solid tailings. For example, caribou was observed in the abandoned Colomac mine drinking water or feeding on tailings. During the colder months, they were seen cratering through snow to access ice and tailings with higher levels of sodium chloride and calcium sulphate (MacDonald and Gunn, 2004). Results of a study by MacDonald and Gunn (2004) suggested that ca. 20% of the diet of caribou in the area around the abandoned Colomac mine were ingested tailings (and up to 50% in one individual);

Without a year- round adaptive management/deterrence plan to prevent wildlife attraction to the TIA, or to areas impacted by tails, a worst case scenario assessment would assume some degree of attraction and feeding in the area could occur, which could lead to population level impacts over the long term.

Recommendation/Request:

As part of an updated WMMP program, design a monitoring program and adaptive management plan, including clear thresholds, that will instigate the use of deterrents to keep wildlife from accessing TIA water, ice, and sub-aerial tails (including vegetation-dusted areas), during operation, closure, and post- closure periods. See also recommendations for KIA-2, which is related to this issue, but focuses on the potential for metal leachates. "

61.6 TMAC RESPONSE

The technical comment has requested information on whether the Tailings Impoundment Area (TIA) will contain salts at higher concentration than the surrounding vegetation and environment, and if so whether the TIA may be an attractant for wildlife. The technical comment then goes on to request that TMAC provide mitigation if the TIA acts as an attractant for wildlife during operations and closure.

It should be noted that sodium is the element that causes the "salty" taste in mammals, and that other similar elements also trigger the same sodium receptors, such as potassium and calcium, to produce a less intense "salty" taste. Each of these elements form a salt with chloride, and so the total concentration of salty-tasting compounds (NaCl, KCl and CaCl) can be found by looking at the chloride concentration.

A geochemical characterization of the local rock to be mined indicates that the concentrations of sodium, calcium, iron, phosphorus, and zinc are not elevated relative

to natural crustal abundance (Table 3.4 "Summary of Elevated Solid-Phase Elements", page 34, Document P6-14). However, some salt (typically calcium chloride and in some cases sodium chloride) will be added during the drilling process. Modeling indicates that the chloride concentrations in the tailings when deposited in the TIA will be approximately 390 mg/kg (Document P6-10 Table 6-2 "Predicted Water Quality in the TIA", page 41). This is higher than concentrations in the surrounding soils, where chloride concentrations in the upper 15 cm range from 11 to 270 mg/kg in the Doris North area. Hence, salts in the TIA may theoretically be an attractant to mammals.

It should be noted that the technical comment states that caribou have been observed licking salt at several mines in the Arctic, but only one example is given from the Colomac mine. The Ekati diamond mine has tailings, which are higher in salts compared to the predictions for the tailings at Doris North (Ekati: 4.5 to 6.5 dS/m compared to Doris North: 0.2 to 2.6 dS/m). Ongoing monitoring of tailings storage at the Ekati Long Lake Containment Facility has recorded caribou walking across the surface of the tailings, but has not recorded caribou ingesting Ekati Long Lake Containment Facility pond water or consuming tailings. Hence, the presence of salts in the TIA at higher concentrations than surrounding soils does not necessarily mean that wildlife will be attracted to the TIA.

To address any potential attraction of wildlife to the TIA, TMAC will conduct monitoring and adaptive management in the following steps:

1) TMAC will design and implement a monitoring program as part of the Wildlife Mitigation and Monitoring Plan (WMMP) to investigate if wildlife are using the site as a salt/mineral lick and will also include TIA dustfall monitoring as part of the Air Quality Monitoring Program.

2) If the outcome from the monitoring program indicates that wildlife are found to be consistently and in large numbers, using the site as a salt/mineral lick, or significant quantities of TIA dust are found to be deposited in the area, TMAC will conduct a risk analysis to determine if the ingestion of tailings or surrounding vegetation could produce health effects for large mammals.

3) If the analysis indicates a health hazard, TMAC will implement deterrent measures for caribou during the operations phase, which will be informed by discussions with the Inuit Environmental Advisory Committee (IEAC).

4) At closure, the TIA will have a 0.3m deep rock cover, creating a barrier from access to the TIA surface by large wildlife. Once suitable water quality is reached, the South Dam will be breached and natural water flow to Doris Creek will be established. As part of the closure plan, TMAC will monitor the integrity of the rock cover.

61.7 ATTACHMENTS

Not Applicable

62. ID# KIA-3

62.1 SUBJECT

TIA Floatation Tailings Dust Fall and Leaching

62.2 REFERENCE

"Environmental Effects and Mitigation, Pk 6, Pt 7

P6-12; Tailings Geochemistry; Section 4.3.1, Table 4.9, Page 24

P6-13; Tailings Management System Design

62.3 SUMMARY

TMAC proposes to deposit all detoxified cyanide leach tailings underground as part of the mine backfill. However, an estimated 2, 350, 000 tonnes of flotation tailings are proposed to be sent to the TIA, which exceeds the volume licensed to be deposited under water. Therefore, TMAC has proposed sub-aerial tailings deposition between the south Dam and a new Interim Dike, confining tailings to the southern limit of the TIA. Their preferred closure strategy is a dry cover (0.3 m over the tailings and breaching of the North Dam, which impounds the Reclaim Pond during the operational stage).

Long term humidity cell tests done on flotation tailings (to be sub-aerially deposited), indicated that after the initial flushing of the samples of contaminants of concern (of Arsenic, Lead, Phosphorus, Chromium, Copper, Selenium, Cadmium, Aluminum, Molybdenum, and Zinc) there was still an increased tendency for long term neutral pH metal leaching of arsenic from the Doris North flotation tailings, and of copper and lead from the central flotation tailings. If the tails spread, therefore, the risk of long term neutral pH leaching of these three metals would also increase, potentially leading to issues if caribou and other wildlife feed in the area, and particularly if they are attracted to feed directly on tailings (see KIA-1).

Copper can have a wide range of lethal and sub-lethal effects on invertebrates, plants, fish, birds, and mammals (reviewed in Eisler, 1998). Ingested lead is also a significant hazard to wildlife, as it can affect the central nervous system of animals and inhibit their ability to make red blood cells. Grazing animals are directly affected by the consumption of forage contaminated by airborne lead and somewhat indirectly by the up-take of lead through plant roots. Invertebrates may also accumulate lead at levels toxic to their predators (US EPA,1986). Finally, arsenic can have multiple toxic effects in wildlife and fish (reviewed in Eisler, 1988). Arsenic levels have been shown to accumulate in tissues in disproportionately bio-toxic forms (Bears eta/. 2006). Low levels

of arsenic have also been shown to impair the ability of fish to turn on genes needed to deal with environmental stressors, suggesting a very low dose mechanism of sub-lethal toxicity, which may occur across many species due to parallel mechanisms of stress-mediated gene translation (Bears eta/. 2006).

Table 3.41in Section 3.4.2, Pk 4,pt 2 identifies an area of 465.5 ha with the potential to be affected by dust fall from the TIA. Part of Ogama Lake and its connection to Doris Lake is included in the potential dust fall area. While Pk 6, pt 7, Section 6.3 presents mitigation plans to apply chemical dust suppressants, to use packed snow as a natural dust suppressant, and to use a water cannon as necessary to minimize dusting of surrounding vegetation by tailings, concerns remain about the potential for arsenic, copper and lead to leach from the solid tailings into the surrounding environment. Heavy winds, the mixing of tails with snow and ice and subsequent melting and spreading, logistical failures in the mitigation plan to adequately suppress dust in a timely manner, and the formation of boils through the 0.3 m of waste rock to be placed over the tailings on closure, could all lead to tailings spreading and long term leaching of these metals. In order to ensure that tailings dust mitigation is working, and leachates do not contaminate the surrounding environment, a strong monitoring program and adaptive management plan must be in place.

The wildlife effects assessment, Pk 4, pt 2, Section 3.5.1, page 3-15, cross references the Air Quality Management Plan provided in Package 5-1for more details on the dust monitoring programs to be implemented at site. However, Table 3-1of Package 5,pt 1indicates that the Tailings facility dust fall monitoring program is currently under development. The tailings facility dust fall monitoring section in the current certificate amendment application reads: ""A dust fall monitoring program will also be developed specifically to monitor dust mobilization and disposition to surrounding areas from subaerial tailings in the T/A. This program is currently in development and transects and specific sample locations are yet to be determined, but will include areas upwind and downwind of the T/A along a transect aligned with the prevailing wind direction. An update to this program will be included in the next iteration of this plan."

The details of this program will be of great relevance in providing assurance that unpredicted dusting of tailings will not occur over the short or long term and will not affect the surrounding soil, plants, water, land, fish, and wildlife. A strong tailings dust fall monitoring program will be critical in ensuring the new tailings facility is managed appropriately. The conceptual tailings dust fall monitoring program should be provided for review, ideally more than 3 months prior to the start of operation, as confidence in the current assessment ratings partially hinge on the presumed appropriateness of the final design of this program.

62.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

High:

If grazing animals are attracted to consume tailings, as they were in MacDonald and Gunn's (2004) report on caribou feeding in the area of the abandoned Colomac mine, or if sub-aerially deposited tailings become spread over the landscape beyond the extent predicted, unimpeded foraging in the area could lead to physiological problems due to arsenic, lead, and copper exposure; and

If the mitigation plans do not eliminate the spreading of tailings via wind deposition, or if they spread via mixing with water and snow and melting, tails may become distributed over vegetation, soils and within water in the surrounding landscape, impacting more vegetation, watercourses, and soils than predicted. This could impact wildlife, wildlife habitat, and other important receptors in the area.

62.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

1. Gap/Issue: The potential for tailings spread over the landscape and to leach contaminants (lead, arsenic, and copper) at a neutral pH over the long term increases the need for a wildlife risk assessment and mitigation or offset program to be tied into the results of a strong tailings dust fall monitoring program (currently under development by TMAC). Inclusion of details regarding how the tailings dust fall monitoring program will be linked to assessing impacts to wildlife habitat (soils and forage vegetation) and to wildlife risk and mitigation would fill this gap.

2. Disagreement with amendment conclusion: Without the details of a tailings dust fall monitoring program that can detect changes in wildlife forage contamination and wildlife risk over time, we cannot be assured that dust control mitigation (which can fail in effectiveness) and generic dust fall monitoring for tails will lead to the full protection of wildlife and wildlife habitat. The monitoring must also detect the spread of sub-aerial tailings and their leached metals over the long term into surrounding vegetation or soils, as this could lead to an increased risk to wildlife, particularly if caribou are attracted to the area (see KIA-1) or begin calving in or near the affected area again in the future. A review of the new management plans to be released 3-6 months prior to project operation and the updated WMMP will be required to determine whether we agree with the conclusions of TMAC in the present application.

3. Reason for disagreement with proposal conclusion: The issue of long term neutral pH leaching of arsenic, copper and lead from tailings, and the potential for tails to spread despite mitigation efforts, highlights the need for the development of a monitoring program that ties together tailings dust fall measurements, the spread of leachates into soils and wildlife habitat (which can occur via windblown dust, but also via mixing with and movement in melting snow), and wildlife contamination risk. Until the monitoring plan is available for review, and is shown to have these components, we cannot agree or disagree with the conclusions that the changes to the TIA management plan will not impact wildlife over the long term.

Recommendation/Request:

As suggested in KIA-2, we suggest that an adaptive management program be developed, which ties together monitoring and thresholds that will instigate a wildlife risk assessment, the use of deterrents to keep wildlife from accessing sub- aerial tails (including vegetation-dusted areas), or other suitable mitigation or offsets, during operation, closure, and post- closure phases;

We recognize that TMAC has committed to providing a revised Tailings Management Plan at least six months prior to the start of Operations, and a revised Air Quality Management Plan at least 3 months prior to operation, or before Sept 15, 2016. We suggest that one of these plans include a strong dust fall monitoring program for the sub-aerial tailings that is clearly tied to adaptive management triggers for wildlife and wildlife habitat protection. If dusting from tailings is found to extend beyond the potential area identified for the TIA, monitoring could trigger a wildlife risk assessment, an adaptive management plan (e.g. expanded wildlife deterrence program to prevent unhealthy levels of exposure to copper, lead and arsenic), monitoring of long term leachates in soils and vegetation, and/or habitat loss or wildlife loss compensation or offsetting programs; and

We suggest dedicating a technical session focusing on the proposed design of the sub-aerial tailings dust fall monitoring program during the upcoming Technical Meeting. We also suggest that a working group be founded to provide input on the design of this program from multiple stakeholders and disciplines that could be affected by tailings dust or leachates in various ways.

62.6 TMAC RESPONSE

In its correspondence dated November 12, 2015 to both the NIRB and the NWB, TMAC indicated that the Air Quality Management Plan would be revised 3 months prior to operations and the Tailings Management Plan generated 6 months prior to operations. There is also a commitment to updating and submitting a revised Wildlife Monitoring and Management Plan for April 2016.

The updated Air Quality Management Plan (AQMP) Revision #3 presented in the Amendment Application (Document P5-1) outlines mitigation measures and monitoring associated with dust and other air-borne emissions for the Doris North Project during construction and operation. This revision includes updating the current licensee to TMAC and including the subaerial tailings deposition and associated proposed mitigation and monitoring measures. The AQMP provides details of the six monitoring programs in place or planned at the Doris Project including:

- passive air quality monitoring;

- particulate monitoring;
- dustfall monitoring;
- construction dustfall monitoring;
- snow core dustfall sampling;
- tailings facility dustfall monitoring;
- incinerator stack emissions testing; and
- meteorological monitoring.

In order to address this potential issue, TMAC will follow several monitoring and management steps:

1. Dust will be monitored in the area surrounding the Tailings Impoundment Area (TIA). Table 1.2-1. ("Relevant Ambient Air Quality Standards for the Doris North Project", P5-1) outlines the current air quality thresholds for particulate monitoring (e.g. dustfall, TSP, $PM_{2.5}$, and PM_{10}) as well as NO_2, O_3, and SO_2. This monitoring would be coordinated with monitoring presented in the Tailings Management Plan and Wildlife Mitigation and Monitoring Plan.
5. The results of particulate monitoring will be compared to thresholds for fugitive dust identified in the Air Quality Management Plan.
6. Wildlife monitoring will also be conducted at the TIA to examine if caribou or other wildlife are foraging at the TIA.
7. If both the particulate monitoring exceeds thresholds and wildlife are foraging near the TIA, then TMAC will conduct a risk analysis to determine if the ingestion of tailings or surrounding vegetation could produce health effects for caribou.
8. If the health risk assessment indicates a caribou health hazard, TMAC will adaptively manage to reduce the potential effect. Options include enhanced dust management steps at the TIA to reduce dust generation and subsequent dustfall and implementing deterrent measures for caribou. The choice of adaptive management will be informed by discussions with the Inuit Environmental Advisory Committee (IEAC).

TMAC is committed to continuing an open and collaborative dialogue and is committed to also engaging regulators, intervenors and public in the development of these management plans.

TMAC would welcome an opportunity to have a focused discussion on monitoring associated with the TIA.

Furthermore, TMAC has carried out supplemental modelling to quantify the potential dustfall and distribution as a result of the subaerial tailings deposition as a means to

validate the conclusions of the effects assessment. Details of the dustfall modelling work (Appendix B GN-11 dustfall modelling memo) will be discussed during the Technical Meeting.

62.7 ATTACHMENTS

Appendix B: GN-11 - 1 Memorandum on the Potential Dustfall Associated with Subaerial Tailings Deposition at TMAC Doris North Project, Nunavut.

63. ID# KIA-4

63.1 SUBJECT

TIA Elevated Parameters of Potential Concern Upon Closure

63.2 REFERENCE

Package S-2, Section 6, Section 10.1; Package 6-10 Table 6-2, Appendix B

63.3 SUMMARY

Water quality in the TIA Reclaim Pond is arguably the biggest uncertainty identified to date, with potentially the largest impact on the closure cost and schedule. The water quality model will be updated and refined, as site water quality data becomes available." Modelling for different project phases has been summarized in Package 6-10 Table 6-2, providing mean and maximum concentrations of water quality parameters in the TIA until the end of the modelling period in 2035. The modeled monthly values are then graphed in Package 6-10 Appendix B which indicates chloride, arsenic aluminum, copper and iron will be elevated above the CCME WQG and above background concentrations at TL-2, the outlet from Tail Lake into Doris Lake.

While we agree "The comparison [between TIA water quality and CCME guidelines] is for reference purposes only as the CCME guidelines apply to natural watercourses, whereas the TIA is a designated tailings impoundment facility", once the North Dam is breached, water from the TIA will be in direct contact with the freshwater environment. At that point, CCME criteria would be a valid comparison.

TMAC provides a contingency stating, "In the case where water quality standards cannot be met by the end of the post-closure period specified in the water management plan, the monitoring time may be extended as required. Alternatively, water-treatment options could be explored once the cause of the · delay is known and quantified.

However, TMAC has neither discussed how elevated parameters in the TIA will impact Doris Lake, or Doris Creek during post closure, nor what treatment options are proposed or feasible if water quality standards are not met.

63.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

63.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

KIA Request: Please include a discussion on the impacts elevated parameters in the Tailings Impoundment Area (TIA) may have on freshwater quality once the North Dam has been breached, and what treatment options can be applied if water quality standards are not met and when they would be applied. The latter is particularly important, as no treatment has currently been proposed for the Project and we note that treatment of a high concentration waste stream at the time of generation is more feasible than treatment of tailings water at lower concentrations at a later date.

Please model the TIA discharge water quality assuming that process waters were treated prior to discharge to the TIA and how this would influence water quality at closure.

TMAC Response: The expected closure water quality in the TIA prior to breach of the North Dam is discussed in the Site-Wide Water and Load Balance Report (document P6-10). The current closure plan incorporates breaching of the North Dam once the TIA effluent quality meets closure objectives and the information presented within the application support this approach. An alternative assessment in the FEIS 2006 (SRK 2006. Water Quality Model, Doris North Project, Hope Bay, Nunavut, Canada. October) included consideration of treatment of TIA effluent prior to discharge to Doris Creek, however, in revisiting the mine plan and proposed Project components and activities, the proposed change to subaerial deposition reduces the effluent capacity within the TIA and separating the detoxified tailings (disposed underground) and the cleaner tailings (disposed in TIA) changes the effluent quality such that treatment prior to discharge is not needed. The only water quality parameters for which exceedances to CCME guidelines have been identified post closure in the TIA are aluminum, copper and iron. These exceedances are marginal at between 1.3 and 3.4 times background values. These exceedances are however within the TIA, which is a designated tailings impoundment. At the receiving environment compliance point in Doris Creek, downstream of the waterfall, the concentrations will be below CCME and therefore protective of aquatic life.

Recommendation/Request:

The Site-Wide Water and Load Balance model uses median monthly background surface water quality and median release rates from the humidity cell tests (to calculate the loadings from the exposed tailings beaches) as input parameters. Using median values, as opposed to 75th percentile concentrations, is not a conservative approach and may underestimate the predicted TIA quality, thereby underestimating potential effects to surface water quality and aquatic life in Doris Creek and Roberts Bay. Since no additional treatment has been proposed, we request that TMAC predict

TIA water quality under enriched conditions, using 75th percentile background concentrations for input parameters.

63.6 TMAC RESPONSE

TMAC believes that the assumptions used for the Water and Load Balance is representative of the most likely site conditions. Furthermore, as illustrated there is considerable conservatism built into the Tailings Impoundment Area (TIA) discharge strategy including holding water in the TIA with sufficient lead time to implement water treatment should that be necessary. None the less, TMAC will run a sensitivity analysis of the Water and Load balance using the 75th percentile for background concentrations and other input source terms. These results will be prepared for presentation at the Technical Meeting in Cambridge Bay in January 2016.

63.7 ATTACHMENTS

Not Applicable

64. ID# KIA-5

64.1 SUBJECT

TIA NPAG Tailings Cover Depth

64.2 REFERENCE

Package 5-2 Section 3.7; Package 6-10, Section 4.2.6

64.3 SUMMARY

TMAC indicates, "At the end of operations the tailings area in the TIA will be closed by construction of an isolation cover, consisting of a single layer of non-acid generating quarry rock. Most of the contaminated water retained in the Reclaim Pond will be pumped through the Roberts Bay Discharge System for undersea discharge. The pond will then be allowed to re-flood naturally to pre-disturbance levels (elevation 28.3 masl). The North Dam will then be breached to re-establish the natural drainage path through an engineered spillway structure."

The "single layer" is later defined as "0.3 m of quarry rock." However, no rationale as to why 0.3 m of quarry rock is sufficient to cap the tailings beach is provided and 0.3 m is not sufficient depth to allow the establishment of a stable permafrost cap.

64.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

64.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"KIA Request: Please provide an assessment as to why 0.3 m of quarry rock is an acceptable depth of cover for the subaerial tailings area and beach given other mines in Nunavut have used up to 3 m of non-acid generating rock (NAG) to cover their tailings.

TMAC Response: The tailings have been classified as non-acid generating with potential for neutral metal leaching. A source load associated with the tailings has been developed and incorporated into the site wide water and load balance model [Document P6-10]. The model indicates that the design of the tailings cover does not need to reduce water infiltration or oxygenation as contamination of surface or subsurface waters are not predicted. Based on these results, TMAC believes that all of the information needed for the review is included in the Application. The design of the final cover will be provided to the NWB prior to its construction.

Recommendation/Request:

The model used to predict the source load from the tailings uses median release rates from the humidity cell tests (to calculate the loadings from the exposed tailings beaches) as input parameters. Using median values, as opposed to 75th percentile concentrations, is not a conservative assessment, does not consider the full range of conditions and may underestimate predicted contaminant release from the TIA, thereby underestimating potential effects to surface water quality and aquatic life in Doris Creek and Roberts Bay.

1) Predict TIA water quality under enriched conditions using 75th percentile concentrations for input parameters.

2) Please use the results of the requested calculations to assess if a 0.3 m is still adequate to cap the TIA.

64.6 TMAC RESPONSE

TMAC believes that the assumptions used for the Water and Load Balance is representative of the most likely site conditions. Furthermore, as illustrated, there is considerable conservatism built into the Tailings Impoundment Area (TIA) discharge strategy including holding water in the TIA with sufficient lead-time to implement water treatment should that be necessary.

None the less, TMAC will run a sensitivity analysis of the Water and Load balance using the 75th percentile for background concentrations and other input source terms, including a recalculated tailings beach source term using the more conservative 75th percentile concentration leach rates from the humidity cell tests. These results, along with a discussion of cover thickness suitability, will be prepared for presentation at the Technical Meeting in Cambridge Bay in January 2016.

64.7 ATTACHMENTS

Not Applicable

65. ID# KIA-6

65.1 SUBJECT

Roberts Bay Discharge and AEMP Monitoring

65.2 REFERENCE

"Environmental Effects and Mitigation, Package 4, Part 7;

Section 4.5.8.1, Page 4-65 (Aquatic Effects Monitoring Program)

65.3 SUMMARY

"In this section of the application, TMAC states that:

""There is currently an approved (by Environment Canada and the Nunavut Water Board) AEMP in place for the Doris North Project, with two near-shore sites in Roberts Bay and one reference site in Ida Bay. TMAC is intending to modify the monitoring in Roberts Bay to include the geographical area of the proposed diffuser and potential area of influence of the TIA effluent and groundwater. An additional deep-water marine reference site will also be included. The final marine AEMP sites will be determined in consultation with Environment Canada and with due consideration of the requirements of the Environmental Effects Program as required under the Mining and Metals Effluent Regulations...The marine portion of the current Doris North AEMP monitors water quality, dissolved oxygen, sediment quality, phytoplankton biomass, benthic invertebrates, and marine bivalves. The proposed new monitoring locations could be adjacent to the proposed diffuser location {100m) and seaward of the proposed diffuser location, perhaps half way between the southern shoreline of Roberts Bay and Melville Sound. The frequency dissolved oxygen, and phytoplankton biomass. Sediment quality and benthic invertebrates are sampled one time per year during the summer. Marine bivalves are sampled one time every three years. The final monitored endpoints and frequency for the modified plan will be determined in consultation with Environment Canada."

While we understand that sampling locations will be added to the AEMP, the former frequency and seasonality of approved sampling also needs to be updated to protect wildlife (and other receptors) as it is not likely to be sufficient given project changes, the wildlife species observed in Roberts Bay, and the potential for modeling errors that monitoring data will serve to test.

65.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Moderate:

The impact assessment contains many assumptions derived from modeling. Assumed patterns need to be tested in a way that will allow for rapid feedback between field monitoring data and adaptive management to ensure that no environmental damage due to water or sediment quality deterioration occurs, and ultimately to protect marine wildlife, fish, and other receptors."

65.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"1. Gap/Issue: The additional AEMP monitoring changes should expand sample locations for diffuser outfall monitoring (as TMAC has indicated they will do in the updated AEMP), and should increase the frequency of sampling near the diffuser, including sampling of marine sediments and wildlife dietary items such as bivalves.

2. Disagreement with amendment conclusion:

We agree with TMAC that new inputs into Roberts Bay will not likely harm marine wildlife, if model assumptions hold true. However, we recognize that there are many points at which the models could fail to accurately predict circulation patterns and upwelling in Roberts Bay correctly in the future (i.e., recognized uncertainty). Therefore, non-significant impacts of the project may rely on the quality of the updated AEMP, which should include more sites, and more frequent water quality, sediment, and bivalve monitoring in areas associated with maximum diffuser impacts will be critical for managing this process and protecting wildlife and other marine resources, and is considered needed to guarantee a non-significant impact. It is therefore difficult to agree with the non-significant impact prior to seeing the detailed changes in the AEMP. Therefore, agreement or disagreement with the conclusions of TMAC regarding impacts of the updated project on marine wildlife in Roberts Bay must be reserved until the details of the updated AEMP are made available for review.

3. Reason for disagreement with proposal conclusion:

Assumptions regarding seasonal flushing of contaminants from Roberts Bay into Melville sound rely on seasonal deep and surface water circulation patterns, temperature stratification, and wind patterns derived from data previously collected in Roberts Bay. Models applied to predict water quality in Roberts Bay assume that past patterns will largely represent future conditions. However, there are factors that could impact the circulation patterns in Roberts Bay that could change during the life of the project. For example, the area may experience a change in Arctic Oscillation mode, climate change may impact circulation patterns, and subsea permafrost melting and associated gas upwelling may occur (for example, as coastal permafrost beneath the

Arctic ocean has started to melt in other locations, such as off the Eastern Siberian Arctic Shelf and Alaska, plumes of methane gas and carbon dioxide are being released from the ocean floor). As these factors are difficult to predict, frequent monitoring at appropriate locations will be critical to ensure that assumptions made for the discharge water modeling continue to hold over time, and to ensure that changes to the discharge regime can respond to monitoring results in a time frame that will protect wildlife and dietary items of wildlife.

At present, marine AEMP sampling for water quality, dissolved oxygen, and phytoplankton biomass occurs four times a year. To allow for adaptive management, the new AEMP monitoring locations to be added near the subsea diffuser should be monitored far more frequently (at least monthly). We also recommend that sediment be sampled near the diffuser at least twice a year (once during the winter when the water is most stagnant), and that marine bivalves in the diffuser's ZOI be sampled annually, rather than once every 3 years, due to their importance in diet of the long-tailed duck, red-throated loon, yellow- billed loon, common loon, Pacific loon, common eider, king eider, and Tundra swan. All of these species were observed in Roberts Bay (Pk 4, Pt 7,Section 4.4.3, Table 4.4-5, p. 4-43). Bivalves are also very important in the diet of bearded seal and are a smaller component of the diet of ringed seal."

65.6 TMAC RESPONSE

1. Further to the response provide to ECCC-8, TMAC notes that the sampling frequency and parameters of the existing AEMP reflect the Canadian MMER EEM requirements. The AEMP Program is also overlain by substantial additional confirmatory sampling required under both the Water Licence and the MMER, and which allows rapid on-the-ground feedback into adaptive management. This additional monitoring includes daily (under the Water Licence Surveillance Network Program (SNP)) and monthly (under MMER) monitoring of effluent discharge quantities, as well as weekly, monthly, semi-annual, and annual monitoring of effluent discharge concentrations (under both the Water Licence and MMER). Altogether, monitoring under the SNP, the EEM and the AMF will provide early detection of, and allow rapid response to, any changes observed in the aquatic environment, and is therefore considered to be protective of human and wildlife receptors. Nevertheless, consideration of sampling location, frequency and media will be added to the AMF Working Group mandate.

2. TMAC supports the effects assessment conclusion wherein no significant effect to marine wildlife is expected. Assessment conclusions will be verified through the collection of AMF and SNP samples. Assessment conclusions are based on maintaining a compliant discharge to Roberts Bay. In the event that operational and discharge monitoring indicates a non-compliant discharge, TMAC will implement contingency measures for non-compliant effluent management (refer to response to AANDC TC-6). Further, designing and implementing an Aquatic Monitoring Framework, which includes a Response Framework, addresses unexpected environmental concerns should they

arise. A suitably designed and implemented AMF is protective of the aquatic environment and, by extension, is also protective of wildlife receptors.

3. TMAC is confident in the suitability of the modelling provided with the Application. Consideration of climate change in relation to the water and load balance model is addressed in TMAC's response to technical comment KIA 11B. To further support the modelling conclusions drawn, TMAC will be conducting 3-dimentional plume modelling, with preliminary results being made available to Parties during the Technical Meeting.

TMAC recognizes that there are requirements for aquatic monitoring in place under the MMER EEM program as well as the SNP associated with 2AM-DOH1323. TMAC is open to consideration of additional sampling as part of the Working Group discussion, proposed for March 2016.

65.7 ATTACHMENTS

Not Applicable

66. ID# KIA-7

66.1 SUBJECT

Potential Interaction with Marine Environment

66.2 REFERENCE

Package 2, Section 3.6.2; Package 3; Package 4,Section 2.5.1,Section 3.4.1; Package S-3, Section 4; Package 6-10,Section 2.2, Section 7

66.3 SUMMARY

"TMAC provides the following potential interactions with the freshwater aquatic environment resulting from the proposed Project changes:

"Potential alteration of Doris Lake outflow;

Changes in surface water quality from runoff water from proposed expanded laydown area and ore storage pad;

Reduction in or alteration of habitat (changes in flow) through water losses; and Removal or alteration of aquatic habitat for infrastructure, including culvert construction."

We note several additional potential interactions the project may have with the freshwater environment:

Saline groundwater will be a significant water quality and quantity management issue under the proposed changes to the project; peak groundwater inflow has been modelled at 3000 m^3/day and the proposed disposal method is ocean discharge. However, little discussion of how TMAC will handle saline groundwater in the event of prolonged diffuser and/or related infrastructure failure is provided. TMAC only indicates that "intercepted groundwater inflows will be stored in the underground sumps and pumped to the Pollution Control Ponds for Temporary Management or to the TIA."

The impact of fugitive dust to surface water quality has not been assessed as a potential impact to water quality. "Subaerial tailings have the potential to generate fugitive dust emissions..." as does vehicular traffic. While we acknowledge "there are proven mitigation measures that will be incorporated in tailings management to reduce emissions from the tailings" we still stress the importance of this pathway as a potential influence to the freshwater environment. We also acknowledge that magnitude of this pathway is reduced as compared with open pit mining.

The freshwater environment will also continue to be directly influenced by water from the TIA "in 2015 and 2016 (Years -2 and -1}" as well as after the North Dam has been breached and the natural flow from Tail Lake has been re-established.

66.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

66.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

KIA Request:

Ia) Please provide an analysis of alternatives for disposal of saline groundwater and a contingency plan should problems arise with the diffuser, marine outfall mixing box, or water transport infrastructure (pipeline) preventing ocean disposal of saline groundwater and please provide volume estimates of short-term storage availability in the event of a failure. If TMAC has insufficient short term storage capacity or treatment capacity, if required, for saline groundwater in the pollution control ponds or TIA and needs to discharge excess water to the freshwater environment or to the nearshore marine environment, an evaluation of environmental impacts to freshwater quality or the nearshore marine environment associated with the proposed saline water management should be addressed.

Ib) Please provide an assessment of variance in the range of volume and concentrations of saline groundwater to be managed.

2) Please include an assessment of the impacts on water quality of fugitive dust stemming from the nearby transportation routes and sub-aerial tailings deposition.

3) Please provide an assessment of the impacts water from the TIA will have on

Doris Lake and Doris Creek when an intentional connection has been established from the waterbody (i.e.: prior to operations and after the North Dam has been breached). (Please also see KIA-TMAC-2.10).

TMAC Response:

1a) Groundwater will not be treated but managed as discussed in document P6-6 (Roberts Bay Discharge System Water Management Options) submitted as part of the application package. The management scheme is based on collecting the groundwater in the underground workings and reusing for drilling;

Excess groundwater will be pumped to the surface and discharged to Roberts Bay via a pipeline and diffuser. In the event that the saline groundwater cannot be discharged to Roberts Bay, mine water would be stored in the mine on a temporary basis. Once the

matter has been resolved discharge to Roberts Bay would resume. Discharge to the surface freshwater environment will not occur.

1b) The range of effluent volumes and concentrations of saline groundwater is presented in application document P6-6 (Roberts Bay Discharge System Water Management Options) and document P4-1Section 4.5.2.

2. Dust and effects to the environment is included in the application document 4 (Environmental Effects Assessment),Section 3.0. Dust will be generated due to project activities, however, the fugitive dust along road corridors was part of the

2006 FEIS and included in current authorizations with an associated Air Quality Monitoring and Management Plan. The change from subaqueous to subaerial tailings deposition will also result in dust generation, however, with design and mitigation measures dust generation will be minimized and no residual effects are anticipated including effects to surface freshwater.

3. Construction of the North Dam was completed in 2012. Catchment water in the Tail Lake outflow channel downstream of the dam are from the remaining natural catchment downstream of the dam. The system represents natural baseline conditions prior to operations and does not need assessment. At closure, the North Dam will not be breached until the TIA water quality is such that it will meet closure objectives. Treatment is currently not identified as being needed with discharge of excess TIA effluent directly to Roberts Bay via pipeline/diffuser. This discharge will be maintained until the TIA effluent meets discharge requirements for freshwater and the North Dam can be breached.

Recommendation/Request:

1a) This response is adequate when cognisant of TMAC's response to KIA-TMAC-2.4 indicating the capacity of the TIA to manage effluent. We consider this issue resolved.

1b) We disagree with TMAC's assessment that section 4.5.2 of Package 4-1or Package 6-6 provides the requested information. While TMAC has provided the peak volume of saline groundwater that will require management, they have not provided any assessment of the variance around this value. Should this value be associated with a high degree of variance, TMAC may have less volume with which to dilute effluent from the TIA during discharges to the receiving environment resulting in a change to the mixing zone in Roberts Bay (also see KIA-TMAC-2.3). Alternatively, TMAC may have a greater volume to discharge under ice to Roberts Bay which may result in differing salinity in the receiving environment from the predictions presented in this amendment application.

We further stress this request given the following differences between seawater in the receiving environment and the saline groundwater from the site. Note this comparison is based on maximum reported seawater concentrations in Roberts Bay as reported by TMAC in Package 4, Section 4.3.7 in Table 4.3.1, and the 95th percentile of groundwater concentrations from Table 4-2 in Section 4.2.3 of Package 6-10:

- Hardness- The 95 percentile in the groundwater is 2x the maximum concentration in Roberts Bay
- Ammonia- The 95 percentile in the groundwater is 22x the max of sea water
- Nitrate- The 95 percentile in the groundwater is about 3x higher than the max of sea water
- Total phosphorus- The 95 percentile in the groundwater is about 17x higher than the max of sea water
- Calcium -The 95 percentile in the groundwater is about 5.5x higher than the max of sea water
- Iron -The 95 percentile in the groundwater is about 7x higher than the max of sea water

2) This response regarding dust generation is adequate. We are also pleased with TMAC's statement in response to KIA-TMAC-2.8 that a dust fall monitoring station will be relocated southeast of the TIA in line with the prevailing winds of the project area.

3) In the Water Management Plan (Module A), section A5.3 TMAC states that once water quality in the TIA meets Doris Creek water quality guidelines, the North Dam in the TIA can be breached and flow resorted to Tail Lake Outflow. Provided the Doris Creek guidelines are those presented in Table A4 of the report, we are satisfied with this response.

66.6 TMAC RESPONSE

Discharge of mine water to the ocean will be done at a constant rate of 3,000 m^3/day as described in Documents P6-6, Roberts Bay Discharge System: Water Management Options and P6-8, Roberts Bay Discharge System: Pump and Pipe Requirements. If there is less than 3,000 m^3/day of inflow, water will be retained in the underground mine sumps until there is sufficient water in the sumps to allow the pump to operate at a rate of 3,000 m^3/day for a period of at least 6 hours. The underground mine sumps have been sized accordingly.

The design rate for the pump and pipeline is 13% greater than the maximum design inflow rate of the mine of 2,650 m^3/day as described in Document P6-3 Groundwater Inflow and Quality Model. This was done intentionally to provide an added factor of safety.

A sensitivity analysis around variability of mine inflow rates was carried out as part of the Groundwater Inflow Model and the results are presented in Table 11 of Document P6-3. Variability of the groundwater quality was also considered in the modeling inputs as indicated in Table 5 of Document P6-3. From the subset of between 19 and 29 individual water quality samples, the 75th percentile value was used as the baseline groundwater quality.

The total mine inflow is the combined inflow of Doris Lake water and groundwater. The ratio of lake water to groundwater is presented in document P6-3, and typically is about 30% groundwater to 70% Doris Lake water. The water quality reaching the Marine Outfall Mixing Box has conservatively been assumed to be equal to the 95th percentile water quality of the blend of groundwater (i.e. 30% of the 75th percentile value from the samples mentioned earlier) and the median Doris Lake baseline water quality as presented in Table 4-2 of Document P6-10, Site Wide Water and Load Balance. Since the flow rate of discharge to Roberts Bay is constant at 3,000 m^3/day, and the 95th percentile water quality from the mine represents the upper bound of water quality that would be discharged to Roberts Bay, TMAC believes that the assessment presented in the application is conservative. A presentation of the variability of water quality would only represent water quality of a lower concentration, and therefore any environmental effect would be less than already presented.

66.7 ATTACHMENTS

Not Applicable

67. ID# KIA-8

67.1 SUBJECT

Mixing Zone Delineation

67.2 REFERENCE

Package 2, Section 3.6.2, Package 6-6 Section 5

67.3 SUMMARY

"TMAC states: The proposed discharge criteria for the water from the TIA will be MMER limits in the discharge system and CCME Guidelines within Roberts Bay. Water quality modelling results show that the TIA discharge water quality would be in compliance with these criteria under a wide range of conditions without the need for additional water treatment."

The distance designated as the "mixing zone" is not outlined. TMAC only states the "end of pipe discharged water quality for all three scenarios was determined to be below MMER limits (MMER 2015)... [and] To meet the CCME water quality guidelines within the marine environment mixing zone, a 20:1dilution (i.e. 20 parts seawater to 1part discharge water) would need to be achieved."

67.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

67.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"KIA Request: What is the distance from the diffuser at which CCME water quality guidelines will be met in Roberts Bay (i.e.: what is the size of the mixing zone)? Please demonstrate how the 20:1dilution will be achieved. Please provide modeling results for all three discharge scenarios (groundwater only, groundwater and TIA, TIA only) in both the open water season when full exchange with Melville Sound is expected and under ice when the water exchange is negligible. We note these seasonal differences specifically as they were highlighted by TMAC in Package 2.

TMAC Response: Dilution will be achieved rapidly given the pumping and small portals. Of the Canadian Council of Ministers of the Environment (CCME) metals in effluent, maximum predicted chromium concentrations (0.0062 mg/L; Table 4.5-3, document P4-1) will require the greatest dilution to meet CCME guideline levels (0.0015 mg/L; Table 4.5-1, document P4-1) in the receiving environment of Roberts Bay (baseline: 0.001mg/L;

Table 4.5-2, document P4-1), in this case a 9.2:1dilution. This will be reached within 1 m of the diffuser portals, and given this parameter requires the greatest dilution, the 'CCME mixing zone' will be 1 m. Modeling results for the 3 requested scenarios during summer and winter can be provided during the technical review portion of the Amendment review process.

TMAC's approach in the effects assessment (P4-1,Section 4.5.2) of deriving water quality targets for Roberts Bay and comparing predicted effluent concentrations (for all three discharge scenarios) is not sufficient to evaluate the effects of the project. This approach does not determine the size and properties of the mixing zone where water quality will be above CCME guidelines.

We request that TMAC model the mixing zone (using effluent chemistry) for all three discharge scenarios (groundwater only, groundwater and TIA, TIA only) in both the open water season and under ice using effluent chemistry. This is important because cadmium and copper are predicted to be above the CCME marine quality guidelines in the groundwater and TIA mixed effluent, and mercury in the TIA effluent (Water and Load Balance, Table 6-3). In addition, 75th percentile baseline concentrations (Robert's Bay, effluent concentrations) should be used as input to the model, to predict water quality under slightly enriched conditions.

In addition, total mercury predictions for groundwater and TIA effluent, and TIA effluent should be included in the effluent predictions. High detection limits in the source terms do not negate the need to predict concentrations in the effluent and the receivers. Data from other studies and sites can be used in the model, while additional sampling and analysis (at low detection limits) is being completed. The model can be refined and updated, once site-specific data becomes available.

67.6 TMAC RESPONSE

Dilution zones in Roberts Bay resulting from the passage of the Tailings Impoundment Area (TIA) and groundwater through a diffuser were modelled using the US EPA's VISUAL PLUMES program. This modelling application is capable of simulating single submerged plumes from diffuser systems in stratified ambient waters, and predicts several plume characteristics such as the dilution, rise, and size of effluent plumes. Each of the TIA+groundwater (7,000 m^3/d for 4 months, 3,000 m^3/d for 8 months), TIA only (4,000 m^3/d, 4 months only), and groundwater only (3,000 m^3/d for 12 months) discharge scenarios were modelled under a series of effluent salinities (0‰, 11‰, 25.8‰). Results showed that dilutions of 100:1 were consistently predicted to occur within 5 m of the diffuser.

TMAC acknowledges that cadmium, chromium, and mercury are predicted to have maximum concentrations above marine Canadian Council of Ministers of the Environment (CCME) guideline levels in the TIA + groundwater effluent; however, these concentrations will only be 2-3 times that of their respective guideline before entering Roberts Bay and are predicted to be diluted by upwards of 100:1 within 5 m of the diffuser. Given that the maximum predicted dilution required to meet CCME guidelines for all parameters is below 6:1 (mercury based on maximum undetectable concentration of 0.0001 mg/L), it is expected that the resulting plume will meet CCME receiving water criteria very close to the diffuser. Furthermore, the maximum predicted effluent concentrations and discharge rates will occur during the open-water season, with the resulting plume expected to be fully flushed from the deep waters (20 m to seafloor) within 2 to 3 weeks (Rescan 2012). This indicates that the water quality in Roberts Bay is predicted to be safe for marine life during the operation of the Roberts Bay Discharge System.

Water quality predictions in Roberts Bay have been updated for each of the TIA + groundwater, TIA only, and groundwater only discharge scenarios, including results using the elevated mercury detection limits (0.0001 mg/L) from the TIA water (see attached memorandum Appendix B: KIA-8 - 1). TMAC will further update these results using three-dimensional hydrodynamic modelling to simulate mixing zones, plume movement, and predict water quality concentrations (CCME parameters) for each of the three discharge scenarios over the Project phases. Using 75th percentile baseline water quality concentrations will be considered for the hydrodynamic modelling.

Reference:

Rescan. 2012. *Doris North Gold Mine Project: 2011 Numerical Simulation of Roberts Bay Circulation*. Prepared for Hope Bay Mining Limited by Rescan Environmental Services Ltd.

67.7 ATTACHMENTS

Appendix B: KIA-8 - 1 Response Memo to Kitikmeot Inuit Association (KIA) for Technical Comment KIA-8

Appendix B: INAC-4 - 1 Validation of Groundwater Quality Predictions

68. ID# KIA-9

68.1 SUBJECT

Consideration of future development in the Hope Bay Belt

68.2 REFERENCE

Package 4, Figure 4.5-1, 4.5-2, 4.5-3

68.3 SUMMARY

All parameters of potential concern in the referenced figures show increasing concentrations in Roberts Bay year over year due to effluent discharge. TMAC indicated that water in Roberts Bay was totally exchanged with Melville Sound during the open water months. We further note that all of these parameters (Nitrate-N, salinity arsenic, cadmium, chromium, mercury) are very close to or above their respective CCME WQG after 6 years of production for what appears to be up to a month.

68.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

68.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

KIA Request: Please provide a discussion of why concentrations are increasing year over year despite annual full exchange with Melville Sound. Please clarify maximum concentrations that are expected after 6 years.

Please provide a discussion of how CCME water quality criteria in Roberts Bay will be met if TMAC proceeds with Phase 2 of the project given that effluent will continue to be discharged to Roberts Bay.

TMAC Response: See response#3 to IR KIA-32 regarding increasing concentrations in Roberts Bay despite full annual exchange. TMAC appreciates the reviewer's comment but Phase 2 is beyond the scope of this Application and so is therefore not appropriate to be discussed herein.

Recommendation/Request:

We disagree with the proponent's response. Consideration of future development in the Hope Bay Belt and their associated impacts should be included as part of the cumulative effects assessment for this application (see our response to KIA-1). The location of Phase 1 infrastructure predisposes, to some extent, the location of future infrastructure.

The Madrid/Boston projects are separate but related neighbouring projects, and TMAC plans to develop the resources in the Belt in a series of phases, continuously producing mines over time. While Doris Mine is operating, TMAC plans to commence the permitting and development of the Madrid/Boston project (Project Description, Section 1.7.1). It is therefore reasonable, and a requirement under the NIRB's environmental impact statement framework, that TMAC includes a discussion of how the effluent from Phase 2 of the project will affect Roberts Bay in this application and to assess feasible means to maintain water quality in Roberts Bay under an expanded discharge scenario. Phase 2 expansion is a reasonably foreseeable project.

68.6 TMAC RESPONSE

As KIA has noted, TMAC is currently planning the Phase 2 Project (activities and infrastructure associated with mining of the Madrid and Boston areas for which NIRB has issued EIS Guidelines (NIRB December 2012). Various alternative approaches to the management of water associated with mining and the processing of ore from Madrid and Boston are currently being evaluated and studied. However, at present the detail of the Phase 2 Project is not sufficiently advanced to permit TMAC to provide a meaningful detailed "discussion of how the effluent from Phase 2 of the project will affect Roberts Bay in this application and to assess feasible means to maintain water quality in Roberts Bay under an expanded discharge scenario".

However, the use of the existing TIA and discharge to Roberts Bay is one of several alternatives that will eventually be presented in the Phase 2 Environmental Impact Statement (EIS). The Phase 2 EIS will include an assessment of the potential effects to Roberts Bay for this alternative and will include consideration of potential cumulative ecosystem and socioeconomic effects that could result from the impacts of the Phase 2 Project combined with the amended Doris North Project and other past, present and future projects (including the Madrid Advanced Exploration Project).

The Type B water licence application for the Madrid Advanced Exploration Project is required to support activities necessary to inform the planning of the Madrid Project under Phase 2. While TMAC has not identified any changes that are required to the Type A water licence as a result of the advanced exploration project planned for Madrid, further details regarding the interactions between Doris North and the Madrid Advanced Exploration Project will be presented at the Technical Meeting to be held in January 2016. These details will be intended to address the reviewers' comments regarding potential cumulative effects between these 2 projects.

68.7 ATTACHMENTS

Not Applicable

69. ID# KIA-10

69.1 SUBJECT

Hydrogeology

69.2 REFERENCE

"Package 6 Engineering and Design Documents

P6-3 Groundwater Inflow and Quality Model (SRK, 2015) Package 4, Section 2"

69.3 SUMMARY

"The primary objectives of the Groundwater Inflow Modeling work undertaken by SRK (2015) was to predict the Doris Mine groundwater inflow rate and quality over the life of the mine, to provide input to the site water balance, and to inform engineering on the site water management plan. The results of the groundwater model were ultimately used to predict the 0.23 m decrease in Doris Lake surface water levels, and corresponding delay in outflow timing and volumes from the lake.

Results of the Doris Mine groundwater model (SRK, 2015) suggest that mine inflow will increase to a maximum of 2,650 m^3/day, decreasing when some sections of the mines are completed and sealed off from other areas of active mining. By year 6 (completion of mining), the total inflow to · the mine is predicted to be about 1,630 m^3 /d. About 70% of the mine inflow is associated with water from Doris Lake with the remainder coming from deep regional groundwater.

TMAC has requested a 3,000 m^3/day maximum water taking, suggesting an approximately 13% factor of safety for mine inflow rates.

Sensitivity analysis suggests that the predictions of inflows are sensitive to the hydraulic conductivities of volcanic rock and lake bed sediment. For example, changing the hydraulic conductivity values used in the model by 1order of magnitude for the lake bed sediments results in a 2.9 times increase in inflow from Doris Lake.

The modeling work according to SRK (2015) assumes that "the groundwater management plan will include active control measures such as advance probe drilling and pre-grouting of highly conductive structures prior to intersection with the mine workings, and additional pumping capacity to handle potentially higher than predicted inflows and may also need to consider ongoing assessment of where and how bulkheads and backfill are used."

TMAC has indicated in review meetings that groundwater withdraw/dewatering cannot exceed 3,000 m^3/day, regardless of the mine inflow rates. Engineering solutions, including abandonment, were suggested as options to manage any increase in mine inflows. "

69.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium

69.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"1) Further characterization of local heterogeneity for important hydrogeologic features (e.g., thickness and hydraulic conductivity of indurated lake bed sediments; major structural characteristics of volcanic rocks including anisotropy of K, etc.,) would ideally provide more confidence in the predicted mine inflow rates. For example, there are only two samples for the indurated lake bed sediment. Given the very low K used for the indurated lake bed sediments in the model it is expected that this unit may play a significant role in controlling the mine inflow from Doris Lake. However, it is recognized that TMAC has restricted mine dewatering to 3,000 m^3/day, regardless of whether further studies indicated higher mean hydraulic conductivities for those sediments.

2) Given the range of measured Kvalues shown in the report, and in the absence of additional field data, additional sensitivity simulations would ideally be performed which increase the K values of each of the two lake bed sediments and alteration zone by 1.5 to 2 orders of magnitude. However, given that the mine plan does not allow for greater than predicted dewatering rates, this exercise would be redundant. Greater than predicted flows will need to be managed through active control measures as described in SRK (2015).

3) E>Drawdown calculations for Doris Lake presented in Section 2:5.2 of Package 4 would typically be provided as a range, based on the range of inflows observed from the sensitivity simulations presented in the modeling report. Table 11 indicates that mine inflows could be as much as 2.9 times greater than those used for lake height calculations presented in Section 2.5.2 (Package 4). Typically, lake height values would be calculated based on the additional sensitivity simulations, however as noted above, TMAC will limit the dewatering and subsequent lake level impacts by taking active steps to limit dewatering to 3,000 m^3/day.

4) There is no indication of the spatial distribution of mine inflow from the modeling results. This would be useful to identify key portions of the design that may experience higher inflow rates and may require additional mitigation (as suggested by SRK, 2015) during construction and operation. It is assumed that this information will be part of the ongoing water management planning.

Recommendation/Request:

It would be useful for TMAC to provide additional details regarding management of groundwater inflows during mining operations. These details should include specific methods, triggers, and mitigation/contingency measures for ensuring that mine operations can proceed at dewatering rates below 3,000 m^3/day and that groundwater inflow can be effectively managed.

69.6 TMAC RESPONSE

Mine water inflow has been modelled as described in Document P6-3, Groundwater Inflow and Quality Model. The modeling assumed that water inflow will be actively managed as described in Section 3.3.8 of P6-3. TMAC is currently permitted to withdraw 480,000 m^3/a from Doris Lake. TMAC is not requesting additional water withdrawal through this amendment application; mine water inflow is not included in the 480,000 m^3/a.

Mine water inflow is not a water taking requested by TMAC. The processes of how this will be achieved will be described in the TMAC Groundwater Management Plan that will be submitted 90 days prior to start of Operations, i.e. Sept 1, 2015. This Groundwater Management Plan will include methods and triggers, as well as mitigation and contingency measures for reducing inflow to the mine workings, both from Doris Lake and from the surrounding talik zones.

In the interim, in order to provide additional clarity to reviewers, preliminary details about the primary means of reducing mine inflow are presented in this response.

Inflow from Un-grouted Exploration Drill Holes

Existing un-grouted exploration drill holes that were drilled from the lake could transmit flow to the underground workings. These will need to be plugged if/when they are intercepted. At other mine sites and/or tunnels, flowing drill holes are managed by installing expanding mechanical packers to stop the flow. In cases of high inflow rates, flow or pressure relief holes are drilled to facilitate mechanical packer installation. The Groundwater Management Plan will provide complete details of how this will be evaluated and implemented.

Targeted Point Source Grouting

Inflow is expected from cracks and fissures intercepted as mining progresses. These inflow sources will be grouted. Targeted grouting of these features are standard practice for mining operations and tunnels.

Targeted, point source grouting will be carried out using the standard production drilling equipment (jumbo, stopper, or jackleg) and mobile grouting equipment to inject low viscosity, quick setting grouts to block inflows from fractures in the wall rock. If needed, additional pressure relief holes may be drilled into fractures to reduce flows to facilitate grout injection.

The use of low viscosity (similar to water) grouts allows for maximum grout penetration into the small aperture fractures without the grout separation damage that occur when using cement/particle based grouts. Poly acrylamide grouts are commonly used in civil tunnelling projects for this purpose.

The additional advantage of the polyacrylimide grouts is the quick setting nature as the polymer will crosslink or "set" on contact with water and form a stiff gel. The gel has the shear strength required to hold back high water pressures in the aperture.

Grouting procedures and types would be detailed in the Groundwater Management Plan.

Placement of Mine Backfill

Mining stopes will be backfilled as mining progresses for overall mine stability. This backfill will however also serve to restrict mine inflow from exposed fractures and bulk rock in the buried floors and walls of the stope. The backfill method will not allow for tight backfill of the stope backs (i.e. the ceiling or roof of the stope), and as a result mine inflow will not materially be restricted from these sections of the mine after backfilling has taken place. However, this section of the stope will have been accessible for targeted grouting if inflows were observed during stope access development, so any significant flows will already have been mitigated.

Construction of Hydraulic Plugs (i.e. Bulkheads)

If significant inflow continues in portions of the mine after grouting and backfilling have been carried out, these sections of the mine will have hydraulic tunnel plugs installed in the access development tunnels. The plugs will be used to trap water behind them and allow that portion of the mine to flood. The resulting increase in water pressure in the stopes will equalise with the overlying water pressure and degrade the hydraulic gradient to that section, thereby reducing mine water inflow.

Hydraulic plugs will be keyed into the wall rock and designed to handle the expected design pressure. Hydraulic plugs are used in underground mining projects worldwide where high inflows or flooded workings are anticipated.

69.7 ATTACHMENTS

Not Applicable

70. ID# KIA 11A

70.1 SUBJECT

Site-Wide Water and Load Balance -Consideration for Climate Change

70.2 REFERENCE

Package 6-10; Sections 3.2, 5.2

70.3 SUMMARY

5.2 Modelling Approach

The water and load balance model for the Doris North Project was run from 2010 to 2035 on a daily time step. The run time was selected to cover multiple phases, including a calibration period from 2010 to 2014 (Years -7 to -3), mine operations from 2015 to 2021 (Year -2 to 5), closure in 2021 and post-closure. Post-closure conditions were modelled 15 years after closure.

The water balance was run using probabilistic simulations, with multiple realizations and variable hydrology. During the calibration period, available measured climate and flow data were applied, including flows reporting to the TIA from mine site collection ponds and discharge to Doris Creek. For future predictions, climate data was generated based on the historical record, with discharge predicted based on empirical rating curves and/or pumping capacities.

The load balance was run as a deterministic simulation under average hydrological conditions. This is consistent with the application of source terms derived based on an average hydrological year.

70.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

70.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"The model predicts future water and load balance to year 2035. It used historical climate data from Cambridge Bay for future conditions, but makes no reference to how climate change was incorporated. Please explain how the effects of climate change were applied to the historical dataset used for future predictions.

The water balance was run using probabilistic simulations, with variable hydrology. The load balance was run as a deterministic simulation under average hydrological conditions. The "variable" hydrology used in the water balance is not defined or referenced in the report. The effects of a wet or dry hydrological conditions on load balance are not considered if the load model was only run using average hydrological conditions. Concentrations of selected parameters (e.g. metals) may increase in during wet or dry years.

Recommendation/Request:

What was the date range for the historical climate dataset? Explain how the effects of climate change were applied to the historical climate dataset used for future predictions. If climate change was not considered, please incorporate climate change effects into the modelling, as per latest guidance provided by the International Panel for Climate Change {IPCC), to determine the effect on effluent quality over the projected mine life.

Please define "variable hydrology" as it was used in the water balance modeling. Incorporate wet and dry hydrological conditions into the load balance modeling to determine the effect of wet and dry years on effluent quality.

70.6 TMAC RESPONSE

The variable hydrology in the model is based on historical precipitation and temperature data from 1953 to 2014 at Cambridge Bay. As described in Document P6-10,Water and Load Balance Model, it was found that there is little orographic effect for precipitation in the area. Consequently, no adjustment was made for transposing the Cambridge Bay precipitation data. The temperature data from Cambridge Bay was corrected based on a correlation between coincident temperature measured at the site (Doris met) and Cambridge Bay.

The variable hydrology that was implemented for the water balance was generated by running the model as a Monte Carlo simulation. The Monte Carlo simulation was established for 100 model runs. Variable climate data was generated by randomly sampling a start year from the historical time series for each model run. All results from the 100 model runs were recorded and saved in the model to compile and produce a probability distribution of the results (i.e. 5^{th}, 50^{th} and 95^{th}). These results illustrate the range of wet and dry conditions based on the historical period of record. Table KIA-11A -1 provides a summary of the frequency analysis that was completed using the historical time series to evaluate the probability of wet and dry conditions. It was found that within the existing period of record, a 200-year wet (333 mm in 1993) and a 400-dry event (109 mm in 1953) was observed and included in the probabilistic simulation.

Table KIA-11A - 1: Summary of the Annual Precipitation Frequency Analysis

Hydrological Condition	Return Period (years)	Annual Precipitation[1] (mm)
Wet	1000	358
	200	333
	100	321
	50	308
	20	288
	10	272
	5	252
Average	2.33	215
Dry	5	181
	10	163
	20	149
	50	133
	100	123
	200	114
	1000	95

Source: Z:\01_SITES\Back River\1CS020.008_FEIS\700_Water_Mgt_System_Update\Water Balance\Analysis\Treatment_Input_Rev00_SPB.xlsx
Notes: 1. Annual precipitations based on a hydrological year and frequency distribution based on a Log-Normal Distribution.

Climate change was not included in the probabilistic simulation since it was found that total annual precipitation to only increase by 6% by 2040. Given that the project life is only six years, climate change is not expected to cause significant changes in terms of hydrology estimates.

TMAC will run the variable hydrology to illustrate the effect of the water quality results in the TIA for wet and dry years as a sensitivity analysis. Since the waste rock source term load is very small compared to the load from the upstream-undisturbed flows to the TIA, concentrations in the TIA are not expected to be materially different. The results of this sensitivity analysis for the 5th and 95th percentile water quality results based on variable hydrology will be prepared for presentation at the Technical Meeting in Cambridge Bay in January 2016.

70.7 ATTACHMENTS

Not Applicable

71. ID# KIA-11B

71.1 SUBJECT

Site-Wide Water and load Balance -Input Parameters

71.2 REFERENCE

Package 6-10; Sections 4.2.2, 4.2.3, 4.2.6

71.3 SUMMARY

Modeling approach using median concentrations for inputs.

71.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

71.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"To predict TIA water quality, the model uses median monthly background surface water quality and median release rates from the humidity cell tests (to calculate the loadings from the exposed tailings beaches) as input parameters. Using median values, as opposed to 75th percentile concentrations, is not a conservative approach as it does not consider enriched conditions and may underestimate the predicted TIA quality, thereby underestimating potential effects to surface water quality and aquatic life in Doris Creek and Roberts Bay.

Recommendation/ Request:

Predict TIA water quality under enriched conditions. Use 75th percentile background for all input parameters.

71.6 TMAC RESPONSE

TMAC believes that the assumptions used for the Water and Load Balance is representative of the most likely site conditions. Furthermore, as illustrated there is considerable conservatism built into the TIA discharge strategy including holding water in the TIA with sufficient lead-time to implement water treatment should that be necessary. None the less, TMAC will run a sensitivity analysis of the Water and Load balance using the 75th percentile for background concentrations and other input

source terms. These results will be prepared for presentation at the Technical Meeting in Cambridge Bay in January 2016.

71.7 ATTACHMENTS

Not Applicable

72. ID# KIA-11C

72.1 SUBJECT

Site-Wide Water and Load Balance- Mercury, cyanide, and selenium predictions

72.2 REFERENCE

Package 6-10; 6.3.1

72.3 SUMMARY

Modeling approach precludes mercury, cyanide, and selenium in it predictions.

72.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

72.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"Did not predict cyanide, mercury and selenium in TIA, and mercury in the effluent discharging to Roberts Bay from the Marine Outfall Box. Free-cyanide was not predicted due to "lack of data", and mercury and selenium were excluded due to high detection limits in the mill effluent water dataset.

Cyanide, mercury and selenium are potentially parameters of concern for the site. The lack of data and high detection limits do not preclude the need to predict TIA concentrations for these parameters. Undertaking additional analyses with low detection limits, and/or and obtaining additional information should be provided, with the commitment to updating the model when the data becomes available.

Recommendation/ Request:

Complete additional analyses for mercury and selenium using low-level detection limits. Obtain additional information (or use information from other sites) to predict cyanide concentrations in the source terms to predict cyanide concentrations.

72.6 TMAC RESPONSE

Please see response to ECCC-4. The results from aging tests will be used to model concentrations of WAD cyanide, selenium and mercury in the TIA and at the point of

discharge in Roberts Bay. These results will be prepared for presentation at the Technical Meeting in Cambridge Bay in January 2016.

72.7 ATTACHMENTS

Not Applicable

73. ID# KIA-12

73.1 SUBJECT

Prediction of Environmental Effects on Water Quality

73.2 REFERENCE

Package 4-1,Section 4.5.2

73.3 SUMMARY

Lack of nitrate prediction in modeling Roberts Bay's surface water.

73.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

73.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

"Section 4.5.2.2- ""Nitrate"" of the Environmental Effects report states...""by having the diffuser at 40 m depth, below the upper sun lit portion of the water column, nitrate in the TIA effluent and groundwater will not be readily available to phytoplankton, which will be photo-synthetically active in the upper water layers"". However, according to Section 4.3.3 (Basin Circulation) of the report, deeper water flowed into Roberts Bay from Melville Sound, and the top layer flowed seaward for roughly 70% of the measurement period. Figure 4.3-3 also shows deeper water in Roberts Bay circulating into the upper layer.

The movement of water between deep and surface layers and how this affects surface water concentrations of nitrate and other COPC is not clear. The proponent has not modeled a mixing zone, or the resultant concentrations in the deep or surface waters. A water quality model is needed to determine the concentrations of nitrate and other parameters in the immediate mixing zone, and any mixing between the deep and surface layers.

The proponent relies on exchange of Roberts Bay with the main ocean body to reduce COPC concentrations in Roberts Bay each year. Nitrate from Roberts Bay will eventually enter the wider circulation of the Arctic Ocean in the confined and shallower waters of the large embayment at the mouth of Roberts Bay that is confined by the large peninsula. TMAC has not provided any assessment of expected concentrations or the potential for nutrient enrichment there.

Recommendation/ Request:

Provide a water quality model to determine the concentrations of nitrate and other parameters in the immediate mixing zone, and in deep and surface layers and confirm the prediction that nitrate will not be available in the surface waters of Roberts Bay. Please provide an assessment of nitrates in the ocean waters beyond Roberts Bay, from the Hurd Islands east to the head of the large bay, as shown in the Google maps image below. (refer to Original KIA-12 submission for the Google maps image)."

73.6 TMAC RESPONSE

Trapping depths have been calculated for the proposed discharge plume using the US EPA's VISUAL PLUMES software (EPA 2003). This is the depth where the effluent has mixed with the ambient waters such that their densities are in equilibrium. At this point the plume ceases to rise (presuming the effluent is less dense than the surrounding waters as is the case for the proposed discharge into Roberts Bay), and spreads horizontally.

Under a variety of discharge options (TIA+groundwater, groundwater only, and TIA inputs only) and salinities (0 to 25.8‰), trapping depths of the discharge plume were estimated to be between 29 m to 38 m depth, in other words, a rise of 2 m to 11 m above the diffuser. This indicates the top of the trapping depth will be more than 15 m below the base of the summer pycnocline (see Figure 4.3-11, Document P4-1), the density interface that separates the deep waters of Roberts Bay from the surface waters and where deep-water nitrate would be entrained into the surface mixing layer where it could be accessed by phytoplankton. At this depth, the plume will not interact with the pycnocline or surface mixed layer and numerical simulations of Roberts Bay currents indicate that the deep waters (20 m depth to seafloor, including the effluent plume) will be fully flushed every 2 to 3 weeks (Rescan 2012). Thus, it is concluded that the effluent plume (and nitrate contained therein) will not interact with the surface waters of Roberts Bay and will not contribute to additional primary productivity in the inlet. This will be tracked through monitoring of Roberts Bay as part of the Aquatics Monitoring Framework that will include physical profiling and the collection of water quality and phytoplankton biomass samples.

With respect to Melville Sound, it is expected that the effluent plume leaving Roberts Bay would be further incorporated into the much greater volume of bottom water in Melville Sound. However, it is possible that at some point in Melville Sound a portion of the 'plume' could interact with the surface waters. If this occurred, the plume would be extremely dilute and the predicted increase in productivity from nitrate inputs would be inconsequential. For example, if the total concentration of nitrate discharged during the period when effluent nitrate concentrations and rates are expected to be greatest, (open-water season; 1.8 mg N/L at 7,000 m^3/d for 4 months), was *instantaneously*

added to the surface mixed layer of Melville Sound up to the Hurd Islands (surface area 1,305 km^2; depth of 10 m), it would only increase nitrogen levels by 0.00015 mg/L. This predicted increase is an undetectable change given the level of nitrate detection limits (0.006 mg N/L). While this single-pulse scenario is implausible – all deep-water will not be entrained into the surface layer and all nitrate will not be added instantaneously – it indicates the extreme magnitude of events that would be required for nitrate (or any other water quality parameters) discharged into Roberts Bay to have a measureable effect in Melville Sound.

73.7 ATTACHMENTS

Not Applicable

74. ID# KIA-14

74.1 SUBJECT

Attraction or Avoidance of Grizzly Bears to the Mine Site

74.2 REFERENCE

Pk 4, pt 2, Section 3.4.3, Pages 3-13 to 3-16

74.3 SUMMARY

Grizzly bears are observed relatively frequently at the Roberts Bay site. TMAC suggests that the project amendment will have no impact on grizzly bears. No additional monitoring efforts are currently suggested or committed to in order to monitor impacts to this species. On page 3-14, Section 3.4.3, TMAC states that '"grizzly bears and wolverine are also the subject of ongoing DNA-based monitoring programs aimed at quantifying the number, habitat use, and effects on these species."' While this suggests that DNA monitoring will detect effects on grizzly bears, TMAC is not proposing to undertake DNA monitoring in the future. As only two years of baseline data exist, the DNA monitoring program will not elucidate impacts to grizzly bears or changes in habitat use or population numbers unless the program is re-instated. As stated in the KIA's review of TMACs 2014 WMMP, the current camera monitoring program is not designed in a way that enables the detection of avoidance or attraction of grizzly bears to the project area {discussed in paragraph 3).

Grizzly bears may be at risk of experiencing mine-related impacts if they begin to avoid areas previously used as familiar seasonal foraging sites around or near Roberts Bay {e.g., near the fish barrier). Habitat avoidance could subsequently lead to a reduction in reproductive success {e.g., as speculated in Schoen and Beier, 1990). While waste management controls and some of the other site-specific monitoring efforts for the Doris North project amendment are important, they will not eliminate the overall effect of the project, along with past and foreseeable future project activities on grizzly bears in this area. There are currently no monitoring programs in place to evaluate avoidance or attraction of this species to the general area associated with the project. Yet, monitoring for potential attraction and avoidance of grizzly bears was a compliance requirement of the WMMP in the original EIS for this project.

While data from the camera monitoring program has been used to attempt to determine whether grizzly bears are attracted to or are avoiding the mine area, the program -as it has been designed - cannot truly address these questions to begin with, and results at present are spurious. The reasons that the camera program is not

currently designed to allow for the detection of attraction or avoidance of the mine site area by grizzly bears are due to the following issues with the program:

Animals were not counted within the same spatial area at each camera {i.e., one camera may show 500 m^2 of open land while an adjacent camera may show 100 m^2 of land, hence there is a higher chance of counting more grizzly bears in the camera showing more area in their field of view). This issue could be corrected by placing posts at set distances from the cameras, such that only individuals between the camera and posts {i.e., within a set distance, that is equivalent between cameras) are counted;

Cameras are clustered more closely together near the project site, increasing the probability of capturing the same individual going from camera to camera closer to the project. Double counting bias should be made equivalent at different distances from the mine to allow for comparisons that can assume equal observer error {i.e., risk of double counting) during the analytical stage among location. For this reason, equal spacing of adjacent cameras is important;

'Control' cameras in the camera monitoring program were considered to be those cameras that were 1 km from the project. However, there is no support for this camera distance being considered as being a control [i.e., outside of the zone of influence of a mining project for grizzly bears, or for caribou {which cameras were also used to monitor originally)]. Harding and Nagy {1980) documented camp avoidance distances at an Arctic coastal tundra site of 1 to 2.0 km for traveling grizzly bears in route to another location, and of 3.2 to 7.2 kilometers for bears that were foraging or leaving the den site. The Alaska Department of Fish and Game (ADF&G; 1987) found a 4.0 km zone of mining influence on grizzly bears in southeast Alaska. Johnson et at. (2005) collared grizzly bears in the arctic and showed that mineral exploration sites had a moderate influence in use of late summer and autumn habitats up to 23 km. Therefore, based on zones of avoidance/influence derived from other projects, the Doris North WMMP is not designed to measure avoidance or attraction to the project site, as most 'control' cameras are not likely to be measuring animals in true control areas; and

Cameras were placed in different habitat types, which increased the number of variables considered and decreased the power to detect a spatial relationship between habitat use and the project (the original compliance question only sought to understand this spatial relationship).

More details on suggestions for improvements to the camera monitoring program are included in the KIA's review of TMAC's 2014 annual WMMP compliance report, which has been shared with TMAC for their consideration.

74.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

High:

Without a properly designed monitoring program for grizzly bears, it is not possible to test predictions of avoidance or attraction, as required of the WMMP for meeting project compliance. As a result, the WMMP monitoring data cannot be used to predict impacts of the amended project activities. The KIA has already noted that the WMMP is unable to answer some of the monitoring plan compliance objectives without alterations to the plan, and that alterations to the WMMP are needed to test the original assumptions of the FEIS (which the project amendment is predicted to not alter, but which wildlife monitoring objectives would still apply to).

74.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

1. Gap/Issue: Impacts to grizzly bears caused by project, due to avoidance or general attraction to the area, are not presently being monitoring in a way that can detect these impacts. Predictions of no impacts to grizzly bears is not supported by other studies and cannot be presumed by extrapolation from the camera monitoring data, as collection methods to date have been flawed. This monitoring program requires further refinement and enhancement, particularly as the project moves forward into an operational mining phase.

2. Disagreement with amendment conclusion: A conclusion of no impact to grizzly bears largely assumes that grizzly bears are not attracted to or avoiding the project site. We cannot objectively reach the same conclusion using monitoring data produced for the project, and a review of other studies of grizzly bears around mining projects would suggest that avoidance may be expected.

3. Reason for disagreement with proposal conclusion: A review of the previously designed WMMP compliance monitoring program developed for this project showed that it does not allow for any conclusions to be made about avoidance or attraction of grizzly bears to the project area, despite this being one of the main goals of the WMMP. Results of other projects would suggest that such impacts could occur and could impact the reproductive success of grizzly bears. Assessing for these potential impacts requires enhancements to the WMMP.

Recommendation/ Request:

A letter from TMAC to the NIRB and NWB issues on November 12, 2015, noted that there is a current Wildlife Mitigation and Monitoring Plan for the Doris North Site. TMAC states in this letter that only if, as a result of technical and public hearings, the plan content needs to be revised prior to the start of Doris Operations, TMAC will commit to providing any revision on or before September 15, 2016.

The inability of the WMMP to monitor attraction and avoidance of the area by grizzly bears is one of the issues identified during the KIA's review of the annual WMMP, which we would like to be discussed during technical hearings.

We suggest re-configuring the camera monitoring program, and adding additional cameras to enable detection of grizzly avoidance of the area. KIA-11

Some suggestions for enhancement of the camera monitoring program within the WMMP include the points below:

- Set up monitoring cameras in transects of increasing distances from the mine site, ensuring that the outermost camera is at a ""true control"" distance, based on previous literature and research. Transects will allow for the nesting of cameras into different 'zones', which may have different overall use by grizzly bears (e.g., NE transect may have more grizzly bears than a SW transect); however, nesting will allow for the documentation of differences based on distance from the mine within each transect, and the average differences by distance can be determined using various analytical techniques;
- Ensure that cameras are the same distances from one another such that the double counting effect is not greater at any particular distance from the mine site;
- Ensure that the same land area is considered for counting animals at each camera. We recommend including coloured posts in the frame at a set distance from the camera, and counting only wildlife within that known, set distance for comparability;
- Ensure that cameras take the same number of photos over the same time periods;
- Purchase spare cameras such that cameras are not ""swapped"" from one location to another in the case that one is damaged, as occurred in 2014. Swapping cameras decreases the power of the study design, and causes partial data sets in certain locations;
- Try to situate all cameras in the same habitat type to minimize extra variables and to focus only on the question of distance by project avoidance; and
- Analyze data using zero-inflated models, or other design-appropriate methods that are effective at analyzing data sets with a large number of zeros.
- Establish study design with careful input from statisticians, and justify control distances using a review of existing, relevant literature on zones of avoidance by grizzly bears.

Monitoring and establishing the zone of avoidance for grizzly bears will enable more realistic future predictions about indirect habitat loss and offset requirements for this species.

Depending on the results of a well-designed WMMP to determine avoidance/ attraction risks to grizzly bears, future contributions to a larger, government-led grizzly bear DNA hair study for cumulative effects on grizzly bears may be warranted.

74.6 TMAC RESPONSE

To address the comment, TMAC would like to clarify that in accordance with the correspondence of November 12, 2015 to NIRB and the NWB, the Wildlife Mitigation and Monitoring Plan (WMMP) is targeted to be updated April 2016, in advance of commencement of operations.

The Wildlife Mitigation and Monitoring Plan (WMMP) is designed to monitor the effects of the Doris North Project as predicted in the 2006 FEIS for the Project. Grizzly bear were a Valued Ecosystem Component (VEC) for the FEIS, which predicted both grizzly bear attraction (to waste management facilities) and avoidance (due to noise and human disturbance) of the Project.

The WMMP monitors bears using remote cameras that are triggered by wildlife and also take timed photos at hourly intervals. The cameras are located on and near the Project site (test cameras) and at greater than 1 km from the project site (control cameras). The annual wildlife monitoring program has reported that cameras located at the waste management facilities for the Project have not recorded grizzly bears at the site, and so it does not appear that bears are attracted to waste management facilities and hence to the Project. The 2014 report also states that the number of bears per camera near the Project facilities is similar to the number of bears per camera at control sites, suggesting that bears are also not avoiding the site. This is consistent with the status of the Project as being in Care and Maintenance during the operation of the 2013 and 2014 camera programs. The minimal activity produced by the Project during the Care and Maintenance phase would not be expected to cause bears to avoid a site.

Cameras are a new method for monitoring the distribution of wildlife populations and have been implemented at the Project site due to the significant improvement in total monitoring effort (the cameras cumulatively represent approximately half a million hours of monitoring/yr) and the reduced disruption to wildlife that this monitoring tool provides. Being a new monitoring methodology, optimal program design and implementation has been evolving since their initial use in 2011. Modifications have been informed by annual Report results as well as comments received from the KIA and GN on previous WMMP submissions as well as the annual reports.

TMAC appreciates the KIA's recent suggestions submitted in this Technical Comment as well as their comments on the 2014 WMMP Compliance Program Report for further improvement to the camera monitoring program. TMAC commits to considering the proposed KIA suggestions as well as the recent Program results, as well as the review produced by Burton et al (2015) of camera program designs. TMAC also commits to engaging further with the KIA on revision to the camera program in the first quarter of 2016, for implementation in 2016.

Although TMAC agrees that the camera program could further improve the programs power to detect change, the existing program does effectively manage the detection probability (as outlined in Burton et al, 2015) and remains a robust program, able to detect changes in the distribution of wildlife at the Project site. As such, the existing camera program is able to detect changes in grizzly bear distribution. TMAC thanks the KIA for a comprehensive technical review of the camera program and looks forward to working collaboratively on progressive improvement.

74.7 ATTACHMENTS

Not Applicable

75. ID# KIA-13

75.1 SUBJECT

Doris lake water levels

75.2 REFERENCE

Package 4-1, 4-2.

75.3 SUMMARY

Based on a peak water loss/use from Doris Lake, the maximum lake drawdown is determined to be 0.23m under ice for assessment. This is within the natural range of lake levels and the proponent (TMAC) anticipates no effects based on this reduction. However, in the Amendment Proposal, potential effects on eggs incubation are considered and a field study was conducted in Fall 2015 to confirm the effects assessment. The results of this study and updated effects assessment are not yet available to the review team.

75.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium

75.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

There is a good understanding of fisheries use in Doris Lake, but some data gaps in locations and use of spawning areas around the lake perimeter. Taking the maximum amount of water as permitted under the existing Water Licence (480,000m3/year), combined with the peak estimated water from Doris Lake into the mine underground workings (610,000 m^3/year),could result in a lake drawdown amount during the winter (equivalent to 0.76million cubic meters). Although this is less than 4% of the lake volume under 2m ice, and within the natural variation, there should be a robust assessment of effects on fisheries as this could affect the shallow perimeters of the lake, where spawning habitat would be located. TMAC can adjust the water use from Doris Lake to reduce the maximum amount withdrawn, therefore the proponent notes that it would be unlikely that the maximum natural drawdown of 0.54m is realized in addition to the 0.23m drawdown due to water use and seepage into the mine workings. The proponent noted that a field study was completed in Fall 2015 to complete a detailed habitat survey of the entire lake perimeter, where eggs and larvae are left to overwinter. TMAC notes that if the lake is drawn down below the natural range, eggs and alevins close to the ice could perish. If this is the case, effects on fisheries in the lake

are unknown. The results of the updated field assessment completed in 2015 have not yet been made available, and therefore a comprehensive effects assessment on fisheries in Doris Lake is not yet available. It is difficult to agree with the effects assessment as presented in the Amendment Proposal while baseline data gaps exist. It is however noted that the modeling represents worse- case scenarios and that this additional study has been completed to help inform appropriate effects and mitigation measures.

Recommendation/ Request:

Recommend that the updated fisheries baseline for Doris Lake be presented, particularly with reference to spawning habitat and fish use. This information should be assessed in conjunction with the hydrological baseline data to accurately quantity potential effects, and any subsequent protection/mitigation/offsetting and monitoring plans."

75.6 TMAC RESPONSE

TMAC has completed a field program designed to quantify potential effects to fish and fish habitat in Doris Lake (providing for the species Lake Trout, Lake Whitefish and Cisco). A memo presenting the results of this effort can be found in Appendix B: DFO 3.2.1 – 1 Doris Lake, Doris Creek, and Little Roberts Outflow Fisheries Assessment Memorandum.

TMAC will undertake a self-assessment to determine whether any serious harm may result following the implementation of site-specific mitigation measures.

75.7 ATTACHMENTS

Appendix B: DFO 3.2.1 – 1 Doris Lake, Doris Creek, and Little Roberts Outflow Fisheries Assessment Memorandum

76. ID# NRCAN-1

76.1 SUBJECT

Geochemical characterization - acid-base accounting (ABA) of waste rock and tailings samples

76.2 REFERENCE

TMAC's 2015 Amendment Application No.1 of Project Certificate No. 003 and Water Licence 2AM-DOH1323 (June 2015): Package 2- Project Description (Sec. 2.1, 2.2, 3.5.1, and 3.5.2); Package 6-12- Tailings Geochemistry (Sec. 3.2 3.3, 4.1, 4.2, 4.3.1, and 4.3.2); Package 6-14- Waste Rock and Ore Geochemistry, Static Testing (Sec. 3.1, 3.2, and 4)

76.3 SUMMARY

Not applicable

76.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

76.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Rationale:

The acid base accounting (ABA) analysis of waste rock and tailings samples has been done using both Sobek or modified Sobek and total inorganic carbon (TIC) based neutralization potentials (NP). The Sobek NP includes the contribution of both carbonate and silicate minerals; the former are fast dissolving and provide meaningful buffering capacity to pH 4, the latter are slow dissolving and only effective under acidic conditions of pH below 4. The TIC derived NP includes the contribution of all carbonates as well as any other inorganic carbon sources such as graphite, if present. While the TIC-NP is conveniently determined by a simple total carbon measurement, it is frequently susceptible to overestimation in presence of other organic or inorganic carbon sources, which do not contribute to ABA, and iron carbonate minerals such as siderite ($FeC0_3$), ankerite [$Ca(Fe,Mg,Mn)(C0_3)_2$] or others, which are ABA neutral, meaning they consume and produce equal amounts of acid. The contribution of such sources or minerals to the TIC-NP needs to be corrected.

The various rock lithologies of the Doris deposit contain significant amounts of iron carbonate bearing minerals: ferroan dolomite, ankerite and siderite, and some other organic and inorganic carbon components, which has resulted in overestimation of the

TIC-NP and, hence, the TIC based neutralization potential ratio NPR (NP/AP). This has implications on the classification of tailings and waste rock in their respective potentially acid generating (PAG) and not potentially acid generating (non PAG) categories, as well as their management strategy. The use of the TIC acronym for the TIC based NP and NPR is also confusing with that of the total inorganic carbon concentration, the latter being the correct designation of the TIC.

The Sobek NP is measured to pH 2 to include both carbonate and silicate components but the availability of the latter fraction above the ARD threshold pH of 5 is unknown. This may have implications on the Sobek NP based ABA classification and metal leaching (ML).

Recommendations/Requests:

a. Please correct the TIC based NP and NPR for the iron carbonate fractions and other non ABA carbon components of the various rock lithologies and revise their classification accordingly in all relevant ABA sections.

b. Please remove the ambiguity in TIC designation for TIC based NP and NPR by naming them as TIC-NP or NP_{TIC} and TIC-NPR or NPR_{TIC}.

c. Please clarify the impact of slow dissolution rate of silicate minerals on the measured Sobek NP above the ARD threshold pH of 5 in low carbonate containing tailings and waste rock samples, and any implications it may have on the Sobek NP based ABA classification and metal leaching, if any.

76.6 TMAC RESPONSE

a.

Throughout the static testing report (Document P6-14), results are presented for both titration based NP methods (standard and modified Sobek NP), and total inorganic carbon expressed in NP units. Although "corrections" were not applied to address the above stated limitations in these methods, the limitations of those methods are considered in the interpretation of the results. TMAC maintains that direct presentation of the results is more appropriate than presenting "corrected" results that encompass additional uncertainties associated with the correction factor used for this purpose. Nonetheless, to address this technical comment, a series of comparative plots and tables are presented to illustrate the sensitivity of the results and interpretation to corrections that account for the iron content of the carbonate minerals.

TMAC would also like to clarify that the TIC reported in Document P6-14 and 6-15 were not based on total carbon analysis, but rather direct measurements of inorganic carbon or by indirect measurement (calculated difference of total carbon and acid insoluble carbon (mostly organic forms and graphite), as described in the methods

section of Document P6-14. Therefore, the TIC measurements do not include organic carbon.

For this analysis, results for TIC in units of $CaCO_3$ eq/t (or alternatively TIC-NP) as presented in the static testing report (Document P6-14) are compared to results for TIC(Ca+Mg) which is defined as the calcium plus magnesium content of the total inorganic carbon content – again in units of $CaCO_3$ eq/t, where TIC(Ca+Mg) = 0.72*TIC. The factor of 0.72 represents the minimum stoichiometric proportion of calcium and magnesium in ferroan dolomite found in SEM data from ferroan dolomite mineral grains in the 17 Doris HCT samples. The sample with the lowest calcium+magnesium content was HC-49, with the following stoichiometry: $Ca(Mg_{0.44},Fe_{0.56})CO_3$ (Document P6-15b, Appendix B1).

The results for TIC and TIC(Ca+Mg) are presented in Figures NRCan-1 - 1 and NRCan-1 - 2, and Table NRCan-1 - 1, and are discussed as follows.

- Figure NRCan-1 - 1a and b present box and whisker plot for TIC and TIC(Ca+Mg) by rock type. As would be expected, the comparison shows slightly lower concentrations of TIC(Ca+Mg) content in comparison to TIC.
- Figure NRCan-1 - 2a and b present TIC and TIC(Ca+Mg) respectively versus AP for the samples from each of the Doris deposits. As would be expected, the comparison shows slightly lower concentrations of TIC(Ca+Mg) content in comparison to TIC, and this results in reclassification of some samples from non-PAG to uncertain ARD potential or from uncertain ARD potential to PAG.
- Table NRCan-1 - 1 shows the proportions of samples classified as non-PAG, uncertain and PAG for samples classified using NP/AP ratios, TIC/AP ratios and TIC(Ca+Mg)/AP ratios. As shown in Table NRCan-1 - 1, use of TIC(Ca+Mg) results in only minor changes to the proportions of samples classified as non-PAG, uncertain or PAG.
  - Mafic to ultramafic volcanics, which are the dominant lithology in the mine area, would change from 91% non-PAG to 89% non-PAG, with a 2% increase in the amount of uncertain and PAG rock.
  - Mafic to ultramafic volcanics mixed with quartz veins, with are a minor unit – and often ore grade material would change from 95% non-PAG to 85% non-PAG, with corresponding increase from 5% uncertain to 19% uncertain.
  - Quartz veins which are primarily ore grade material would change from 46% non-PAG to 27% non-PAG, with a corresponding increase from 30% to 48% uncertain, and from 23% to 25% PAG. Mixed quartz veins showed a similar shift.
  - Diabase showed more appreciable shifts from non-PAG to uncertain or PAG classification due to the low TIC content found in these two rock types. The diabase dikes were deposited after the sulphide and gold mineralization

associated with the gold deposits. As a result, they have a consistently low sulphide content and appreciable quantities of calcium plus magnesium silicate minerals that contribute to the more conventional titration based NP. These samples are classified as non-PAG according to NP/AP ratios. Humidity cell tests and other information supporting a non-PAG classification for diabase is presented in a response to a previous technical comment by AANDC (response to ID# AANDC TC7, presented in Section 41 of December 2015 Letter from TMAC to NWB, RE: TMAC Resource Inc.'s Revisions to Amendment Application No.1 of Project Certificate No. 003 and Water Licence No 2AM-DOH1323: Proponent's Response to NWB Technical Comments).

- Late gabbro intrusives (10a) had a similar proportion of non-PAG samples, but slightly higher proportion of samples classified as PAG (45% to 52%) using TIC(Ca+Mg)/AP ratios. In contrast, the majority of the samples were classified as non-PAG using NP/AP ratios. The majority of these samples had low sulphur concentrations (Document P6-14, Figure 3.3), and calcium+magnesium silicate minerals that are capable of maintaining neutral pH conditions under low rates of sulphide oxidation. Acidic conditions may develop in the relatively small portion of samples with higher sulphide content. However, based on the kinetic testing results (Document P6-15), it is expected that there would be a delay to the onset of acidic conditions and that the material will be backfilled before this occurs.

b.

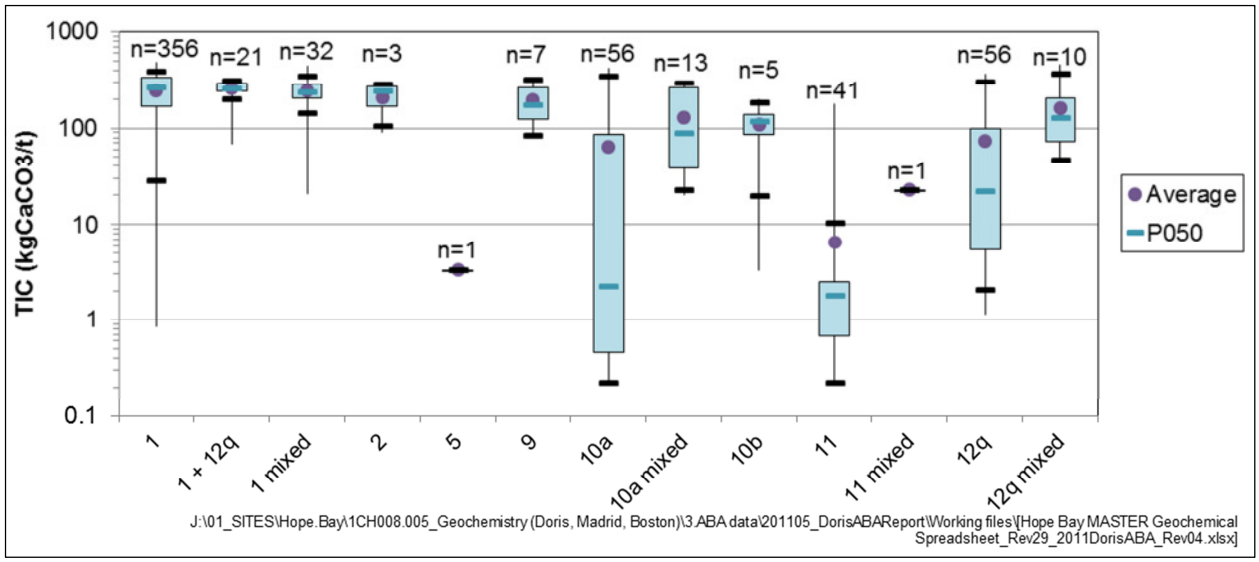
As discussed previously, TMAC would like to clarify that the results reported for TIC are not based on a simple total carbon measurement, and do not include other non-carbonate forms of carbon such as organic carbon or graphite. It is our opinion that the terminology used in the report is appropriate and clear, and that requested revisions to the report are not justified.

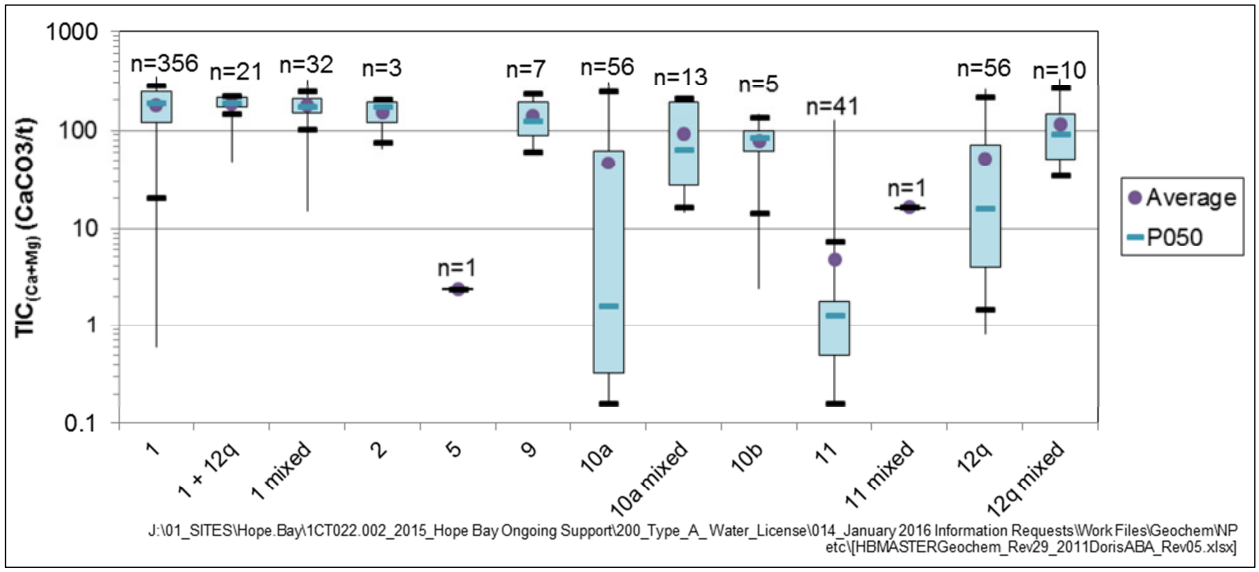
c.

Given that the majority of the significant rock types have median values of TIC(Ca+Mg) greater than 100 kg$CaCO_3$/t, and are not reliant on silicate NP to maintain neutral pH conditions, this response will focus on the rock types that have lower TIC, and that are reliant on silicate NP to maintain neutral pH conditions. These include 10a (gabbro), 11 (diabase), and 12q (noting that quartz veins are typically ore grade material.

Slow dissolution of silicate minerals on the measured Sobek and modified Sobek NP in these rock types may mean that rates of silicate buffering are not sufficient to maintain neutral pH conditions in waste rock that has elevated rates of sulphide oxidation, typically corresponding to samples with sulphide concentrations greater than 0.15 to 0.2% sulphide. As described above, sulphide concentrations in the diabase are typically below this threshold, while sulphide concentrations in the gabbro and quartz veins vary, and some of the waste rock associated with these units is expected to be

PAG. The proposed waste rock management plan is to backfill these materials in the underground mine where they will be flooded and isolated from surface water.





(Note these plots are conventional box and whisker graphs, with the upper and lower extremes showing the minimum and maximum values, tick marks outside the box showing the 5th and 95th percentiles, outer margins of the box showing 25th and 75th percentiles and central division in the box showing the median value).

Figure NRCan-1 – 1. Box and Whisker Plots Showing the Distribution of a) TIC by Rock Type[9], and b) TIC(Ca+Mg) by Rock Type

[9] Plot a is the same as Figure 3.6 of Package 6-14.

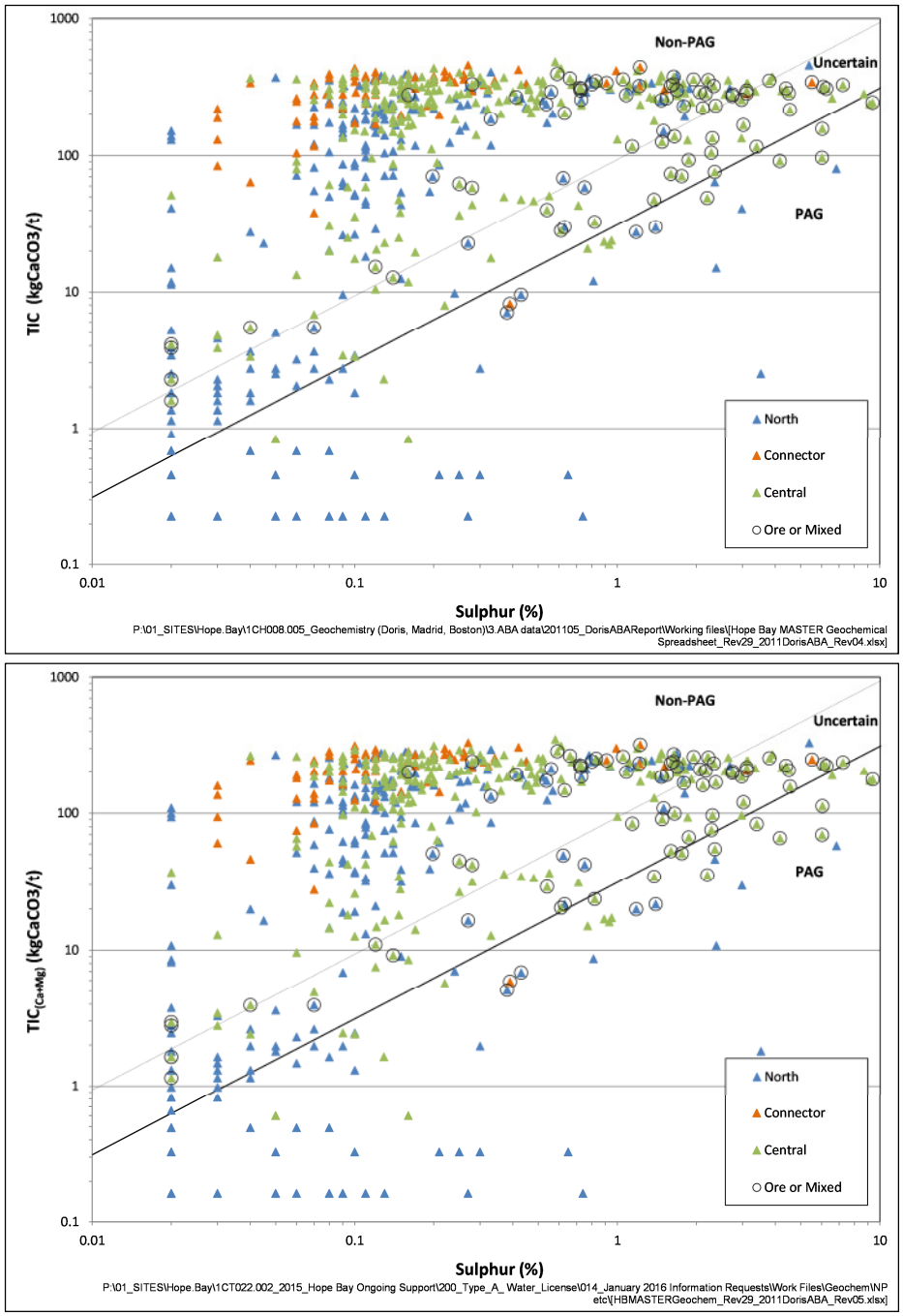


Figure NRCan-1 – 2. a) TIC vs AP (Expressed as Sulphur) for Doris North, Connector and Central Samples[10] b) TIC(Ca+Mg) vs AP (Expressed as Sulphur) for Doris North, Connector and Central Samples

[10] Note that this plot is equivalent to Figure 3.9 in the Static Testing report (Package 6-14). However, the version in the report was inadvertently filtered to show a subset of the available data, and this updated version shows the complete ataset. Figure 3.8 of Package 6-14 also includes this error. An erratum will be issued under separate cover. None of the text or tables describing these results are affected by the filtering error.

Table NRCan-1 – 1. ARD Classifications by NP/AP and TIC/AP According to Rock Type

Lithology	Number of Samples		ARD Classification (% of Samples)								
			non-PAG NP or TIC)/AP >3			Uncertain 1 < (NP or TIC)/AP <3			PAG NP or TIC)/AP < 1		
	NP/AP	TIC/AP or $TIC_{(Ca+Mg)}$	NP/AP	TIC/AP	$TIC_{(Ca+Mg)}$/AP	NP/AP	TIC/AP	$TIC_{(Ca+Mg)}$/AP	NP/AP	TIC/AP	$TIC_{(Ca+Mg)}$/AP
Mafic to ultramafic volcanics(1, 1a, 1ay, 1p and 1u)	396	356	91%	91%	89%	8%	6%	7%	2%	3%	4%
Mafic to ultramafic volcanics (1) mixed with Quartz Vein (12q) only	23	21	74%	95%	81%	26%	5%	19%	0%	0%	0%
Mixed mafic to ultramafic volcanics (1)	34	32	94%	94%	94%	3%	3%	3%	3%	3%	3%
Intermediate Volcanics (2a)	3	3	100%	100%	100%	0%	0%	0%	0%	0%	0%
Sedimentary units (5aj)	1	1	100%	0%	0%	0%	100%	100%	0%	0%	0%
Granitic Intrusives (9n, 9nf)	7	7	100%	100%	100%	0%	0%	0%	0%	0%	0%
Late gabbro intrusives (10a)	61	56	87%	38%	36%	8%	18%	13%	5%	45%	52%
Mixed late gabbro intrusives (10a)	13	13	100%	100%	100%	0%	0%	0%	0%	0%	0%
Other late mafic intrusives (10b)	5	5	80%	60%	60%	20%	40%	20%	0%	0%	20%
Diabase (11c and 11cm)	41	41	100%	20%	7%	0%	54%	56%	0%	27%	37%
Quartz veins (12q)	79	56	42%	46%	27%	29%	30%	48%	29%	23%	25%
Mixed Quartz Veins (12q)	11	10	27%	40%	20%	64%	60%	60%	9%	0%	20%

76.7 ATTACHMENTS

Not applicable

77. ID# NRCAN-2

77.1 SUBJECT

Geochemistry- waste rock and ore storage piles, ARD and metal leaching

77.2 REFERENCE

TMAC's 2015 Amendment Application No.1 of Project Certificate NO. 003 and Water Licence 2AM-DOH1323 (June 2015): Package 2- Project Description (Sec. 2, 2.2, and 3.7); Package 5- Management and Other Plans (P5-3, P5-4); Package 6- Engineering and Design Documents (P6-10, P6-11); Package P6-14- Waste Rock and Ore Geochemistry, Static Testing (Sec. 3.1, 3.2, and 4); Package P6-15- Waste Rock and Ore Geochemistry, Kinetic Testing (Sec. 3.1, 3.2 and 4)

77.3 SUMMARY

Not applicable

77.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

77.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Rationale:

During mining activities, the mined out ore and a portion of the waste rock will be temporarily stored, respectively, in ore and waste rock storage piles constructed on storage pads Q, H, J and U for ore and I and T for waste rock. During precipitation events and snow melts, contact water from these storage piles will be temporarily collected in two pollution control ponds 1 and 2, which depending upon its quality may be discharged directly to Robert Bay or recycled to the mill or pumped to the TIA. Geochemical characterization of the various rock lithologies at the site classified most of the ore as having an uncertain ARD potential and/or PAG and the waste rock as mostly non PAG with a limited proportion classified as uncertain or PAG. The 90th percentiles of most rock lithologies contained elevated concentrations of Ag, As, Cd, Cu, Sb, Bi, Tl and Se which were 10 times or more than that of the average crustal abundances. While the rock contact water from these temporary waste rock and ore storage piles will be collected in two pollution control ponds, it is unclear if there would be any seepage of this contact water to the local ground below the storage pads and

how it will be monitored and intercepted if it does occur. Seepage of this contact water to the local surface/groundwater regime may be detrimental to its quality.

In Table 3.1: Comparison of Waste Rock and Ore from ABA, XRD, & MLA Assessments, Section 3.1.1 Sample characterization - Mineralogy (Package P6-15), the sulphur contents of some of the Humidity Cell test samples from ABA, XRD and MLA (Mineral Liberation Analysis) are quite variable among the three methods used. For example, for the H-36, quartz vein sample, the XRD, MLA and ABA results for total sulphur are reported respectively as 1.07%, 3.3% and 6.03%. In such cases, NRCan questions which measured value should be considered as reliable.

In the ABA analysis of the barrel test samples, the data presented in the sample characterization section 3.2.1 (Package P6-15, page 23) is not clear as the concentrations are presented as percentiles rather than actual concentration values. For example: "with the exception of sample W9 (quartz vein with mafic volcanic), the sulphur content ranged from P26 to P59 with NP and TIC levels ranging from P39 to P75". These concentration values should be given in %S and in kg $CaCO_3$/t, respectively for total and sulphide sulphur, and for NP and TIC- NP.

Recommendations/ Requests:

a. Please provide information on the percentage and total mass of waste rock and ore which will be mined at the site accordingly to their ARD classification of non-PAG, uncertain and PAG categories.

b. Please provide information on the average storage time and tonnage of waste rock and ore in these temporary storage piles and the probability, if any, of ARD and metal leaching occurring during that time.

c. Please clarify if there will be any seepage of the waste rock and ore contact water to the ground below the storage pads and how it will be monitored and intercepted.

d. Please provide information on any ongoing monitoring of the contact water drainage from the existing waste rock and ore stock piles at the site that were stored during the previous, short mining period at the site.

e. Please provide information on any planned usage of the stored waste rock for local fill or tailings cover or for other general construction application which may be susceptible to metal leaching in the long-term.

f. Please provide the criteria used for selecting the realistic total sulphur value when the measured values by XRD, MLA and ABA methods are significantly different for a given sample.

g. For the barrel sample ABA analysis, please provide the sample characterization results as actual concentration values rather than in percentiles.

77.6 TMAC RESPONSE

a.

The total mass of waste rock produced under the proposed mine plan will be approximately 1,400,000 tonnes. An additional 183,000 tonnes is found in the current stockpile. The current geological model includes the diabase dyke (6% of the waste rock), ore zones (which include most of the quartz veins), and then the surrounding volcanic rock (94% of waste), which is a mixture of basalt and all of the other units listed in Table NRCan-1 - 1 in the preceding section. These units are intermixed at too fine of a scale to support geological modelling. Therefore, the proportions of these units was estimated based on the proportions of samples found in the dataset. Using the more conservative TIC(Ca+Mg)/AP classification for all of the units except diabase, and conservatively including all of the quartz vein samples in the calculation, the overall proportion of non-PAG rock is approximately 76%, with the balance occurring as uncertain or PAG.

b.

From the perspective of understanding the potential for ML/ARD to occur in the waste rock stockpiles, the maximum residence time is considered to be more relevant than average residence times. There is currently 183,000 tonnes of waste rock in the existing waste rock stockpile that was placed in 2010/2011 when mining was initiated at Doris North. Waste rock production will ramp up starting in Year -2 (2015), with surface storage requirements reaching a peak in Year 1 (2017). From Year 2 to Year 4 (2018 to 2020), backfilling requirements will exceed waste rock production, and the surface stockpiles will be gradually depleted, with no waste rock remaining in surface stockpiles by the end of the mine life in 2020. Therefore, the maximum duration for surface storage will be on the order of 10 years for the 183,000 tonnes currently on the pile, and 5 to 6 years for waste rock produced as part of the proposed mining operations, which commenced in 2015.

ABA results indicate that the majority of the waste rock will be non-PAG, with a relatively small proportion of material classified as PAG or as having an uncertain potential for ARD. Humidity cell tests on this latter group of samples (Document P5-15) indicate that while it is theoretically possible for acidic conditions to develop in these samples, lag times to onset of acidic conditions would be on the order of decades to centuries (Document P5-15b, Appendix E3). Therefore ARD is not expected to occur during the relatively short period of time that waste rock will be stockpiled on surface.

Contact water from the existing waste rock pile provides a good indication of metal leaching rates, and was the basis for developing source terms for future waste rock, as described in Document P6-10. The waste rock stockpiles are expected to be a relatively minor source of metal loading to the TIA during mining operations (Document P6-10).

c.

Contact water from the waste rock and ore storage pads will be collected either in the existing Pollution Control Pond (PCP#1) and the associated underflow interception sump located at the southeast corner of the existing pad, or a new Pollution Control Pond (PCP#2) located southeast of Pad U. Contact water will be pumped to the TIA in accordance with the current Water Licence (2AM-DOH1323, Part D, Item 27 and Part F, Item 22), and Module 1 of the Water Management Plan (Document P5-3). The Pollution Control Ponds and associated sumps have been designed to prevent seepage from reaching areas downgradient of the storage pads. Therefore, no seepage is expected to bypass this system.

Monitoring and inspection activities to ensure that these facilities are performing as intended are described in Module 1 of the Water Management Plan (Document P5-3). These include visual inspections to determine the function and integrity of the ponds and conveyance structures, staff gauge readings to record pond volumes, flow metering, and sampling and analysis of water quality in accordance with the current Water License. All of the monitoring data is incorporated into the existing monthly and annual monitoring reports submitted to the Nunavut Water Board.

d.

Under the current Water Licence, contact water in the Pollution Control Pond (Station ST-2) is monitored for water quality on a monthly basis during the open water season, and the pond volume and discharges to the TIA are monitored during periods of discharge. A summary of the water quality monitoring data is provided in Document P6-10, Appendix A, Table A-4. A response to a previous comment by AANDC also provides plots of concentration over time for key water quality parameters at this station (response to ID# AANDC TC5, presented in Section 39 of December 2015 Letter from TMAC to NWB, RE: TMAC Resource Inc.'s Revisions to Amendment Application No.1 of Project Certificate No. 003 and Water Licence No 2AM-DOH1323: Proponent's Response to NWB Technical Comments).

e.

Based on the current backfill requirements for the underground mine, it is anticipated that all of the waste rock will be used as backfill. However, waste rock use for construction has been approved through a previous amendment to 2AM-DOH1323; the current Waste Rock and Ore Management Plan (Document P5-4) includes provisions to

segregate potentially "mineralized" and "non-mineralized" rock in separate stockpiles and to use the "non-mineralized rock" for construction. As described in the Management Plan, the waste rock will be segregated according to rock type, with diabase classified as "non-mineralized" due to its consistently low sulphur content, and all other rock types classified as "mineralized" due to variable ARD potential. Existing data for the diabase indicates that it is consistently non-PAG. However, in the event that the diabase is used for construction, further testing will be completed to confirm that it is suitable for that purpose as described in Document P5-4, Section 3.1. TMAC would like to emphasize that the majority of the "mineralized" waste rock is classified as non-PAG, and that the classification of material according to rock type is intended to provide a conservative but practical means of managing waste rock. If backfilling requirements change, other means of segregation could be considered to reallocate a much greater portion of the so-called mineralized waste rock as non-mineralized rock for management purposes.

f.

TMAC acknowledges that there is some variability in the sulphur content measured by XRD, MLA and ABA methods. However, most samples showed reasonable agreement between these different methods, as evident in Document P6-15, Table 3.1, whereas HC-36 is not considered to be a good example of the extent of the variability, likely due to nugget effects associated with the more mineralized quartz veins. In all of the geochemical characterization work presented in this application, sulphur content from the ABA tests are used to determine sulphur content and therefore acid potential, while XRD and/or MLA are used to determine the types of sulphides that are present. Quantification by XRD is affected by detection limits (typically around 1%) and variations in degree of crystallinity (with more crystalline minerals showing disproportionately high representation), while quantification by MLA is limited by the mass of material exposed on a polished section – typically around 3 cm diameter and only a few 10's of microns thick, which can lead to variations or nugget effects in comparison to more standardized assay methods.

g.

Actual concentration values for key ABA parameters from the barrel test samples are provided in Document P6-15, Tables 3.6 and 3.7, p. 24.

77.7 ATTACHMENTS

Not applicable

78. ID# NRCAN-3

78.1 SUBJECT

Tailings disposal, geochemistry and TIA drainage water quality

78.2 REFERENCE

TMAC's 2015 Amendment Application No.1 of Project Certificate NO. 003 and Water Licence 2AM-DOH1323 (June 2015): Package 2- Project Description (Sec. 3.5, 3.5.1, 3.5.2, 3.6, 3.6.2); Package 5- Management and Other Plans (P5-2, P5-3); Package 6- Engineering and Design Documents (P6-10, P6-12, P6-13); Package P6-12- Tailings Geochemistry (Sec. 3, 4 and 5)

78.3 SUMMARY

Not applicable

78.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

78.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Rationale:

The flotation tailings will be sub-aerially deposited in the southern part of the TIA, impounded by South Dam and an intermediate retention dyke (Interim Dyke) approximately 1,500 m north of the South Dam. The remaining portion of the TIA between the Interim Dyke and the existing North Dam will not contain any tailings and will be used as a reclamation pond for recycling effluent to the mill or for direct discharge to Robert Bay. The tailings will be deposited as slurry and discharged from a number of points along the South Dam and the eastern perimeter of the TIA to drain towards the Interim Dyke with a slope of the deposited tailings landscape of about 1%. At closure, the Interim Dyke height will be reduced to match with the elevation of the settled tailings in its proximity.

The Interim Dyke is designed to permit free drainage of the tailings process water while retaining the solids. The tailings will dewater to a water table configuration that will follow the final landscape topography and may have a north-south horizontal gradient of 1% and an elevation difference of ~15 m. The tailings deposition process will also lead to particle size segregation with coarser tailings settling close to the discharge points and the finer fraction settling at more distal locations towards the north and west sides

of the TIA, contributing to varying hydraulic conductivity zones and basin flow paths. The ABA, and oxidation and leaching characteristics of the coarse and fine fractions of the flotation tailings will be also different and may not be the same as those of the total test tailings used in the static tests and kinetic leaching characterization.

The coarse tailings areas will also have very low runoff with the runoff coefficient on the order of 0 to 0.1 contributing to a much deeper zone of precipitation infiltration and leaching, perhaps most of the vadose zone. The fine tailings areas will contribute to a higher runoff with the runoff coefficient on the order of 0.5 to 0.8. These areas will also have a much higher capillary fringe zone that will contribute to quick response of the water table to precipitation events. Thus, in either case, most of the tailings thickness above the water table will contribute to precipitation infiltration and leaching. For these reasons, the assumed leaching depth of 0.1 m and a runoff coefficient of 0.5 in the water quality prediction model for the deposited tailings in the TIA cannot be justified.

At closure the tailings surface will be covered with the mined waste rock to a nominal thickness of about 0.3 m. Freeze back analysis of the settled tailings in the TIA showed that the tailings mass will be completely frozen in about 10 years following tailings reclamation and decommissioning. The predicted active zone of the tailings basin has been calculated to be about 1 m for the existing climatic conditions increasing to about 3 m over a 100 year period due to the global warming trend with the predicted global mean temperature rise of 4 °C. Perhaps, in the north, the temperature rise may be more due to the loss of winter snow and summer ice covers. Thus, for the post closure water quality prediction modelling of the TIA basin, the entire depth of the active zone should be realistically considered as the leaching depth of the tailings which will also increase three folds in about 100 years.

Recommendations/Requests:

a. Please provide the particle size distribution of the flotation tailings, and information on how the particle size segregation process during deposition would impact their ABA and oxidation and leaching characteristics.

b. As the tailings particle segregation is expected in the TIA, please provide the rationale/validity of using the tailings leaching depth of 0.1 m and runoff coefficient of 0.5 in the TIA water quality prediction modelling.

c. Please provide a comparative evaluation of the TIA water quality modelling using the tailings leaching depth as that of the unsaturated zone before complete freeze up of the tailings, and that of the active zone after the freeze-up including the impact of climate change on the basin water quality.

d. Please provide information on the water quality impacts of the mineralized waste rock cover placement on the tailings at closure.

78.6 TMAC RESPONSE

a.

Particle size distribution data for four flotation tailings samples, including one from Doris Central are provided in Appendix B: NRCan-3 - 1. Tailings deposition will be by conventional spigotting methods, and is expected to result in segregation of coarser tailings in beach areas.

The flotation tailings have total sulphur concentrations ranging from 0.02 to 0.53% (median 0.06), NP/AP ratios ranging from 12 to 207 (median of 58) and TIC/AP ratios of 9 to 130 (median of 91) are clearly non-PAG (Document P6-12). Even if segregation results in some concentration of sulphides on the beaches, this is not expected to change the ARD classification appreciably due to the consistently high NP present in the tailings solids.

b.

At closure, the depth of oxidation will be governed by the depth of saturation in the tailings. As described in Document P6-13, permafrost is expected to develop at a depth of 1 metre, and over time this will increase to a depth of 3 metres. The presence of permafrost will create an aquitard beneath the tailings, effectively limiting seepage to a narrow zone along the edge of the Interim Dike. In the immediate area of the Interim Dike, seepage losses will result in desaturation of tailings up to the depth of permafrost (maximum of 3 metres). However, this will be over a limited area of the impoundment, and in tailings that are located approximately 1,200 metres from the spigot point, suggesting that they would be inherently fine grained with limited rates of air entry. Throughout the rest of the impoundment, infiltration will exceed the rate of seepage loss, and the depth of saturation will be very close to the tailings surface – likely far less than the average depth of oxidation used in the current source term estimates for the tailings. For this reason, an oxidation depth of 0.1 metres is considered to be a reasonable basis for the source term estimates. Similar conditions are expected prior to freeze-back, although depths of oxidation could be somewhat deeper in the immediate vicinity of the Interim Dike.

Further support for a limited depth to saturation in the tailings is presented in the 2006 closure plan for the Lupin Mine (Appendix 2 of Abandonment and Restoration Plan Lupin Tailings Containment Area Water Licence NWB1LUP0008 Lupin Mine, Nunavut, Kinross Mining, June 2005). Results from field investigations in the Lupin tailings showed that water levels in covered areas of the Lupin tailings were above the tailings level in 8 of 9 test pits excavated in the impoundment. The single exception was located close to one of the perimeter dykes, where seepage losses would be expected to exceed recharge. The results of this work were used to support changes to the original closure

plan for the site which called for a thick esker cover to promote freezing conditions throughout the tailings.

The runoff factor used in the calculations is used to estimate the total flow interacting with the tailings – either as surface runoff or as infiltration and then lateral flow through the tailings. In the source term calculations, we assume that the total mass of contaminants released by sulphide oxidation will be released into the total volume of runoff water. The runoff volume corresponds to the total amount of water interacting with the tailings and reporting to the tailings pond – therefore, in effect, the source term could have been presented as a mass loading rather than a concentration. For this reason, we do not feel that model is sensitive to potential variations in runoff coefficient.

c.

The unsaturated zone of the tailings is not expected to correspond to the full depth of the active zone as described above, therefore further evaluation is not warranted.

d.

TMAC would like to clarify that the cover over the tailings surface will be constructed using quarry rock, with essentially the same range of geochemical characteristics as the material that was used to build all of the existing pads and roads at the Hope Bay site. Nonetheless, the potential loadings from cover placement were considered in the water and load balance model, as described in Package 6-10, Section 4.2.6. The cover source term was equivalent to the source term for surface infrastructure area (Document P6-10, Section 4.2.7), which was based on the 95th percentile concentrations from seepage data measured in 2013 and 2014 at non-waste rock impacted locations at Doris and along the Doris Windy Road.

78.7 ATTACHMENTS

Appendix B:

NRCan-3 – 1 Particle Size Distribution

79. ID# NRCAN-4

79.1 INTRODUCTION

Permafrost

Documents Reviewed:

TMAC Resources Inc., June 2015, Revisions to TMAC Resources Inc. Amendment Application No.1 of Project Certificate No. 003: Package 1 - Project Summary

Package 2 - Project Description

Package 3- NIRB and NWB Application

Package 4 - Identification of Potential Environmental Effects and Proposed Mitigation

Package 5 - Management and Other Plans

Package 6 - Engineering and Design Documents

TMAC's Response to Information Requests- Table of responses (September 10, 2015) and Technical Memo in response to NRCan IRs 1c and 1d (December 4 and 1, 2015 respectively) Project Certificate NIRB [NO.: 003] for Approved Doris North Project, September 15, 2006

Introduction:

TMAC submitted a revised project description in June 2015. An important difference from the approved Project is a revision of the design of the Tailings Impoundment Area (TIA). The approved project consisted of subaqueous tailings disposal with a water cover at closure. Subsequent modification to mine plans and an anticipated increase in tailings volume necessitated a further modification to the TIA to handle an increased tailings volume. The revised project description now consists of subaerial tailings deposition and a dry cover at closure. The documentation submitted in support of the revised project was reviewed to determine if additional information was required to facilitate the technical review. The review focussed on the revised plans for the TIA and issues of stability of the foundation and tailings containment structures. In September 2015, NRCan requested additional information and TMAC responded in November 2015. TMAC provided additional information regarding the design of the TIA including the stability analysis and role of frozen conditions in maintenance of the integrity of the TIA. The additional information was helpful in providing a better understanding of the plans for the TIA. NRCan generally agrees with the approach taken by TMAC in their preliminary design and impact assessment associated with the TIA and understands

that further analysis and refinement of the design will occur as the project moves to a more advanced stage. NRCan offers the following comments and recommendations for consideration by NIRB and TMAC in formulating final design plans and environmental monitoring and management plans.

79.2 SUBJECT

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

79.3 REFERENCE

TMAC's 2015 Amendment Application No.1 of Project Certificate NO. 003 and Water Licence 2AM-DOH1323 (June 2015)- Package 2 (P2-1, sec. 3), Package 6 (P6-13, inc. App. B, C, D, E, F, G), Package 5 (P5-2 sec. 2, 3,5,9; P5-3 sec 2,3); Response to NRCan IR-1 and accompanying memos, December 2015, (Also response to AANDC IR-14, KIA IR-5,35 October 23, 2015); Project Certificate NIRB [NO.: 003] (September 15, 2006)

79.4 SUMMARY

Not applicable

79.5 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

79.6 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue:

The revised plan for tailing disposal is subaerial hydraulic tailing disposal in the south end of the TIA behind an interim dyke with a dry cover at closure. Dams for the TIA must be designed to ensure that water is retained and there is no release of water to the surrounding environment prior to water quality meeting compliance guidelines. The Interim Dyke must be designed to ensure that tailings are contained between it and the South Dam during deposition and to ensure that tailings are not released to the adjacent pond during closure. Stability of the various structures must be maintained to ensure the facility performs as intended. Settlement or heave of the foundation related to loading or freezing and thawing can lead to deformation of dams and dykes and the tailing pile which can have implications for stability and performance.

Proponent's Conclusion:

The TIA will be designed to ensure the long-term stability of the tailing surface and retaining structures in order to minimize the risk of tailings and/or tailings water to the

environment and therefore minimize the risk of acid rock drainage and metal leaching into surface water (P5-2, sec 3.7). The North and South Dams are part of the approved project (P2-1, section 3.5). The only new structure required is the Interim Dyke which will be left in place at closure but will not be required to be a water retaining structure at closure, i.e. it will retain only the tailings (P5-2, section 3.7, 5.9). The preliminary analysis provided indicates that the Interim Dyke will be stable over the long-term (P6-13, App. E). Thermal modelling indicates that over time the tailings and the foundation will freeze and although not required for TIA performance (Response to NRCan IR-1), the freezing will enhance the performance of the TIA (6-13, App. F).

NRCan's Conclusion and Rationale:

NRCan generally agrees with TMAC's approach. For the most part TMAC has taken a conservative approach to their design and analysis. For example, unfrozen conditions have been considered for the stability, seepage and water quality modeling even though frozen conditions are anticipated to be established within and beneath the tailings with frozen conditions maintained beneath the North and South Dams. NRCan would note that although there have been detailed investigations of foundation conditions for the North and South Dam alignments, there have not been detailed geotechnical investigations for the Interim Dyke alignment (e.g. P6-13, sec. 2, 4 and App. E). Foundation characteristics for stability and settlement analysis for the Interim Dyke are based on information gathered on overburden characteristics for the project site including other lakes and the limited boreholes drilled in Tail Lake (P6-13, sec. 4, App. E, G). Fine-grained marine sediments were assumed for the analysis and NRCan agrees that this is a conservative approach and appropriate for the preliminary design stage. NRCan recommends that further geotechnical investigations will be conducted to support final engineering and the stability and settlement analysis will be refined to incorporate any new information.

Additional information, in response to NRCan IR-1, was provided by TMAC in December 2015 regarding the potential for pore water expulsion and frost heave during freezing of the tailings and the underlying foundation and the implications for TIA performance. The memos provided by SRK present additional analysis to support TMAC's conclusions that pore water expulsion and frost heave will not have any significant effects on the TIA performance. With respect to pore water expulsion, TMAC has taken a conservative approach regarding the unfrozen moisture content of the tailings and its salinity and has shown that there would be limited release of water to the talik beneath the tailings and no significant impact on groundwater quality.

With respect to frost heave, TMAC has indicated that this was not considered explicitly in the stability analysis or deformation/performance of the tailing cover presented in P6-13. In their memo in response to NRCan IR-1, SRK provides additional analysis regarding the impacts of frost heave on TIA performance. The potential for excess ice formation is anticipated to be low and the cover will only be constructed in the winter following

closure at the earliest at which time the tailings are expected to be completely frozen (PS-2). Any heave will have already occurred so that further heave and deformation of the cover is not expected. Uniform foundation materials are expected beneath the tailings so differential heave is not anticipated during freeze-back. NRCan generally agrees that the qualitative assessment provided by SRK is appropriate for the preliminary design stage. NRCan does note that TMAC has indicated that there is potential for freezing point depression due to marine sediments in the foundation and that for dam design a freezing point of -2.3°C was used in the thermal and creep analysis (P6-13, App. E, F). Freezing of the foundation may be slower and the presence of unfrozen water at sub-zero temperatures could result in segregation of ice formation. The thermal analysis presented for the tailings and underlying foundation presented in P6-13 {App. F) appears to be based on 1-D modelling with only vertical heat flow considered as freezing rates appear to be spatially uniform. The presence of the pond adjacent to the Interim Dyke would result in warmer conditions in the northern portion of the pile and foundation and it would be more appropriate to consider lateral and vertical heat flow (2-D thermal model). Although uniform foundation conditions might exist the rate of freezing may be variable and this could result in differential movement during freeze- back.

Monitoring of the TIA is required during the post-closure phase but TMAC does not anticipate that this will be required in perpetuity. The monitoring plans will be defined in an Operations, Maintenance and Surveillance Manual to be submitted to the Nunavut Water Board prior to TIA operations (Response to NRCan IR-1). This will include triggers to determine when monitoring can be suspended. Additional plans for post-closure monitoring including that to ensure physical stability of the cover are included in P5-2 (sec. 9) and P5-3 (sec. 2 and 3). NRCan would also note that there were conditions in the certificate for the approved project that are also relevant to the modified project including conditions 11-16 as well as commitments for additional thermistor installation during construction for monitoring of permafrost conditions (Certificate App. A, Permafrost #1, 2). The Addendum to the certificate conditions also included commitments (App. A) to do all necessary analysis to ensure dam safety prior to construction and to consider additional dam foundation characterization to complete final design.

Summary and Recommendations:

The analysis provided to support design of the TIA including stability and thermal analysis is appropriate for the preliminary design stage. As mentioned above a number of conditions and commitments included in the certificate for the approved project are also relevant to the revised project plans. NRCan also offers the following recommendations for consideration at the detailed and final design stage.

- NRCan recommends that TMAC consider additional geotechnical investigations to characterize foundation conditions for the Interim Dyke and the tailings pile and refine their thermal and stability analysis to include new information.

- NRCan recommends that TMAC consider 2-D thermal modelling to ensure that variable freezing rates in the pile and foundation do not result in differential movements that could impact facility performance.

79.7 TMAC RESPONSE

TMAC is committed to completing further characterization of the Interim Dike foundation prior to construction.

Following further characterization of the Interim Dike foundation, TMAC will complete the detailed engineering for the Interim Dike. All engineering analysis, including the thermal analysis will be revisited to ensure that they are appropriate given the site specific foundation conditions. At this point, It is however premature to suggest that 2D thermal analysis would be the most applicable approach.

79.8 ATTACHMENTS

Not applicable

80. ID# NRCAN-5

80.1 INTRODUCTION

Groundwater (Hydrogeology):

Documents Reviewed:

TMAC Resources Inc., June 2015, Revisions to TMAC Resources Inc. Amendment Application No.1 of Project Certificate No. 003: Package 1 - Project Summary

Package 2 - Project Description

Package 3- NIRB and NWB Application

Package 4 - Identification of Potential Environmental Effects and Proposed Mitigation

Package 5 - Management and Other Plans; P5-3 Water Management Plan

Package 6- Engineering and Design Documents; P6-3 Groundwater Inflow and Quality Model

TMAC Resources Inc. Responses to IR Comments on the Doris North Project Terms and Conditions within Project Certificate No.003 and application to amend the Water Licence 2AM- DOH1323, November 2015

SRK Consulting, December 4, 2015. Doris North Project Memo- Response to NRCan IR-3 & AANDC IR#13: Estimation of the Time Required for Underground Mine to Fill

Hope Bay Gold Project: Stage 2 Overburden Characterization Report, September 2009. Prepared by SRK Consulting (Canada) Inc.

SRK Consulting (Canada) Inc. (2006). Design of the Tailings Containment Area- Doris North Project, Hope Bay, Nunavut, Canada. Report submitted to Miramar Hope Bay Ltd October, 2006. SRK Project No. 1CM014.008.165

Project Certificate NIRB [NO.: 003] for Approved Doris North Project, September 15, 2006

Introduction:

In June 2015, TMAC submitted an amendment application to amend their previously approved project for the Doris North Project. This application includes the previously approved mining of the entire Doris Deposit with an expected mine life of up to 6 years, increases of mining rate and mill throughput rate, expanded and revised laydown

areas, cyanide destruction of tailings, ability to overwinter fuel barges as contingency, effluent discharge to Robert's Bay rather than Doris Creek, and removal of the requirement to maintain a certified lab on site. Key changes include a change from subaqueous tailings disposal to subaerial disposal and backfill underground, and the use of Quarry 3 for non-hazardous waste storage. The Tailings Impoundment Area (TIA) will have a dry cover at closure.

In September 2015, NRCan requested additional information on the amendment application related to hydrogeology (IR#2 and IR#3) and received responses from TMAC in November 2015. NRCan requested additional information on monitoring plans for the TIA and on the post-mining groundwater regime. TMAC provided some additional information that provides clarification; however, it is NRCan's opinion that there is still some uncertainty regarding groundwater inflows into the underground mine, the post-mining groundwater regime around the underground mine, and monitoring and mitigation programs in the vicinity of the TIA. This can influence potential impacts to groundwater and surface water receptors. NRCan's technical review elaborates on this and provides recommendations for consideration by NIRB and TMAC in developing final design plans and environmental monitoring and management plans.

80.2 SUBJECT

Groundwater inflows into the underground mine

80.3 REFERENCE

Not applicable

80.4 SUMMARY

Not applicable

80.5 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

80.6 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue:

Because the Doris Deposit extends south and encompasses the Doris Central and Doris Connector Zones, which are under Doris Lake, TMAC now expects to encounter groundwater during mining. Testing shows it may be saline and this water will be collected and sent through a new pipeline directly to Roberts Bay, instead of Doris Creek as Miramar (the previous proponent) originally planned. During mining,

groundwater could flow from Doris Lake, through cracks in the rock at the bottom of the lake, into the mine. TMAC plans to manage this water by plugging holes in the rock and pumping the water out of the mine. Groundwater inflows into the underground mine from the surrounding deposits are also expected. NRCan is concerned that the combined water inflow into the underground mine may be greater than anticipated. This would in turn have an effect on water management.

Proponent's Conclusion:

TMAC has stated that if flows of 3,000 m^3/day into the underground mine are exceeded, mining will cease, and measures will be implemented to mitigate the flow. They propose mitigating this using pressure grouting in the affected areas. TMAC has also indicated that as mining advances forward, exploration drilling will help identify the location and sources of substantial inflows.

NRCan's Conclusion and Rationale:

It is NRCan's view that there is some uncertainty associated with the underground mine inflow predictions. Precise volumes of inflow have not yet been determined and the plans to manage this water requires more detail. The uncertainty results, in part, due to the way the groundwater system was modelled and to the information available to input into the model. It appears as though the model was not calibrated. Additionally, TMAC acknowledges that the distribution of hydraulic conductivity in the unfrozen ground is very complex and the specific features that control the flow are not well understood. There are several hydrostratigraphic units displaying unique hydraulic properties (e.g. lake bed sediments, the diabase, the zone of high conductivity surrounding the Doris deposit, and the volcanic rocks). The sensitivity analysis of the numerical groundwater model indicates that the model is highly sensitive to the hydraulic conductivity of the geological materials, hence if this parameter is not precisely characterized there could be error in the predictions.

Recommendations/Requests:

- NRCan requests that TMAC provide clarification on model calibration.

- It is recommended that inflows into the underground mine be further constrained prior to commencement of mining.

- It is also recommended that the water management plans, and monitoring and mitigation plans consider that inflows into the underground mine may be greater than predicted.

80.7 TMAC RESPONSE

The reviewer is requested to refer to the response to Technical Comment INAC-3 of this document for a response to these questions.

80.8 ATTACHMENTS

Not applicable

81. ID# NRCAN-6

81.1 SUBJECT

Post-mining groundwater regime around the underground mine

81.2 REFERENCE

Not applicable

81.3 SUMMARY

Not applicable

81.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

81.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue:

NRCan had requested clarification on how the proposed change to subaerial tailings disposal would affect the post-mining groundwater flow regime in the vicinity of the underground mine. NRCan also asked for clarification on the time required for the underground mine to fill and potential impacts to groundwater flow and quality. NRCan's concern is that since TMAC plans to dispose of potentially acid generating (PAG) material and detoxified tailings in the underground mine, the water quality in the underground mine may become contaminated and will need to be contained. Additionally, the existing groundwater is highly saline and has elevated concentrations of dissolved chloride, ammonia, boron, cadmium and manganese. Inflow of this water into the underground mine will contribute to poor water quality in the underground mine.

Proponent's Conclusion:

TMAC states that adverse effects to groundwater quality are not expected. They indicate that about 6% of the tailings are comprised of detoxified cyanide leach tailings, which will be deposited in the underground mine. In humidity cell tests, these tailings showed a propensity for leaching of several metals and development of acidic conditions. In their December 4, 2015 memo, TMAC presented details on the time required for the underground mine to fill. TMAC has estimated the refilling time to be about 2 years. They argue that once mining ceases, the underground workings will

have no further impact on groundwater regime, as the final expected groundwater elevation will be well below surface openings.

NRCan's Conclusion and Rationale:

Typically in permafrost regions, the area around an underground mine is within permafrost and groundwater inflow into the underground mine is minimal. Likewise, once the underground mine has flooded, there is minimal flow between the water contained in the underground mine and the groundwater system. However, the revised mine plan extends into the talik underneath Doris Lake, which has an open talik, allowing for connection from Doris Lake to deeper groundwater. In northern permafrost regions the larger lakes are essentially connected through open taliks which extend to the deeper groundwater system. Regionally there are groundwater flow patterns that flow from lakes with higher elevations to lakes with lower elevations. NRCan notes that TMAC has not fully considered the effect of this regional groundwater flow pattern on the fate of water within the underground mine workings. This is important to consider as the underground mine workings are below Doris Lake and within this lake's talik that is connected to deeper groundwater. This regional groundwater flow system could impact containment of the underground mine water. TMAC does mention in their December 4, 2015 memo that there is evidence to indicate that groundwater currently flows from the open talik base upwards to Doris Lake.

Recommendation/Request:

- To improve the current understanding of the post-mining groundwater flow regime in the vicinity of the underground mine, it would help to consider the context of the regional groundwater flow system and specifically, determine the fate of water in the underground mine. It is recommended that TMAC determine whether the water will flow towards Doris Lake or towards deeper groundwater.

81.6 TMAC RESPONSE

In the response to the technical comments AANDC TC3 submitted to the NWB in December 2015, TMAC committed to provide an estimate of the potential flux of groundwater into Doris Lake post closure at the Technical Meeting in Cambridge Bay in January 2016.

81.7 ATTACHMENTS

Not applicable

82. ID# NRCAN-7

82.1 SUBJECT

Monitoring and mitigation in the vicinity of the TIA

82.2 REFERENCE

Not applicable

82.3 SUMMARY

Not applicable

82.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not applicable

82.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Issue:

Miramar originally planned to place tailings under water within the TIA. TMAC still plans to place the tailings into the TIA, with some of the tailings being placed within the original lake area and some of the tailings placed on the ground around the original lake area. The tailings, which haven't been exposed to chemicals will be placed behind a new dike in the middle of the TIA. Water will drain off of the tailings and through the dike. The water on the other side of the dike, in the tailings pond, will be used as process water in the mill or will be treated and pumped to Roberts Bay. The tailings will become dry and will be covered with ice or sprayed with a material that will prevent the tailings from becoming dusty. Once the mine is closed, the tailings will be covered with a layer of rock, and will freeze under the rock. The remaining tailings, which have been exposed to chemicals used to extract gold, will be treated and placed underground as mine backfill. NRCan had previously suggested that it may be necessary to monitor seepage rates and groundwater quality of seepage water from the TIA.

Proponents Conclusion:

TMAC indicated that such monitoring plans would be documented in a site-wide Water Management Plan and in the Tailings Containment Area Operational, Management and Surveillance (OMS) Manual, which will be submitted to the NWB prior to the commencement of TIA operations. TMAC indicates that they plan to monitor seepage rates down gradient from the North and South Dams. TMAC notes in response to NRCan

IR#2 that they are not anticipating the need to monitor shallow groundwater in the vicinity of the TIA and that this is addressed in NRCan IR#1.

NRCan's Conclusion and Rationale:

Upon examination of the response to NRCan IR#1, NRCan notes that TMAC plans to monitor TIA containment dams for 5 years in the post-closure period. TMAC notes that shallow groundwater beneath the TIA is confined to the closed talik beneath the TIA and the surrounding active layer. TMAC does not address the issue of shallow groundwater monitoring in the vicinity of the TIA, so this issue is still outstanding.

While NRCan would prefer to have a framework for monitoring developed during the technical review phase, it is acknowledged that the detailed monitoring plan is often developed during the detailed design phase and is required to meet the regulatory guidelines set by NIRB.

Request:

- NRCan requests that TMAC provide justification for the statement that there is no need to monitor shallow groundwater in the vicinity of the TIA.

82.6 TMAC RESPONSE

In our response to NRCan IR#1, TMAC explained that shallow groundwater in the TIA catchment is limited to the closed talik beneath the original Tail Lake, which is now the designated TIA, as well as the active layer in the surrounding landscape of the catchment.

Shallow groundwater draining from the active layer, eventually would flow into the TIA and since this surrounding landscape is upstream of the TIA, this shallow groundwater is not impacted by tailings deposition, or mining activity other than the presence of the Secondary Road and Explosives Storage Area and traffic to and from these areas. Shallow groundwater impacted by tailings deposition during the operational and active closure period of the project immediately below the TIA is confined to the closed talik below the TIA and therefore are not resulting in any environmental impact outside of the immediate footprint of the TIA.

At closure the exposed tailings are is covered to prevent erosion and the TIA Reclaim Pond is drawn down completely and allowed to naturally refill to the original outflow elevation of Tail Lake at 28.3 m. Once confirmed that water in the TIA meets discharge criteria, the North Dam is breached and natural discharge to Tail Lake Outflow is re-established. From this point forward the Reclaim Pond is no longer a source of potential groundwater contamination. There still remains a small source load emanating from the active layer of the now frozen tailings underneath the cover; however water and load balance modelling has confirmed that this load is not significant and does not result in

exceedances of CCME Freshwater quality guidelines downstream of the former Reclaim Pond.

TMAC therefore believes that there is no justification for doing any short or long-term, monitoring of shallow groundwater within the TIA catchment basin

82.7 ATTACHMENTS

Not applicable

83. ID# TC 3.1.1

83.1 SUBJECT

Navigation Protection Act - Tail Lake – Tailings Impoundment Area (TIA)

83.2 REFERENCE

P 6-13 Tailings Management System

83.3 SUMMARY

The tailings impoundment area (TIA) at the Doris Project has been assigned to Schedule 2 of the MMER and as such is no longer a navigable waterway. Further, during the assignment process all past uses of the watercourse were assessed prior to it being designated for Schedule 2 inclusion.

83.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Compliance of S.21-23 of the NPA

83.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

Sections 21 to 23 of the NPA apply to all waterways irrespective of whether they are listed in the Schedule of the NPA. These sections prohibit the depositing of certain materials in navigable waters or in non-navigable waters that flow into navigable waters and the dewatering of navigable waters. TMAC has indicated that Tail Lake has been assigned to Schedule 2 of the MMER.

Since Tail Lake has been added to Schedule 2 of the MMER, it is considered to be no longer navigable. Sections 21 to 23 of the NPA only apply to waters that are navigable and because of this TMAC is not required to apply for works occurring within Tail Lake.

Existing Terms and Conditions requiring reconsideration or amendment in light of the issue identified: Not applicable

New Terms and Conditions required in light of the issue: Not applicable

83.6 TMAC RESPONSE

No response required.

83.7 ATTACHMENTS

Not applicable

84. ID# TC 3.1.2

84.1 SUBJECT

Navigation Protection Act - Marine Base Infrastructure

84.2 REFERENCE

Package 6-7 Roberts Bay Discharge System: Surface Infrastructure

84.3 SUMMARY

TMAC has indicated that they will construct a 2.3 km effluent discharge pipeline and 900m berm in Roberts Bay.

84.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Compliance with regulatory requirements of the NPA.

84.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

TMAC has acknowledged that Roberts Bay is part of the Scheduled waters under the NPA and will apply for an NPA approval prior to construction. Please indicate when the construction is scheduled to take place and any temporary works and construction methodology that may be required.

Recommendation:

TMAC must submit a complete application to the Transport Canada. The terms and conditions associated with a potential approval may result in restrictions on the time of construction and any associated temporary works.

Existing Terms and Conditions requiring reconsideration or amendment in light of the issue identified: Not applicable

New Terms and Conditions required in light of the issue identified: Not applicable

84.6 TMAC RESPONSE

TMAC plans to construct the Marine Outfall Pipeline late in the open water season in 2016, following the receipt of all relevant approvals. TMAC plans to submit a complete application to Transport Canada for NPA approval early in 2016.

84.7 ATTACHMENTS

Not applicable

85. ID# TC 3.1.3

85.1 SUBJECT

Marine Safety - Cargo Fumigation and Tackle Regulations (CFTRs)

85.2 REFERENCE

Package 2, section 3-13

85.3 SUMMARY

TMAC will continue to seek out safe and economical ways to improve explosives handling.

85.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Compliance with regulatory requirements of the Cargo Fumigation and Tackle Regulations (CFTR)

Ship Safety Bulletin: Loading and Unloading Explosives (Transportation Canada submission of Jan 8, 2016 Appendix A: Transport Canada Ship Safety Bulletin – Loading and Unloading Explosives)

85.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

With the recent amendment to the explosives regulation Transport Canada would like to provide clarification on the potential impact on Paragraph 155(2) of the CFTR. Paragraph 155(2)(b) of the CFTR refers to the Quantity Distance Principles User Manual published by Natural Resources Canada's Explosives Safety and Security Branch. This tool helps inspectors of explosives (as defined in the Explosives Act, section 2) determine the maximum amount of explosives to store in a facility, while minimizing the risks of damage and/or injury in case of explosion.

Paragraph 155(2)(b) of the CFTR does not apply to ports and does not require wharfs or port facilities to assess their sites against the Explosives — Quantity Distances standard. This means the port authorities must decide whether or not they need to carry out this assessment.

With regards to loading packaged explosives onto a vessel or unloading them from a vessel, Transport Canada will allow handling only of the amount of cargo established using the Explosives — Quantity Distances standard for that wharf or port facility.

Recommendation:

When loading and unloading of explosives occurs at a port or wharf, the proponent will ensure the amount handled is within the limits established by the Explosives – Quantity Distance standard that was established for that facility. The proponent will also adhere to Subsection 155(1) of the CFTR which requires ship masters to give the nearest Transport Canada Marine Safety and Security office and respective port authorities at least 24 hours' notice of their intention to load or unload packaged goods that are explosives (other than Class 1.4S), when their net explosive quantity is 25 kg or more. See Transportation Canada submission of Jan 8, 2016 Appendix A: Transport Canada Ship Safety Bulletin – Loading and Unloading Explosives)

Existing Terms and Conditions requiring reconsideration or amendment in light of the issue identified: Not applicable

New Terms and Conditions required in light of the issue identified: Not applicable

85.6 TMAC RESPONSE

TMAC appreciates being made aware of the Ship Safety Bulletin. TMAC will adhere to requirements for loading and handling explosives within the prescribed regulatory requirements.

85.7 ATTACHMENTS

Not applicable

86. ID# TC 3.1.4

86.1 SUBJECT

Over-wintering Guidelines

86.2 REFERENCE

Package 2, section 3-14.1 Winter Fuel Barges

86.3 SUMMARY

TMAC will continue to ensure that any vessel or barge that is retained is fit for this purpose and that this activity occurs in full compliance with all applicable regulatory requirements.

86.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Compliance with regulatory requirements of the Guidelines for Over-Wintering of Vessels Carrying Oil or NLS in Canadian Waters. (Transport Canada submission of January 8, 2016, Appendix B Guideline for Over-wintering of Vessels Carrying Oil of NLS in Canadian Waters)

86.5 DETAILED TECHNICAL COMMENT/ RECOMMENDATION/ REQUEST

During 2010-2011, fuel was temporarily stored in an Arctic class double hull ship frozen into the ice in Roberts Bay, as there was not enough available tankage on site at the time. This activity was carried out in compliance with Transport Canada regulatory requirements and industry best practices.

In October 2015, Transport Canada updated the Guidelines for Over-Wintering of Vessels Carrying Oil or NLS in Canadian Waters.

Recommendation:

If the over-wintering of vessels carrying oil are required in the future, TMAC will ensure they remain in compliance with Transport Canada's current regulatory requirements and guidelines as stated in the Guidelines for Over- wintering of Vessels Carrying Oil of NLS in Canadian Waters. (Appendix B)

Existing Terms and Conditions requiring reconsideration or amendment in light of the issue identified: Not applicable

New Terms and Conditions required in light of the issue identified: Not applicable

86.6 TMAC RESPONSE

TMAC recognises that the Guidelines have been updated and commits to complying with current applicable regulatory requirements.

86.7 ATTACHMENTS

Not applicable