DORIS MINE

Responses to Technical Comments, Nunavut Water Board
REVISIONS TO TMAC RESOURCES INC. AMENDMENT APPLICATION NO.1 OF PROJECT CERTIFICATE 003 AND WATER LICENCE NO. 2AM-DOH1323

December 2015

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DORIS MINE

Responses to Technical Comments, Nunavut Water Board

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LIST OF ACRONYMS

Acronym	Definition
AANDC	Indigenous and Northern Affairs Canada
AEMP	Aquatics Effect Monitoring Program
AMF	Aquatic Monitoring Framework
CCME	Canadian Council of Ministers of the Environment
DEIS	Draft Environmental Impact Statement
DFO	Fisheries and Oceans Canada
EC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
FEIS	Doris North Final Environmental Impact Statement
FSL	Full Supply Level
HCT	Humidity Cell Test
IEAC	Inuit Environmental Advisory Committee
IIBA	Inuit Impact and Benefit Agreement
KIA	Kitikmeot Inuit Association
MMER	Metal Mining Effluent Regulations
NWB	Nunavut Water Board
RPD	Relative Percent Differences
TDC	Total Dissolved Solids
TIA	Tailings Impoundment Area
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
VEC	Valued Ecosystem Components
WAD	Weak Acid Dissociable
WMMP	Wildlife Mitigation and Monitoring Plan

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).

The primary area of concern is immediately below natural lake ice, where eggs and larvae left by fall-spawning fish overwinter. If the lake is drawn down below the natural range, eggs and alevins close to the ice could perish. Consequently, a detailed habitat survey was completed around the entire perimeter of the lake in fall 2015, focusing on the 1 to 4 m zone. In addition, hydroacoustics, gillnetting, angling, underwater video, and visual observations were used to further categorize lake habitats and to identify spawning locations within the lake for Lake Trout, Lake Whitefish and Cisco. This information is currently being assessed in conjunction with existing fisheries and hydrological baseline data to provide further confidence in the effects assessment.

This report will be provided in response to technical comments made during the NIRB technical review, in advance of the technical meeting.

2.7 ATTACHMENTS

Not Applicable

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 B: 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 B: 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 B: 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 B: 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 B: 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 1 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 m³/year (blue line), and this occurs for only two years of operations.

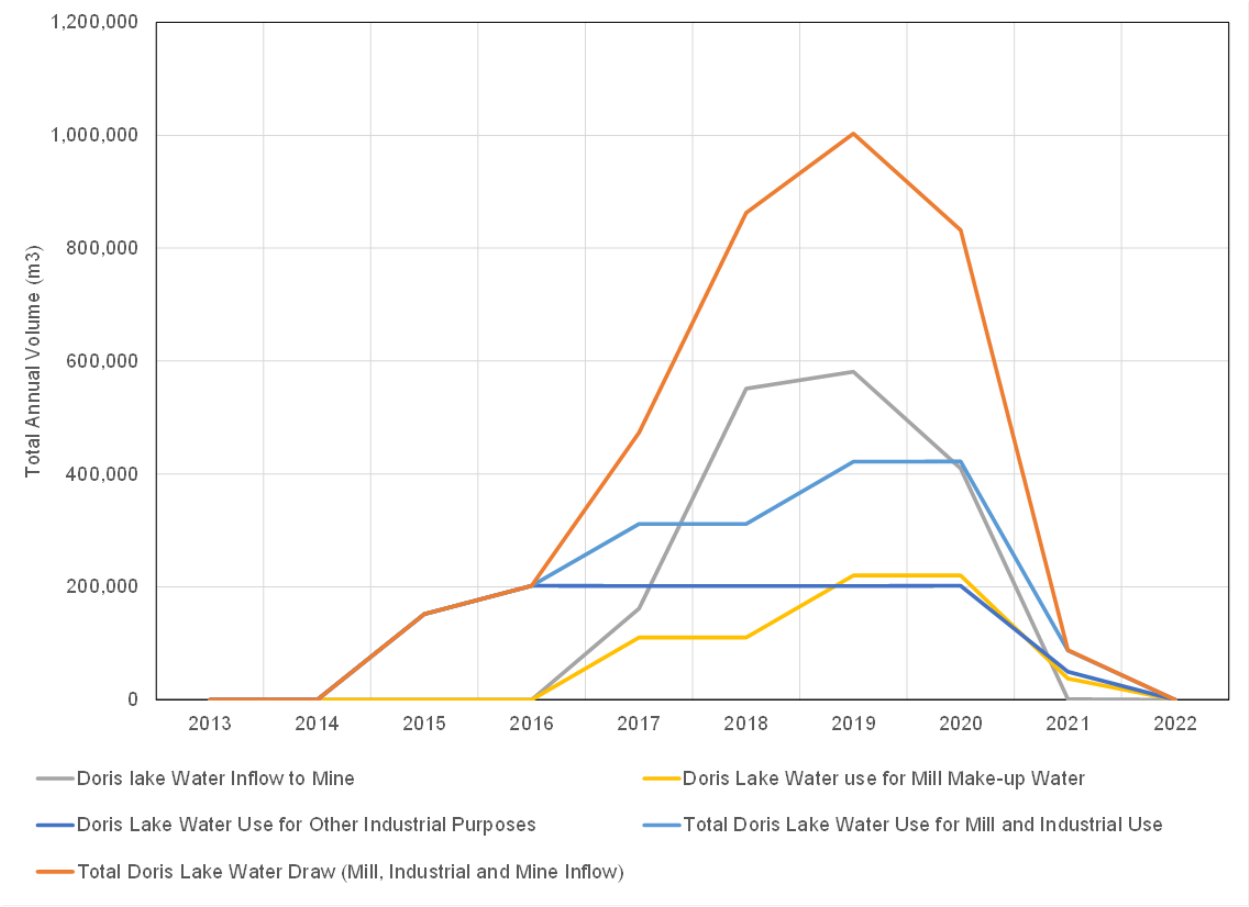

Figure 1: Water withdrawal and losses Doris Lake during Operations.

3.7 ATTACHMENTS

Appendix B:

- 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.

Preliminary results (final results forthcoming in early January 2016) from the 2015 field program, including a spawning habitat survey in Doris Lake indicate 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

Not Applicable

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 is being investigated further through hydrological 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).

Preliminary results of the hydrological modeling indicate that a 6.2% reduction in discharge will have a negligible effect on water depth in Little Roberts Lake Outflow; water depths in riffle/boulder gardens (the most vulnerable habitat type) are predicted to drop by 1 cm in August and 3 cm in September (when adult fish return from the ocean). This represents a 1% drop in August and 5% in September and indicates that water depth through riffle/boulder gardens will remain above 65 cm in August and 56 cm in September. This level of depth change will not restrict Arctic Char and Lake Trout migrating back to Roberts Lake from Roberts Bay beyond what is naturally experienced. The results of the hydrological modeling will be provided in response to technical comments made during the NIRB technical review, in advance of the technical meeting.

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

Not Applicable

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 construction 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 A: 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# EC-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 B: Figure EC-1/EC-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 B: Figure EC-1/EC-8 – 1: Proposed AEMP Sampling Stations

10. ID# EC-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# EC-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 EC -2, these parameters will be included in both the mixing box and Robert's Bay models.

11.7 ATTACHMENTS

Not Applicable

12. ID# EC-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 EC-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 EC-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# EC-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 EC-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 EC-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# EC-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 EC-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.

Table EC-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 Only[4]	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.

14.7 ATTACHMENTS

Not applicable

15. ID# EC-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 A: EC-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 A: EC-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 1 shows the progressive changes in concentration of total dissolved solids (TDS) throughout the development, between 19,000 and 39,000 mg/L.

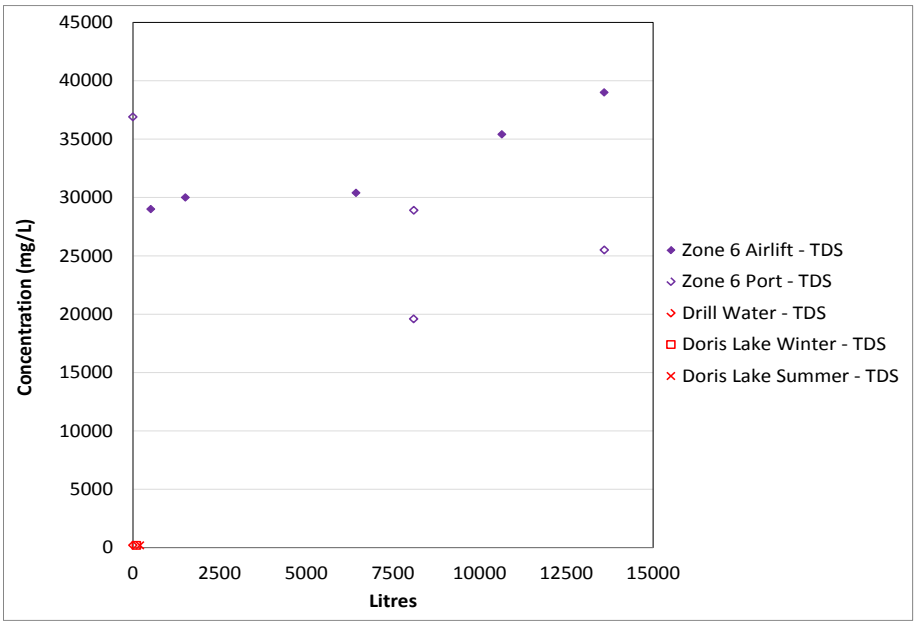

Figure 1: Concentration of Total Dissolved Solids in 10WBW001 Zone 6

Graphs showing trends for pH, conductivity, dissolved magnesium, chloride, dissolved calcium, sulphate, dissolved sodium and total barium are provided in Appendix A: EC-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 A: EC-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 are not considered 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.

15.7 ATTACHMENTS

Appendix A for:

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

16. ID# EC-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 B: Figure EC-1/EC-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

See Appendix B: Figure EC-1/EC-8 – 1: Proposed AEMP Sampling Stations

17. ID# EC-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# EC-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# KIA-1

19.1 SUBJECT

TIA Expansion Capacity

19.2 REFERENCE

Package 1, Section 1.7.1; Package 6-13, Appendix B

19.3 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.

19.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

19.5 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.

19.6 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.

19.7 ATTACHMENTS

Not Applicable

20. ID# KIA-2

20.1 SUBJECT

TIA Wildlife Attraction and Deterrence

20.2 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

20.3 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.

20.4 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).

20.5 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. "

20.6 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, Package 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 (Package 6-10 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 (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).

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.

20.7 ATTACHMENTS

Not Applicable

21. ID# KIA-3

21.1 SUBJECT

TIA Floatation Tailings Dust Fall and Leaching

21.2 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

21.3 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.

21.4 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.

21.5 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/hearing. 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.

21.6 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 Monitoring 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.

2) The results of particulate monitoring will be compared to thresholds for fugitive dust identified in the Air Quality Management Plan.

3) Wildlife monitoring will also be conducted at the TIA to examine if caribou or other wildlife are foraging at the TIA.

4) 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.

5) 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.

21.7 ATTACHMENTS

Not Applicable

22. ID# KIA-4

22.1 SUBJECT

TIA Elevated Parameters of Potential Concern Upon Closure

22.2 REFERENCE

Package S-2, Section 6, Section 10.1; Package 6-10 Table 6-2, Appendix B

22.3 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.

22.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

22.5 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.

22.6 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.

22.7 ATTACHMENTS

Not Applicable

23. ID# KIA-5

23.1 SUBJECT

TIA NPAG Tailings Cover Depth

23.2 REFERENCE

Package 5-2 Section 3.7; Package 6-10, Section 4.2.6

23.3 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.

23.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

23.5 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.

23.6 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.

23.7 ATTACHMENTS

Not Applicable

24. ID# KIA-6

24.1 SUBJECT

Roberts Bay Discharge and AEMP Monitoring

24.2 REFERENCE

"Environmental Effects and Mitigation, Package 4, Part 7;

Section 4.5.8.1, Page 4-65 (Aquatic Effects Monitoring Program)

24.3 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.

24.4 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."

24.5 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."

24.6 TMAC RESPONSE

1. Further to the response provide to EC-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 meetings.

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.

24.7 ATTACHMENTS

Not Applicable

25. ID# KIA-7

25.1 SUBJECT

Potential Interaction with Marine Environment

25.2 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

25.3 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.

25.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

25.5 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.

25.6 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.

25.7 ATTACHMENTS

Not Applicable

26. ID# KIA-8

26.1 SUBJECT

Mixing Zone Delineation

26.2 REFERENCE

Package 2, Section 3.6.2, Package 6-6 Section 5

26.3 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."

26.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

26.5 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.

26.6 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 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.

26.7 ATTACHMENTS

Appendix A: KIA-8 - 1 Response Memo to Kitikmeot Inuit Association (KIA) for Technical Comment KIA-8

27. ID# KIA-9

27.1 SUBJECT

Consideration of future development in the Hope Bay Belt

27.2 REFERENCE

Package 4, Figure 4.5-1, 4.5-2, 4.5-3

27.3 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.

27.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

27.5 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.

27.6 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 meetings to be held in January 2016. These details will be intended to address the reviewers' comments regarding potential cumulative effects between these 2 projects.

27.7 ATTACHMENTS

Not Applicable

28. ID# KIA-10

28.1 SUBJECT

Hydrogeology

28.2 REFERENCE

"Package 6 Engineering and Design Documents

P6-3 Groundwater Inflow and Quality Model (SRK, 2015) Package 4, Section 2"

28.3 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. "

28.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium

28.5 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.

28.6 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.

28.7 ATTACHMENTS

Not Applicable

29. ID# KIA 11A

29.1 SUBJECT

Site-Wide Water and Load Balance -Consideration for Climate Change

29.2 REFERENCE

Package 6-10; Sections 3.2, 5.2

29.3 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.

29.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

29.5 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.

29.6 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. 5th, 50th and 95th). 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.

29.7 ATTACHMENTS

Not Applicable

30. ID# KIA-11B

30.1 SUBJECT

Site-Wide Water and load Balance -Input Parameters

30.2 REFERENCE

Package 6-10; Sections 4.2.2, 4.2.3, 4.2.6

30.3 SUMMARY

Modeling approach using median concentrations for inputs.

30.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

30.5 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.

30.6 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.

30.7 ATTACHMENTS

Not Applicable

31. ID# KIA-11C

31.1 SUBJECT

Site-Wide Water and Load Balance- Mercury, cyanide, and selenium predictions

31.2 REFERENCE

Package 6-10; 6.3.1

31.3 SUMMARY

Modeling approach precludes mercury, cyanide, and selenium in it predictions.

31.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

31.5 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.

31.6 TMAC Response

Please see response to EC-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.

31.7 Attachments

Not Applicable

32. ID# KIA-12

32.1 Subject

Prediction of Environmental Effects on Water Quality

32.2 Reference

Package 4-1,Section 4.5.2

32.3 SUMMARY

Lack of nitrate prediction in modeling Roberts Bay's surface water.

32.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium Risk

32.5 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)."

32.6 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.

32.7 ATTACHMENTS

Not Applicable

33. ID# KIA-13

33.1 SUBJECT

Doris lake water levels

33.2 REFERENCE

Package 4-1, 4-2.

33.3 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.

33.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Medium

33.5 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."

33.6 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).

The primary area of concern is immediately below natural lake ice, where eggs and larvae left by fall-spawning fish overwinter. If the lake is drawn down below the natural range, eggs and alevins close to the ice could perish. Consequently, a detailed habitat survey was completed around the entire perimeter of the lake in fall 2015, focusing on the 1.5 to 4 m zone. In addition, hydroacoustics, gillnetting, angling, underwater video, and visual observations were used to further categorize lake habitats and to identify spawning locations within the lake for Lake Trout, Lake Whitefish and Cisco. This information is currently being assessed in conjunction with existing fisheries and hydrological baseline data to provide further confidence in the effects assessment.

This report will be provided in response to technical comments made during the NIRB technical review, in advance of the technical meeting.

TMAC will undertake a self-assessment to determine whether any serious harm may result following the implementation of site-specific mitigation measures.

The preliminary results from the 2015 field program, including a spawning habitat survey, in Doris Lake indicated 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.

33.7 ATTACHMENTS

Not Applicable

34. ID# KIA-14

34.1 SUBJECT

Attraction or Avoidance of Grizzly Bears to the Mine Site

34.2 REFERENCE

Pk 4, pt 2, Section 3.4.3, Pages 3-13 to 3-16

34.3 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.

34.4 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).

34.5 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.

34.6 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.

34.7 ATTACHMENTS

Not Applicable

35. ID# AANDC TC1

35.1 SUBJECT

Water Quality Predictions – Input for Process Water

35.2 REFERENCE

P6-10, Site-Wide Water and Load Balance; and

P6-12, Tailings Geochemistry

35.3 SUMMARY

Not Applicable

35.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

35.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The methodology for the determination of process water source terms (the amount and chemical form of contaminants released from a specific source for a specific period of time) has not been provided.

The Proponent has not made it clear whether the source terms and the sample results are comparable, i.e. whether the results are an aggregate of analyses over a period of time or if they are from a single sample. Section 4.2.4, P6-10 shows the process effluent source terms used and it is stated that they are based on historical geochemical studies. Section 4.5, P6-12 shows the individual sample results. It is not clear how the values used in the water quality model were derived from the sample results.

Recommendation AANDC requests that the Proponent provide an explanation of the methodology for selection of the process water source terms used in the site-wide

water and load balance model and confirm that the sources are comparable to the individual sample results.

35.6 TMAC RESPONSE

Section 2 of Document P6-12 provides a description of the metallurgical testing that has been completed as part of this project. The main purpose of the metallurgical tests has been to optimize the process and determine the amount of gold recovery that can be expected during operations. Additional objectives include generation of samples for environmental testing, and optimization of the cyanide destruction process. Due to the importance of obtaining accurate estimates of gold recovery for the economic evaluations, sample selection and test design were key considerations in all of this test work. The metallurgical samples were selected to represent average ore characteristics from each of the deposits, and are typically comprised of composite samples from a large number of spatially and geologically representative ore samples. The metallurgical testing was completed using pilot scale testing methods with recirculation of process solutions to simulate actual conditions in the mill. Further documentation of these tests is provided in the references cited in Table 2.1 of Document P6-12.

Process water samples were collected from most of the metallurgical tests listed in Table 2.1 of Document P6-12. The process water samples included flotation tailings from the Doris Central, Doris Connector and Doris North zones, and detox tailings from Doris Central (1 sample) and Doris North (2 samples) are considered to be representative of the process streams that will be generated in the Doris mill. Detailed results from these samples are provided in Appendix K of SRK 2015 (Document P6-12b; provided to parties and the NWB upon request on Nov 20, 2015) and are summarized in Table 4.11 of Document P6-12. It is noted that the data for the Doris North flotation tailings sample was incorrectly transcribed in Table 4.11. A revised table (Table AANDC TC1 - 1) is presented below. TMAC apologizes for any confusion that this error has caused.

Process water effluent source terms as summarized in Table 4.3 of Document P6-10 were calculated based on a blend with 86% flotation tailings water and 14% detox tailings water. The calculation was based on the maximum results from the three flotation samples and the maximum results from the three detox samples. For example, for sulphate, the maximum value from the flotation tailings was 70 mg/L, and the maximum value form the detoxified tailings was 530 mg/L, resulting in an 86%/14% blend with 134 mg/L. The blended values are the values that were presented in Table 4.3 of Document P6-10.

Table AANDC TC1 - 1: Analytical Results of Process Water Generated in Metallurgical Test Work

Parameter		Units	Screening Criteria	Doris Central Flotation Tailings	Doris Connector Flotation Tailings	Doris North Flotation Tailings	Doris Central Detoxified Tailings	Doris North[1] Doris North Detoxified Tailings	Doris North[1] DC02 Detoxified Tailings
Final pH			6.5-9	8.4	8.1	8.38	8.5	8.6	8.6
Alkalinity				107	180	164	160	-	-
Sulphate	SO_4	mg/L		48	70	43	530	-	-
Fluorine	F	mg/L		0.45	0.25	0.45	-	-	-
Total Cyanide		mg/L		-	0.06	*0.01*	98	3.8	2.3
Thiocyanate		mg/L				*1*		216	132
Nitrate	NO_3	mg/L	2.9	*0.02*	*0.01*	*0.01*	*0.6*	-	-
Nitrite	NO_2	mg/L	0.06	0.1	*0.01*	*0.01*	*0.5*	-	-
Ammonia as N	NH_3	mg/L	0.41	-	-	*0.01*	-	2.9	1.1
Aluminum	Al	mg/L	0.1	*0.05*	*0.05*	0.17	*0.01*	0.02	0.058
Silver	Ag	mg/L	0.0001	0.00036	*0.00005*	*0.00005*	0.11	0.016	0.0055
Arsenic	As	mg/L	0.005	0.0024	0.0018	0.006	*0.02*	0.002	0.0068
Calcium	Ca	mg/L		35	27	16	0.65	706	162
Cadmium	Cd	mg/L	0.000017	0.00035	*0.00002*	0.00008	0.0014	*0.0001*	*0.0001*
Cobalt	Co	mg/L		-	-	0.0002	0.0142	0.056	0.069
Chromium	Cr	mg/L	0.001	0.0035	0.0027	0.0028	*0.05*	0.005	0.0063
Copper	Cu	mg/L	0.002*	0.018	0.0019	0.0025	0.071	0.079	0.46
Iron	Fe	mg/L	0.3	4.9	0.78	*0.05*	0.22	0.73	0.99
Mercury	Hg	mg/L	0.000026	*0.0001*	*0.0001*	*0.0001*	0.0001	0.0001	0.0001
Magnesium	Mg	mg/L		15	16	8.4	0.34	20	19
Manganese	Mn	mg/L		0.17	0.064	0.015	0.01	0.032	0.063
Molybdenum	Mo	mg/L	0.073	0.13	0.11	0.0098	0.015	0.082	0.071
Sodium	Na	mg/L		19	114	159	-	-	-
Nickel	Ni	mg/L	0.025*	0.0045	0.0039	0.0014	0.03	0.07	0.009
Phosphorus	P	mg/L	0.1	0.12	1.4	1.0	*0.01*	-	-
Lead	Pb	mg/L	0.001*	0.0027	0.0002	*0.0001*	*0.002*	0.0025	0.002
Antimony	Sb	mg/L		0.00093	0.00038	0.0013	*0.002*	0.13	0.034
Selenium	Se	mg/L	0.001	0.0008	0.0034	0.004	*0.1*	*0.01*	*0.01*
Zinc	Zn	mg/L	0.03	0.028	0.0098	0.04	*0.1*	0.04	0.026

blue italics = value equals laboratory detection limit. Detection limit shown.

[a] Screening criteria are based on CCME guidelines for protection of aquatic life. Where these are hardness dependent, the minimum guideline is shown.

[1] Process water data compiled based on advice from Gekko which included the averaging of values from the final cycles of each detoxified test to provide final values.

RED highlighted cells indicate corrected values

References:

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

35.7 ATTACHMENTS

Not Applicable

36. ID# AANDC TC2

36.1 SUBJECT

Groundwater Quality Predictions

36.2 REFERENCE

P6-3, Groundwater Inflow and Quality Model;

P6-10, Site-Wide Water and Load Balance; and

AANDC IR#5 to the NWB

36.3 SUMMARY

Not Applicable

36.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

36.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

No discussion has been provided regarding the potential loadings to the underground mine water from water that has come in contact with mine walls, backfilled waste rock or tailings during operations. Should sulphide oxidation occur on the exposed rock walls, waste rock and/or underground tailings; it would represent a source term that is not accounted for in the loading model used to develop water quality predictions.

Recommendation: AANDC requests that the Proponent provide an explanation of the rationale for the absence of underground mine source terms in the model.

AANDC further requests that the Proponent describe the potential for acid rock drainage (ARD) and metal leaching (ML) from mine walls, waste rock and underground tailings as well as their potential impacts to mine water quality and downstream receptors.

36.6 TMAC RESPONSE

The contribution of loading from underground sources was not accounted for in the water quality models because they were considered to be relatively minor in comparison to potential loadings from the natural groundwater, and they will only be present during operations and for the relatively short period that it will take to flood the mine.

Some further rational for not including underground source terms in the water quality models is provided as follows:

Conditions within the Mine:

- Groundwater inflows in underground mines do not generally interact to the same extent with backfilled materials as they would in surface waste rock piles. There are typically areas that are quite dry where the majority of the backfill is completely sheltered from interaction with groundwater inflows, and others where focussed areas of inflow interact with the backfill – typically only at the margins of the stopes where the highly permeable broken rock is in contact with much less permeable bedrock. The implications of this are that 1) only a small portion of the backfill will interact with groundwater, and 2) the portion that does interact will do so at much lower rock to water ratios than would be present in a surface waste rock facility. In other words, concentrations will be much more. dilute.
- As described in response to AANDC 13 portions of the mine are in permafrost and will be isolated from groundwater flow as they freeze back. There is also potential to isolate and flood portions of the mine using bulkheads and other measures.

Backfilled waste rock:

- Backfilled waste rock will be comprised of a similar mixture of rocks as those found in the surface waste rock piles. Although salt from use of brines in the mining process, and ammonia and nitrate from blasting activities are elevated in seepage from the waste rock, concentrations of sulphate and metals are generally very low. The overall rock to water ratio in the surface waste rock piles is on the order of 14, in comparison to expected overall rock to water ratios in the underground mine of approximately 4. As discussed previously, only a small

portion of the waste rock will be in contact with groundwater inflows. Therefore, the effective rock to water ratios in those inflow areas are expected to be much lower than the overall ratios – likely on the order of 10 to 100x less (i.e. ratios in the range of 0.4 to 0.04).

Lower rock to water ratios generally result in proportionally lower source concentrations. On this basis, the current concentrations from the waste rock pile provide a highly conservative indication of concentrations associated with underground waste rock. A comparison of the waste rock pile concentrations to the current source terms for groundwater is provided in Table x. The results show that Al, Cr, Co, Cu, Hg, Ni, Tl, Hg and V concentrations exceed concentrations in the groundwater by a factor of 1.5x or more. (Noting that the comparisons for Cr, Hg, Tl are misleading because values in the waste rock data were all below detection limits). Although concentrations of these parameters are higher than concentrations in the groundwater, they are all quite low in comparison to applicable guidelines. Therefore, even without considering additional dilution by groundwater, they are not expected to be present at levels that would result in impacts to groundwater, or the marine receiving environment.

Mine Walls:

- Contributions from the mine walls are expected to be inconsequential in comparison to waste rock due to much smaller exposed surface area.

Backfilled Tailings:

- Backfilled tailings will be comprised of the detoxification tailings. These are comprised of a sulphide concentrate that has been leached by cyanide to recover the gold and then run through a cyanide destruction circuit to remove cyanide. The sulphide content of the detox tailings is much higher than that of the ore, waste rock, and the flotation tailings that will be stored in the TIA. Most of the samples that were characterized in the geochemical program were classified as potentially acid generating. As noted in the comment, acidic conditions developed in one of the humidity cell tests after a delay of about 200 weeks – or almost 4 years.
- The cyanide residues will be mixed with waste rock and will be distributed throughout the mine. Therefore, during operations, most of the tailings mass will be exposed to oxidizing conditions. As with the waste rock, the majority of this material will be sheltered from interaction with groundwater. However, some interaction is expected to occur.
- During operations, ground conditions in the Doris Mine are expected to be below 5 °C, therefore rates of sulphide oxidation will be approximately 5x slower than laboratory reaction rates, suggesting that there would be a lag time of almost 20 years before the onset of acidic conditions in this material. The backfilled

workings will be exposed for a relatively limited amount of time – approximately 6 years during of operations and approximately 4 months to 1.7 years following closure (see response to NRCan IR-3 & AANDC IR#13, dated December 3, 2015 for details on the reflood estimations). Therefore, the detox tailings will be flooded within an approximately 8 year time period, and backfilled tailings are expected to remain neutral throughout this period.

- In addition to the delay to onset of acidity resulting from cold conditions, neutralization potential associated with the backfilled waste rock is expected to limit the onset of acidity.

  Due to the relatively low rock to water ratios expected within the mine workings, water quality associated with the backfilled tailings are expected to be less than concentrations found in humidity cell tests on detox tailings samples (Document P6-12 and Appendix G of Document P6-12b, provided to parties and the NWB upon request on Nov 20, 2015). A summary of concentrations from the humidity cell tests is provided in Table AANDC TC-2. A comparison of these results to results from the groundwater indicates that concentrations of all of the parameters are within an order of magnitude of those in the groundwater.

Explosives Residues:

- Ammonia and nitrate originating from explosives residues have been accounted for in the predictions of underground mine water quality, as described in Document P6-10.

Table AANDC TC-2 Concentrations in Existing Waste Rock Seepage, HCT tests on Detoxified Tailings and Groundwater

Parameter	Waste Rock Seepage (ST-2)	HCT Tests on Detoxified Tailings*	Groundwater
pH	7.8	7.6	7.7
Sulphate	113	587	1900
Chloride	1370		18000
Total Ammonia	28.4	0.5	3.4
Aluminum Al	0.12	0.013	0.035
Antimony Sb	0.00050	0.00061	0.00095
Arsenic As	0.00073	0.020	0.0024
Barium Ba	0.10	0.015	0.12
Cadmium Cd	0.00013	0.00018	0.00012
Calcium Ca	470	142	2000
Chromium Cr	0.0050	0.00020	0.00086
Cobalt Co	0.0046	0.013	0.0015
Copper Cu	0.0077	0.0010	0.0012
Iron Fe	0.37	0.010	4.70
Lead Pb	0.00034	0.00010	0.00029
Magnesium Mg	65	78	1300
Manganese Mn	0.86	0.24	1.70
Mercury Hg	0.00010	0.000020	0.000049
Molybdenum Mo	0.0050	0.0017	0.018
Nickel Ni	0.0057	0.0046	0.0018
Potassium K	26	7	240
Selenium Se	0.0020	0.010	0.0019
Silicon SiO2	0.0000	4.70	3.10
Silver Ag	0.000020	0.00017	0.000097
Sodium Na	398	14	8700
Strontium Sr		0.33	27.00
Thallium Tl	0.00020	0.00020	0.000086
Tin Sn	0.050		0.036
Titanium Ti	0.0060	0.00050	0.0049
Uranium U	0.0012		0.000089
Vanadium V	0.0019	0.00020	0.00086
Zinc Zn	0.020	0.015	0.15

Notes: * max value from the two tests is presented.

36.7 ATTACHMENTS

Not Applicable

37. ID# AANDC TC3

37.1 SUBJECT

Groundwater Quality Post-Closure

37.2 REFERENCE

P6-3, Groundwater Inflow and Quality Model; and

NRCan IR#3 to the NIRB

37.3 SUMMARY

Not Applicable

37.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

37.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The Proponent indicates that groundwater quality will not be affected by project activities but this has not been substantiated by the documents provided for review. The documents do not include discussion on mine flooding after operation of the mine is finished, potential impacts of mine flooding on groundwater quality, and potential for groundwater discharge to Doris Lake after mine closure.

It is noted that Proponent's response to NRCan IR#3 indicates that mine inflow calculations will be provided; however, they have not yet been received.

Recommendation: AANDC requests that the Proponent provide the rationale to support their conclusion that the project will not have an adverse effect on groundwater quality.

37.6 TMAC RESPONSE

Please see the response to AANDC-TC2 for information on the potential sources of loading to groundwater during mining operations.

During reflooding of the mine, oxidation products that have accumulated in the backfilled materials and on the mine walls will be released into the flooded mine pool. Solubility limits and attenuation reactions are expected to sequester part of this load, but some sulphate and metals will be released into solution. The concentrations are not expected to be particularly high because the backfill is expected to have a neutral pH. The groundwater is also not considered to be a groundwater resource due to the low permeability of the surrounding bedrock and the naturally occurring groundwater salinity. Additionally, all of the openings to the underground workings are above the potentiometric surface, so there will be no discharges from the reflooded mine.

Total flows from the underground mine pool into Doris Lake are expected to be very low due to the limited hydraulic gradient at closure, and the low permeability of the lake sediments. However, further evaluation of water quality in the reflooded mine, and the potential flux of groundwater into Doris Lake will be prepared and made available at the Technical Meeting in Cambridge Bay in January 2016. See Appendix A: AANDC TC3 Technical Memo for further details.

37.7 ATTACHMENTS

Appendix A: AANDC TC3 – SRK Technical Memo Estimation of the Time Required for the Underground Mine to Fill

38. ID# AANDC TC4

38.1 SUBJECT

Water Quality Predictions – Input for Exposed Tailings Beaches

38.2 REFERENCE

P6-10, Site-Wide Water and Load Balance;

P6-12, Tailings Geochemistry; and

AANDC IR#2 to the NWB

38.3 SUMMARY

Not Applicable

38.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

38.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Although the majority of the methodology for the selection of source terms for tailings beaches are provided in Section 4.2.6, Document P6-10, the humidity cell test (HCTs) results were not provided. It is noted that the median laboratory release rates were used from the HCTs but not the rationale for using these rates.

Recommendation: AANDC requests that the Proponent provide the basis for the selection of the median HCTs release rates and demonstrate that this is appropriate (or conservative) for both operations and post-closure.

38.6 TMAC RESPONSE

Complete results for the humidity cell tests are provided in Appendix G and H of SRK 2015 (Document P6-12b; provided to parties and the NWB upon request on Nov 20, 2015). The release rates for flotation tailings that were used for the predictions are provided in Table G.3 of SRK 2015 (*Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay – Supporting Data; Document P6-12b*). Given that there were only three samples, use of the median value was considered to be a reasonably conservative basis for predicting water quality associated with the exposed tailings. However, TMAC acknowledges that the 75th percentile results would provide a more conservative indication, although TMAC does not consider it necessary to be that conservative.

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.

38.7 ATTACHMENTS

Not Applicable

39. ID# AANDC TC5

39.1 SUBJECT

Water Quality Predictions – Input for Ore and Waste Rock Stockpiles

39.2 REFERENCE

P6-10, Site-Wide Water and Load Balance, Section 4.2.9

39.3 SUMMARY

Not Applicable

39.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

39.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Contaminant loadings from ore and waste rock stockpiles were defined from water quality samples taken from stockpiles that were in place in 2010 and 2011. Median concentrations were selected from the 2011 to 2014 dataset; hence, the data represent waste rock that has been exposed for a maximum of 3 to 4 years after placement. The mine plan calls for 6 years of operations, which allows more time for sulphide oxidation and acid generation and metal leaching. The selection of median rates could underestimate loadings from these stockpiles. In addition, there is no discussion regarding the characteristics of the existing stockpiles on surface compared to what is expected in the future.

Recommendation: AANDC requests that the Proponent provide details regarding the basis for selecting source terms for waste rock and ore stockpiles and what can be expected in the future.

39.6 TMAC RESPONSE

The approach used to develop source terms for the waste rock was to use median results from monitoring data from the existing waste rock stockpiles (monitoring location ST-2), to calculate actual loading rates from this source. This type of approach is not always available for use in developing source terms, but is considered to be far more accurate than extrapolating from small scale laboratory tests to full scale field conditions. Considering the relatively small contribution of flow and loading from this source, additional refinements in terms of choice of statistics and variations in rock type

would not be expected to result in significant changes in water quality predictions for the TIA. Nonetheless, additional information on the potential for changes in metal loading rates over time that could result from changes in sulphide oxidation rates or stockpile composition is provided as follows.

As noted in the comment, the existing waste rock pile at Doris has been exposed for a relatively short time period – and the data used in the assessment reflects an exposure period of only 4 years. Under the new mine plan, rock from the underground workings will be exposed for up to 6 years. The additional period of exposure will result in ongoing sulphide oxidation and metal release from the piles. However, geochemical characterization results indicate that the majority of the waste rock and ore is not-potentially acid generating, indicating that pH is not expected change over time. Under stable pH conditions, sulphide oxidation rates and therefore metal leaching rates are also unlikely to increase over time. Monitoring results from the existing waste rock pile and humidity cell test results also support the assumption of stable loading rates over time:

- Figures 1 to 3 are plots of SO_4, As, and Cu over time in discharges from the existing waste rock pile (monitoring station ST-2). The results for SO_4 and As indicate a slight increase in sulphate concentrations during the first year of operations (when rock was still being placed on the pile), followed by 3 years of stable concentrations. The results for Cu show decreasing concentrations over time. The increases during the first year of operation can easily be attributed to active deposition of waste rock during the first year of monitoring.
- Figures 4 and 5 show plots of SO_4 and As over time in the humidity cell tests. For the majority of tests, both of these parameters show a gradual decrease over time, with SO_4 reaching stable concentrations after about 20 weeks, and arsenic showing a continuing decline in concentrations over time. In both cases, there is no evidence to suggest that reaction rates are increasing as a result of increased rates of weathering. Similar plots are provided in Appendix D of SRK 2015 (P6 15b, provided to parties and the NWB upon request on Nov 20, 2015).

Changes in the composition of the waste rock and ore stockpiles could also result in changes over time, but as stated previously, these are likely small in comparison to the uncertainties associated with scaling laboratory test data to field conditions. Detailed records on the amount and type of rock in the current waste rock and ore stockpiles have been recorded as part of the ongoing monitoring programs for Doris North. This information is provided to the Nunavut Water Board (NWB) in annual Waste Rock, Ore and Quarry Monitoring Reports (eg. SRK 2012). Mining activities prior to 2015 resulted in the production of approximately 183,000 tonnes of waste rock and an additional 9,400 tonnes of ore. Approximately 55% of the rock was identified as diabase, 34% was identified as basalt, and the remainder was basalt with quartz veining (mostly ore grade

material). An appreciable portion of the basalt was hornfelsed basalt located in close proximity to the diabase. In future, it is expected that a greater portion of the rock will be basalt and altered basalt.

Although the mixture of rocks types is expected to change, there are only a few parameters that show clear differences in metal leaching rates from the different rock types. Plots of stable leaching rates for SO_4, As, Cu, and Zn provided in Figure 6, show that SO_4 leaching rates are highest in the rocks with appreciable quartz veining (unit 12q), which are ore grade material, and that As leaching rates are highest in the diabase (unit 11c). SO_4 and As rates in the basalt (unit 1) are at the low end of the observed range. Cu and Zn leaching rates do not show any appreciable differences between rock types. Based on this information, increased portions of basalt and decreased portions of diabase could therefore lead to a decrease in arsenic leaching, but would have negligible effects on these other parameters.

As indicated previously, in comparison to the process water, discharges from the waste rock are a minor source of contaminant loading to the TIA, and therefore the predictions of water quality in the TIA are not sensitive to differences in the assumptions used to develop source terms for the waste rock. TMAC concludes that the current source terms for waste rock are adequate for evaluating potential loadings to the TIA.

References:

SRK 2012. 2011 Waste Rock and Quarry Monitoring Report.

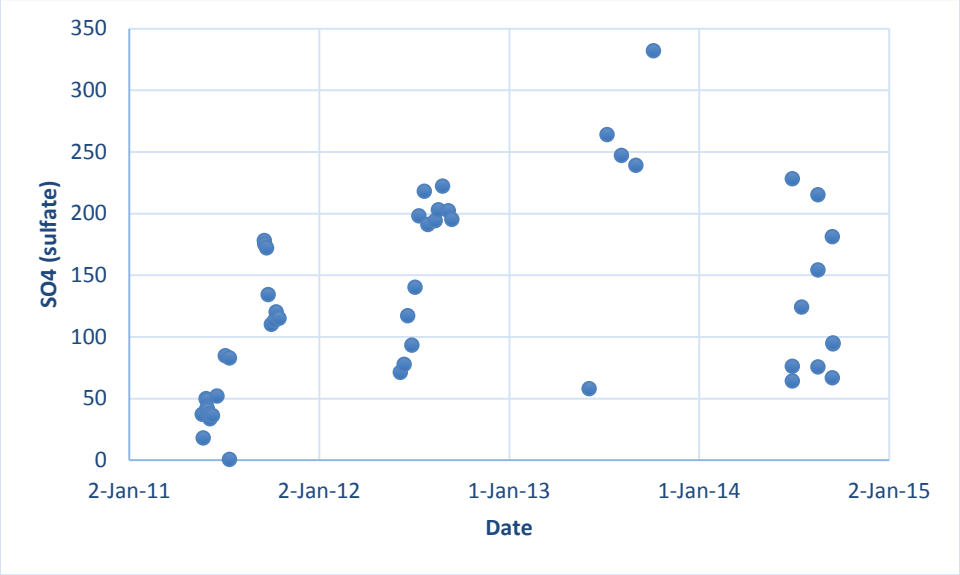

Figure 1 Sulphate Concentrations over time in Monitoring Station ST-2

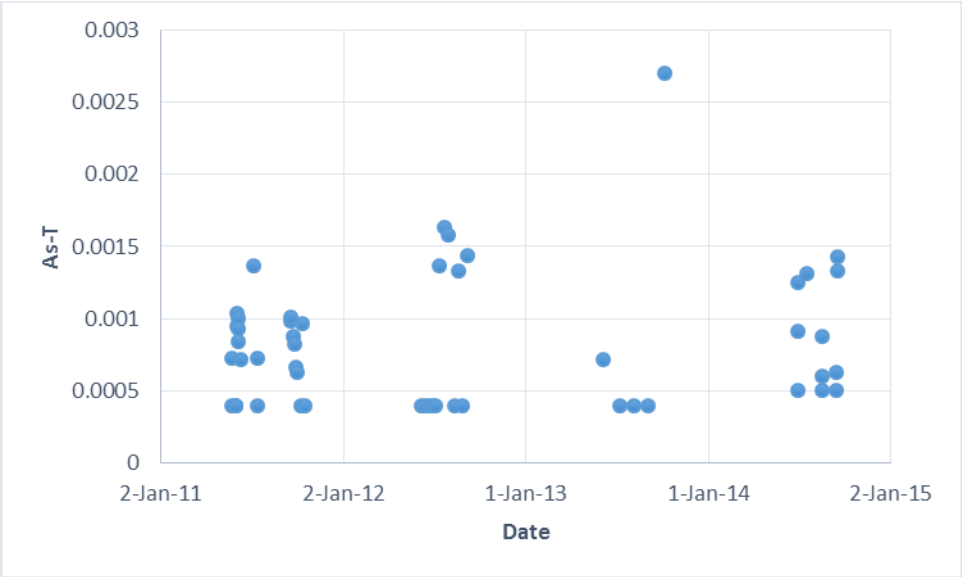

Figure 2 Arsenic Concentrations over time in Monitoring Station ST-2

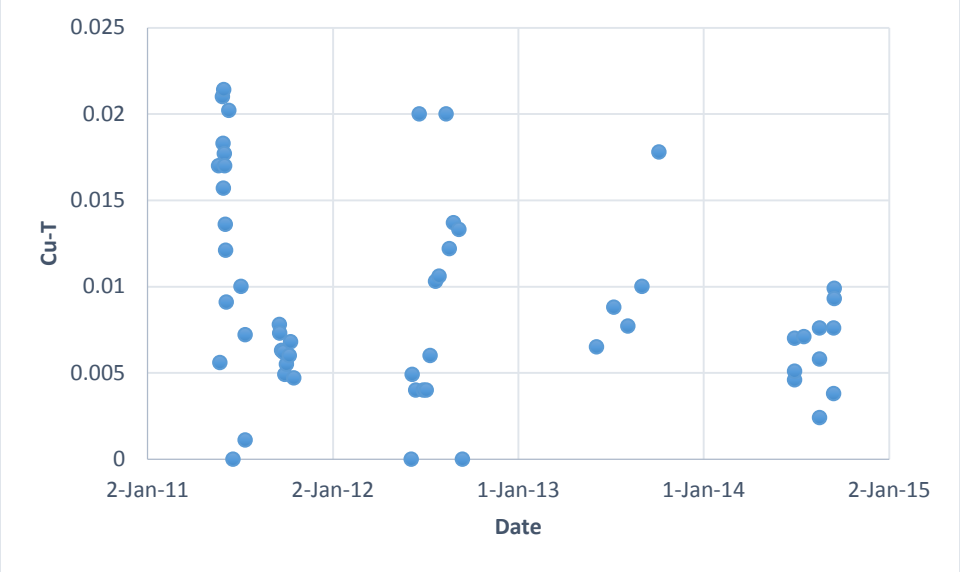

Figure 3 Copper Concentrations over time in Monitoring Station ST-2

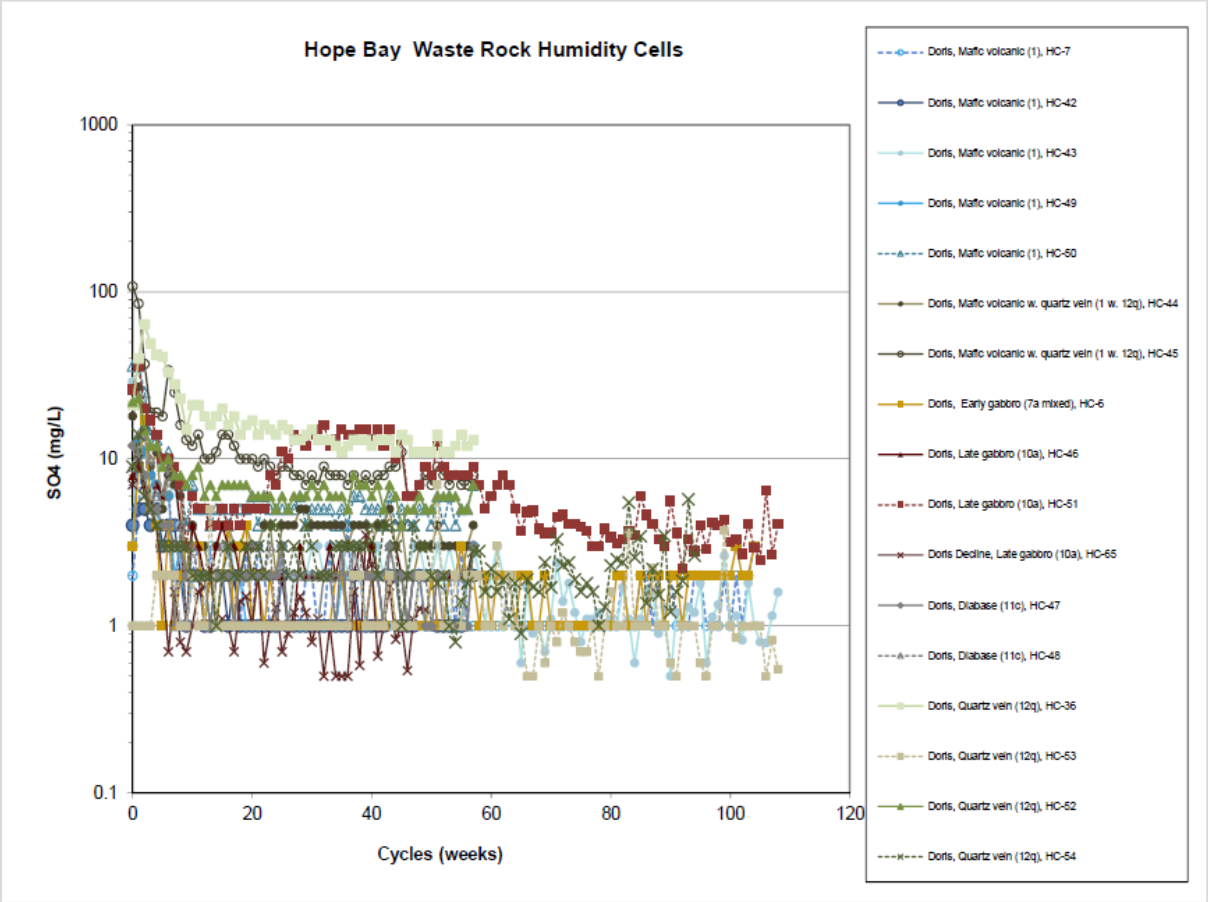

Figure 4 Sulphate Concentrations over time in Waste Rock Humidity Cell Tests

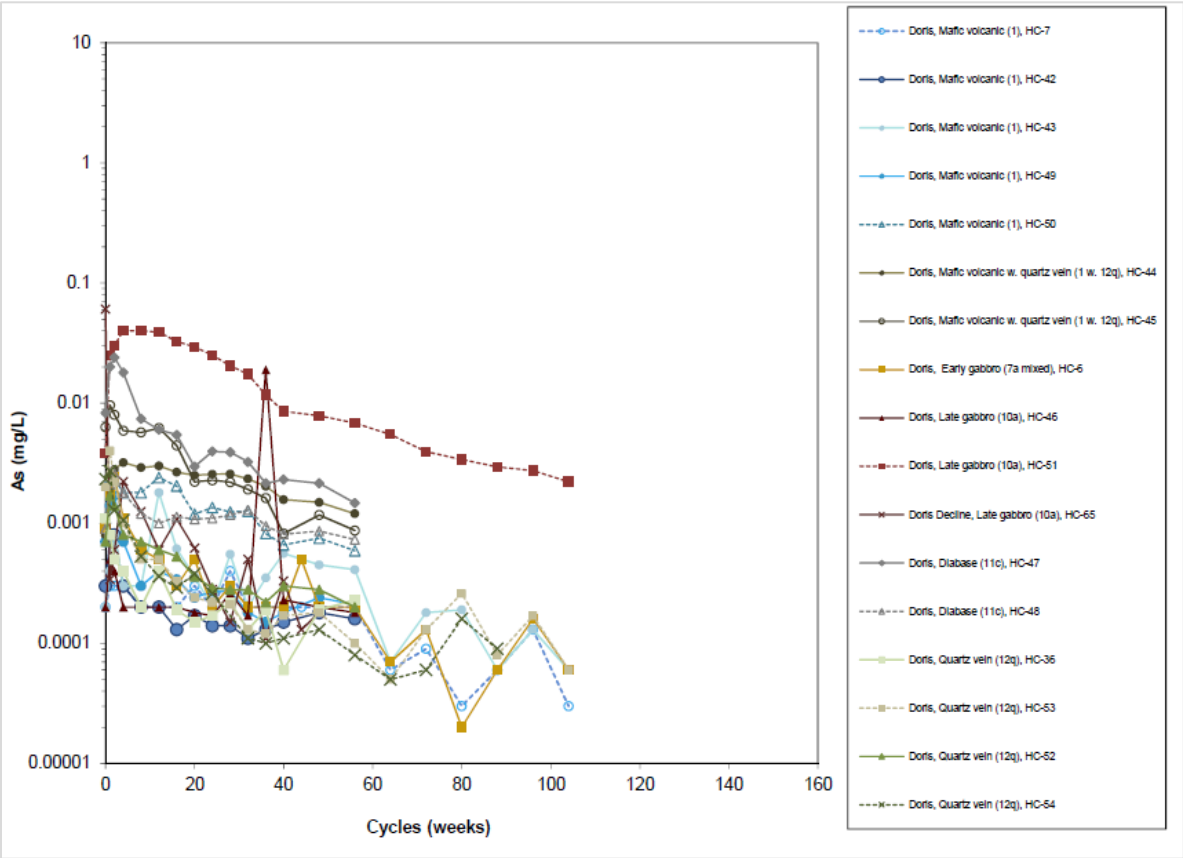

Figure 5 Arsenic Concentrations over time in Waste Rock Humidity Cell Tests

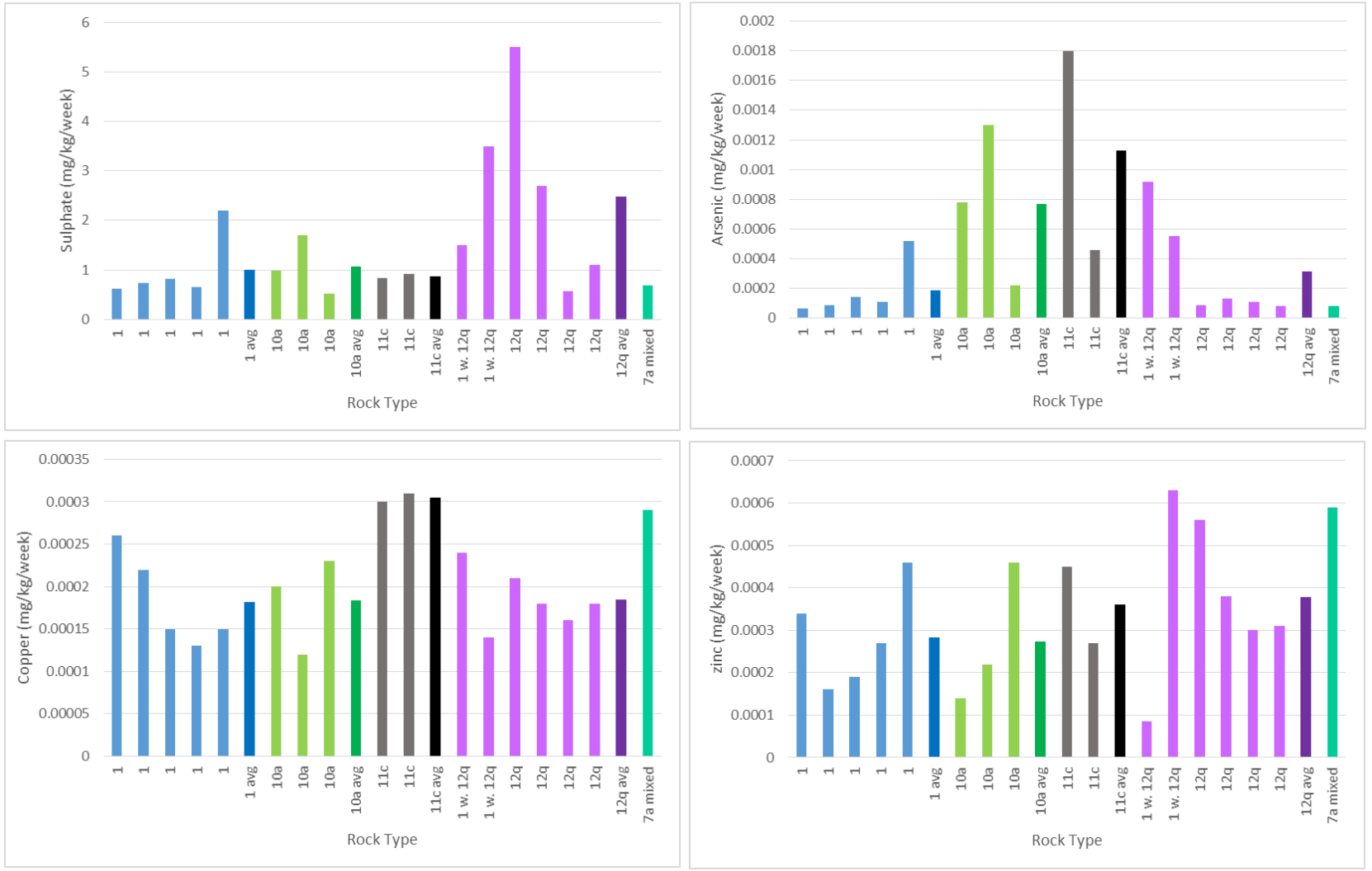

Figure 6 Comparison of sulphate and metal release rates from humidity cell tests, a) sulphate, b) arsenic, c) copper, d) zinc. (lithological codes show include basalt (1), gabbro (10a), diabase (11c), quartz veining (12q), and early gabbro (7a)

39.7 ATTACHMENTS

Not Applicable

40. ID# AANDC TC6

40.1 SUBJECT

There is a concern that the Tailings Impoundment Area (TIA) may not have sufficient storage capacity for water in the event effluent fails discharge criteria and must be stored until a water treatment plant is built.

40.2 REFERENCE

P6-10, Site-Wide Water and Load Balance; and

AANDC IR#8 to the NWB

40.3 SUMMARY

Not Applicable

40.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

40.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

It is understood that the Proponent does not anticipate the need for water treatment to meet effluent discharge criteria. However, we are concerned that the TIA may not have sufficient storage capacity to hold water that requires treatment before discharge while contingency measures are being developed, as this is not specifically discussed in the application. For instance, it could take 2 years or more to design and build a water treatment plant at this remote location.

Recommendation: AANDC requests that the Proponent address the following issues:

- Explain what management processes/water treatment plans are intended to proactively identify problems and install mitigative measures.

- Explain what contingency plans are in place in the event that effluent does not meet discharge criteria. For example, how long can the mine operate without discharging water to the environment, if the underground mine and TIA effluent fail discharge criteria and need to be stored in the TIA? This contingency measure should consider maximum TIA inflows.

40.6 TMAC RESPONSE

The Doris North Water Licence, 2AM-DOH1323 requires a monthly operational assessment of the water balance and the water quality model (Part J Item 21d) as well as reporting in the Annual Report.. As part of this, TIA water quality, and all incoming source loads as listed in Table 4-1 of document P6-10 will be monitored. This will provide TMAC with the necessary early warning signs of any issues that may require TMAC to consider water treatment.

If the TIA effluent does not meet discharge criteria TMAC will retain water in the TIA until a suitable treatment plant can be designed, procured, constructed and commissioned. TMAC believes that an appropriate lead time to do this given the Project location is 1.5 to 2 years. To demonstrate that the TIA has more than sufficient capacity to retain water without any discharge to allow this mitigation plan to be safely implemented, the existing Site-Wide Water and Load Balance Model (Supporting Document P6-10 of the Amendment application) was run for two Scenarios. In each Scenario the time to reach full supply level (FSL) of 32.5 m in the TIA was estimated.

Scenario 1, presents the case when mining and processing continues without allowing discharge from the outset. Scenario 2, presents the case of premature closure, i.e. should at any point in the Project Life the project be placed in Care and Maintenance and TIA discharge has to cease (Table AANDC TC6 - 1). For both these scenarios, the TIA becomes a zero discharge facility, with the only water loss being evaporation. In all cases different hydrological conditions was evaluated ranging from the 5th to the 95th percentile, where the 5th percentile represents dryer than average conditions and the 95th percentile represents wetter than average conditions.

For Scenario 1, TIA discharge is similarly assumed not to occur from the outset . For Scenario 2 premature closure is assumed to start at the end of each calendar year starting 2015 (i.e. no tailings are actually ever placed). In Table AANDC TC6 - 1, Case 7 is represents the case where TIA discharge ceases when planned mine production ceases in April 2021.

The predicted average time for the TIA to reach FSL assuming no further discharge from the outset of mine production is 6.5 years assuming mean hydrological conditions. This means the TIA will reach FSL by February 2022, which is about 10 months after planned mining production ceases. Assuming 95th percentile hydrological conditions this period

reduces to 5 years (i.e. by June 2020). With 5th percentile hydrological conditions this time period extends to 8 years (i.e. June 2023).

For the Scenario 2 premature closure cases presented in Table AANDC TC6 - 1 below, the predicted mean time for the water level in the TIA to reach FSL after operations cease is 9 years, ranging from a minimum of 5 years to a maximum of 14 years depending on variable hydrology. In all of these cases this time period extends well beyond the planned mine life.

Table AANDC TC6 - 1: Scenario 2 - Time for TIA to Reach Full Supply Level Assuming Premature Closure

Case	Premature Closure Date	Date TIA Elevation Reaches FSL			Years to Reach FSL		
		Mean	95th Percentile	5th Percentile	Mean	95th Percentile	5th Percentile
1	12/2015	01/2028	06/2025	06/2030	12	9	14
2	12/2016	01/2029	06/2026	09/2030	12	9	14
3	12/2017	06/2028	06/2026	06/2030	10	8	12
4	12/2018	01/2028	06/2026	05/2030	9	7	11
5	12/2019	07/2027	06/2025	06/2029	8	5	9
6	12/2020	03/2028	06/2026	06/2030	7	5	9
7	04/2021	03/2028	06/2026	06/2030	7	5	9

These model simulations therefore clearly demonstrate that the TIA has sufficient capacity to retain water for an extended period, which in all cases is at least 5 years. This is why TMAC is confident that should unforeseen conditions result in TIA effluent water quality not meeting discharge standards, water can be retained in the TIA until a suitable mitigation strategy such as water treatment can be implemented. A period of 5 years is more than sufficient to design, procure, construct and commission a water treatment plant. This time period is likely 2 to 3 times longer than necessary to successfully implement water treatment.

Finally, TMAC wishes to remind the reviewer that mine water does not report to the TIA. Mine water is pumped directly to the ocean via the Mill Mixing Box as described in Supporting Documents P6-6, Roberts Bay Discharge System: Water Management Options and P6-8, Roberts Bay Discharge System: Pump and Pipe Requirements of the amendment application. Should the mine water quality exceed levels that can be discharged to the ocean, the water will be retained in the mine.

40.7 ATTACHMENTS

Not Applicable

41. ID# AANDC TC7

41.1 SUBJECT

Waste rock for use in construction

Basis for criteria for using rock outside of the containment system

41.2 REFERENCE

P5-4, Waste Rock and Ore Management Plan; and

P6-14, Waste Rock and Ore Geochemistry, Static Testing

41.3 SUMMARY

Not Applicable

41.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

41.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

It is understood that all rock excluding diabase will be treated as mineralized rock, will be stored separately and eventually return underground (Section 3.1, P5-4). Diabase will be stored in a separate stockpile within a designated waste rock storage area and can be considered for construction use outside of the pollution control area if it meets certain criteria (e.g. sulphur < 0.2%). There is no basis for the criteria provided. It is noted that 27% of diabase samples were classified as potentially acid generating (PAG) and 54% were classified as uncertain (Section 3.2, P6-14).

Recommendation: AANDC requests that the Proponent explain the basis for criteria selection to determine whether diabase can be used for construction outside the containment area.

41.6 TMAC RESPONSE

TMAC would like to clarify that all of the diabase samples from both the pre-mine characterization programs (refer to Documents P6-14 and P6-14b) and underground monitoring programs (SRK 2012) has been classified as not-potentially acid generating (non-PAG) on the basis of NP/AP ratios. The classifications reported in the technical comment above are based on TIC/NP ratios. TIC/NP ratios are not considered to be an

appropriate means of classifying the ARD potential of the diabase because the sulphur content of the samples and the rates of sulphide oxidation are is sufficiently low that silicate NP is capable of buffering pH at neutral pH levels. This is supported by:

- Laboratory based kinetic tests that ran for a period of 57 weeks without any change in pH (Appendix D of Document P6-15b)
- Ongoing field barrel test that ran for 3 years without a change in pH (Appendix G of Document P6-15b)
- Consistently neutral pH conditions in the existing waste rock pile which is comprised predominantly of diabase
- A lack of natural acidity in seepage and runoff originating from weathered talus on the "Mesa" at Doris, which is comprised of diabase

The criteria selected for use in construction was based on a threshold that would be sufficient to flag material that is above the normal range of sulphur found in the diabase, but still within thresholds where silicate buffering is effective. Static testing results for 43 pre-mine samples (presented in Document P6-14b), and 17 underground monitoring samples from the diabase (SRK 2012) show that the maximum S content in the diabase is 0.13%. Detailed results for the pre-mine samples are provided in Appendix G of Document P6-14b, and detailed results from the monitoring programs are provided in SRK 2012 (data provided as Attachment K1). The threshold where silicate buffering remains effective is based on SRK's experience with similar rocks in the Canadian Shield.

41.7 ATTACHMENTS

Not Applicable

42. ID# AANDC TC8

42.1 SUBJECT

Monitoring mineralized rock

42.2 REFERENCE

P5-4, Waste Rock and Ore Management Plan, Table 4

42.3 SUMMARY

Not Applicable

42.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

42.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

The waste rock segregation approach seems to rely on visual observations with confirmatory testing based on tonnage (min. 1 sample/10,000 tonnes rock). There is no discussion describing how the visual inspections will lead to segregation decisions.

Recommendation: AANDC requests that the Proponent provide an explanation of the basis for the waste rock segregation plan and the potential for acid rock drainage and metal leaching from "non-mineralized" rock.

42.6 TMAC RESPONSE

The waste rock segregation approach is based on visual identification of rock type – to separate the non-mineralized diabase from all other types of rock. Previous monitoring and characterization results for the diabase (also documented in the response to AANDC TC7) show a high degree of consistency in the geochemical characteristics of the diabase, indicating that accurate identification of the geology is a sufficient basis for segregation.

Diabase can be readily identified in both drill core and in the mine workings by its distinct appearance. The location of the diabase has also been included in the geological model for the site, and can therefore be anticipated with reasonable accuracy during mine development.

TMAC notes that the current mine plan has a waste rock backfill requirement that will return all of the waste rock underground so that post closure no waste rock will be left on surface.

42.7 ATTACHMENTS

Not Applicable

43. ID# AANDC TC9

43.1 SUBJECT

There is concern regarding the filtering capability of the Interim Dyke (proposed to be constructed from run of quarry) to retain tailings; also if mitigative measures are required

(retrofitting upstream face with finer rock layer or geotextile), this will only be done after some tailings have passed into the Reclaim Pond.

There is insufficient consideration of the effects of buildup of hydrostatic head on the Interim Dyke's upstream side if the rock becomes blinded.

43.2 REFERENCE

P6-13, Tailings Management System;

P6-10, Site-Wide Water and Load Balance; and

AANDC IR#22 to the NIRB

43.3 SUMMARY

Not Applicable

43.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

43.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation The design of the Interim Dyke is such that the drainage rate through the Dyke exceeds the volume of supernatant water that will get added every day (SRK 2015 – Site-Wide Water and Load Balance Model Report)

The Proponent has stated that the stability design has considered a hydrostatic head behind the Interim Dyke. The Proponent has further stated that some tailings may enter the Reclaim Pond and that this should not significantly affect water quality.

The placement of layers on the upstream face while the Tailings Impoundment Area (TIA) is being used may be difficult to control and ineffective.

Recommendation AANDC requests that the Proponent provide greater detail on how they will undertake the placement of layers on the upstream face while the TIA is in operation.

43.6 TMAC RESPONSE

TMAC submitted a technical memo to the NWB and NIRB on December 4, 2015, prepared by SRK titled "Response to AANDC-NIRB IR#22: TIA Interim Dike – Filtering Requirements". This technical memo, included as Appendix A: AANDC TC9 to this document, provides a detailed evaluation of the filter criteria necessary to ensure

adequate performance of the Interim Dike. This technical evaluation confirms that the run-of-quarry material proposed for use in construction of the Interim Dike will not retain tailings and therefore a specific filter design as presented in the memo is required from the outset. A comprehensive technical and economic trade-off of the final filter choice will be made as detailed engineering advances as described in the memo. Since this filter will be part of the initial construction, prior to commencement of tailings deposition no retrofitting is required.

43.7 ATTACHMENTS

Appendix A: AANDC TC9 – SRK Technical Memo Filter Requirements

44. ID# AANDC TC10

44.1 SUBJECT

There is concern that water may build up adjacent to the toe of the thermal rock fill pads, and thus alter the thermal properties of the permafrost maintenance system.

44.2 REFERENCE

Interim Closure and Reclamation Plan. July 2015 Detailed Cost Estimate

44.3 SUMMARY

Not Applicable

44.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

44.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

In previous geotechnical inspections it is stated that water should not be allowed to pond against the edges of the thermal rock fill pads. When this occurs ponded water must be pumped away, particularly after precipitation /melt events, since the standing water can change the thermal characteristics of the system and promote permafrost degradation.

Generally, the proposed decommissioning of the rock fill pads is simply to regrade the surface. This does not address scenarios where water has historically ponded against the thermal pads. There is no explanation as to how this will be handled after closure.

Recommendation: AANDC requests that the Proponent provide an explanation of measures that will be implemented to ensure that water will not pond against the edges of the thermal rock fill pads after closure.

44.6 TMAC RESPONSE

Surface infrastructure at Doris North has been in place since 2007. There is therefore a long history of the performance of these structures, including areas where ponding adjacent to the roads or pads occurs. This history has confirmed that there are very few areas where pumping is required. Annual geotechnical inspections will continue to observe all areas, including areas of known ponding, and as a result, by closure areas of concern will be well known.

In areas where prolonged ponding persists and the only suitable mitigation throughout Operations is pumping, the closure strategy will be the same as that for areas where culverts or stream crossings are constructed: areas restricting flow will be excavated to restore drainage and thereby prevent ongoing ponding.

The Interim Closure and Reclamation Plan (Document P5-2 of the Amendment application) will be revised prior to Operations to reflect this commitment. The closure costing estimate will be adjusted to address this issue; based on the site conditions it is believed that about 10 areas of concern may exist with a cumulative closure cost of $26,000 in undiscounted 2015 Canadian dollars.

Further discussion of the addition of this cost, as well as the overall reconciliation of the cost estimate with the AANDC independent closure cost estimate is provided in Appendix A: AANDC TC10 of this document.

44.7 ATTACHMENTS

Appendix A: AANDC TC10 – SRK Technical Memo Closure Cost Estimate Analysis

45. ID# AANDC TC11

45.1 SUBJECT

Tailings Management Strategies

45.2 REFERENCE

P6-13 Tailings Management System:

Appendix B – Tailings Management Strategies Alternatives Assessment

Section 3.3 Alternate Tailings Disposition Methods (Package 6 Part 8, page 3-4, pdf page 13-14); and Section 4. Preferred Tailings Management Alternative (Package 6 Part 8, page 6, pdf page 16)

45.3 SUMMARY

Not Applicable

45.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

45.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

In Section 3.3 (P6-13, Appendix B), the proponent states that, 'Alternative

#4 – Subaerial hydraulic tailings deposition with a dry cover at closure:....The negatives include fugitive tailings dust, ice entrainment and possible limited availability of reclaim water.' 'Alternative #5 – Subaerial filtered (dry-stack) tailings deposition with a dry cover at closure.....Drawbacks of this strategy includes.....compaction of the tailings and a requirement to manage fugitive tailings dust until such time as the closure cover is in place.'

In section 4 (P6-13, Appendix B), the proponent states that, 'The preferred tailings disposal strategy is sub-aerial slurry tailings deposition.'

Observation: Fugitive tailings dust emissions associated with sub-aerial disposal of tailings during operational phases can be a major environmental concern. Wind-blown dust may impact the surrounding freshwater resources. The subaerial disposal of tailings has been proposed as 'subaerial hydraulic tailings (Alternate # 4)' and 'subaerial filtered or dry-stack tailings (Alternate #5)'.

In order to understand the behavior of the dry tailings disposal in the Tailings Impoundment Area during operation, physical laboratory test results on tailings should be provided. These tests include particle size analysis (grain size distribution) and hydraulic conductivity test.

In particular, a grain size distribution test of the tailings will provide the information on the level of fugitive dust emissions during the project's operational phases. The physical characterization of tailings will further help in the selection of an appropriate control technology to be implemented for dust suppression during the operational phases.

Recommendation: Please provide the physical test results of tailings including particle size analysis (grain size distribution) and hydraulic conductivity. The behavior of the sub-

aerial tailings during project operations in light of the physical tests should be documented.

Please provide information on the level of dust suspension (during operations) in light of the grain size distribution of the tailings. Details on the particular control measure(s) to be implemented should also be documented.

45.6 TMAC RESPONSE

Particle size analysis for the tailings is included in Appendix A: AANDC TC11 -1 of this document and hydraulic conductivity is outlined in Amendment Application document P6-13, Appendix H, Section 2.4, Table 1.

Particle size analysis indicates solids fraction of the tailings is composed of 37.4% fine sand, 51.2% silt and 11.4% clay (See Appendix AANDC TC11 - 1, p.4). These data and the hydraulic conductivity of 5.4 x 10^{-7} m/s (under thawed conditions) have been considered within design criteria for the TIA and the predictive water balance and water quality calculations presented within the Amendment Application.

It is anticipated that dust will be generated due to the particle size and climatic conditions of the Project and dust mitigation measures are included Project design and management as described in Appendix I of Document P6-13. The primary dust control measure will be the use of environmentally suitable chemical dust suppressants. The application of those 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.

Ongoing monitoring programs of tailings deposition and air quality will be implemented to confirm these anticipated results and to ensure mitigation measures are meeting objectives.

45.7 ATTACHMENTS

Appendix A: AANDC TC 11 – Particle Size Analysis

46. ID# AANDC TC12

46.1 SUBJECT

Sewage Treatment

46.2 REFERENCE

P6-10 Site-Wide Water and Load Balance:

Section 3.2.8 Water Use

(Package 6 part 5, page 10, pdf page 19); and

Section 4.2.5 Sewage Water

(Package 6 part 6, page 18, pdf page 3)

46.3 SUMMARY

Not Applicable

46.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

46.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Issue: In Section 3.2.8 (P6-10), the proponent states that, 'The sewage effluent rate was estimated assuming a unit rate of 0.15 m3/day per person and a camp size of 280 people, which is 42 m3/day (15,500 m3/year).

In Section 4.2.5 (P6-10), the proponent states that, 'Concentrations of treated effluent discharged to the TIA during operations are based on typical performance estimates from packaged sewage treatment plants.

Table 4-4 provides the estimated sewage concentrations applied to the sewage effluent of 42 m3/day during operations and for one year after closure.'

Observation Table 4-4 (Sewage Effluent Source Term) provided by the proponent lists the estimated concentrations of the parameters of the treated sewage. In addition, the parameters required in the Water Licence, No. 2AM- DOH1323, have not been reported (i.e., pH, BOD5, TSS, fecal coliforms, oil and grease, etc.).

Details on the Packaged Sewage Treatment Plants in terms of contaminant removal efficiency and the actual concentration of the required parameters (including pH, BOD5, TSS, fecal coliforms, oil and grease, etc.) to be discharged in the TIA have not been provided.

Recommendation: Please provide details on the Packaged Sewage Treatment Plants in terms of contaminant removal efficiency and the actual concentrations of the

required parameters (including pH, BOD5, TSS, fecal coliforms, oil and grease, etc.) to be discharged in the TIA.

46.6 TMAC RESPONSE

TMAC operates Sanitherm SaniBrane Membrane Bioreactor (MBR) Model # TMR140-200W Plants at site. The details of the Sanibrane MBR operation, as well as the general management of this facility can be found in the 2014 Doris North Waste Water Management Plan (the "Plan") submitted to the NWB in April of 2014. Each Plant is rated for 180 man capacity. Currently only one plant is in operation, although 2 plants may run in parallel at any one time when the number of personnel at site warrant it. A third plant was brought to site in 2015 and will act as contingency stand-by whenever two plants are in operation.

Sanibrane MBR's have been in operation at Doris North since the initial opening of the camp, and have proven capable of meeting water licence wastewater effluent discharge criteria. Monthly effluent monitoring results for ST-8 (the SNP monitoring location), confirming compliance with Water Licence criteria for pH, BOD_5, TSS, fecal coliforms, and oil and grease for each year of operation can be found in the 2AM-DOH1323 Annual Reports located on the NWB ftp site.

The average annual effluent concentrations are as listed in Table AANDC TC12 - 1 below.

Table AANDC TC12 - 1. Average and Median Annual ST-8 Effluent Concentrations

		pH (pH unit)	TSS (mg/L)	BOD5	Oil & Grease (mg/L)	Oil & Grease (Visible Sheen)	Fecal Coliform
2009	**Average**	6.99	1.5	2.6	0.6	No visible sheen	0.7
	Median	7.56	1.5	1.6	0.5	No visible sheen	0.5
2010	**Average**	6.77	1.3	4.1	1	No visible sheen	8.5
	Median	7.05	1.5	2.6	0.5	No visible sheen	0.5
2011	**Average**	7.28	1.7	4.7	1.3	No visible sheen	1050
	Median	7.34	1.5	2.9	1	No visible sheen	0.5
2012	**Average**	6.76	1.5	7.1	2.1	No visible sheen	22.3
	Median	6.71	1.5	4.45	0.5	No visible sheen	0.5
2013	**Average**	7.23	1.5	2.7	3.2	No visible sheen	0.6
	Median	7.18	1.5	1	2.55	No visible sheen	0.5
2014	**Average**	6.39	1.5	2.1	2.01	No visible sheen	0.5
	Median	6.34	1.5	1	2.5	No visible sheen	0.5

46.7 ATTACHMENTS

Not Applicable

47. ID# AANDC TC13

47.1 SUBJECT

Water Treatment

47.2 REFERENCE

P5-3 Water Management Plan, 2.2.Extent of Infrastructure Requiring

Water Management

(package 5 part 6, page 4, pdf page 12)

P6-12 Tailings Geochemistry, Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay

Section 5 Summary and Conclusions

(Package 6, Part 7, Page 30, pdf page 91)

47.3 SUMMARY

Not Applicable

47.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

47.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Issue: In Section 2.2 (P5-3, Extent of Infrastructure requiring water management), the proponent states that, 'Water that comes into contact with ore and waste rock may not meet effluent water quality discharge limits following the settling of suspended solids. Additional treatment of the contact water is expected.'

In Section 5 (P6-12, Summary and Conclusions) the proponent states that, 'Process water chemistry associated with the tailings slurry samples, analyzed to provide an indication of possible water chemistry to be discharged to the tailings facility, indicated

elevated levels for several aqueous phase metals that varied by tailings type and ore zone.'

In Section 5 (P6-12, Summary and Conclusions) the proponent states that, 'Process water chemistry between the Doris Central, Doris Connector and Doris North solutions was notably different with the Doris Central process water characterized by higher metals. Chromium was elevated in all three solutions; molybdenum, and iron were elevated in both Doris Central and Connector solutions; while cadmium, copper, and zinc were elevated in Doris Connector and Doris North Solutions. The Doris Central and Doris North flotation tailings water were also elevated in silver and lead, and aluminum and arsenic, respectively.'

Observation: The proponent has a plan to discharge process water and floatation tailings in TIA. In light of laboratory test results, the process water will contain elevated concentrations of metals (cadmium, copper, zinc, chromium, molybdenum and iron) and arsenic. The water that will come in contact with ore and waste rock will also be loaded with contaminants.

The floatation tailings water will contain elevated concentration of lead, silver, aluminum and arsenic.

The details on water treatment system (s) have not been provided. In light of the laboratory test results, the treatment system to be used should be capable of removing different contaminants; therefore, the contaminant removal efficiency of the proposed system should also be analyzed.

Recommendation: The details on water treatment system (s) should be provided. The efficiency of the proposed water treatment system (s) should be analyzed in terms of contaminant removal efficiency.

47.6 TMAC RESPONSE

TMAC would like to reiterate that water treatment is not required. TMAC is however committed to ensure that water quality meets discharge criteria, and have therefore proposed water treatment as a mitigation strategy.

As described in the response to AANDC TC6, should for any reason the water quality in the TIA not be suitable for discharge, there is sufficient capacity in the TIA to retain water for a period of at least 5 years. This is sufficient time to design, procure, construct and commission a water treatment plant should one be required. TMAC is therefore of the opinion that it is not necessary to provide details on the possible methods or removal efficiencies of a possible water treatment plant at this time.

47.7 ATTACHMENTS

Not Applicable

48. ID# AANDC 1

48.1 SUBJECT

Water Quality

48.2 REFERENCE

P2-1, Project Description with Executive Summary

48.3 SUMMARY

Not Applicable

48.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

48.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Provide clarification or the methodology and rationale on how the improved water predictions can be verified if on-site water quality monitoring laboratory is not required.

TMAC Response: The on-site laboratory identified in the Project Certificate was required to confirm water quality met discharge criteria prior to discharge. Under the current Project Certificate and Water Licence, Tailings Impoundment Area (TIA) effluent is permitted to discharge seasonally into a low flow, sensitive freshwater creek, and so frequent monitoring during discharge was required. With the change to a marine discharge strategy, there will no longer be a discharge to the creek, so monitoring to the extent that an onsite lab would be needed is no longer required.

Further, with the change in mill process from Merrill Crowe to resin in leach, and tailings disposal wherein leach tailings are disposed of underground instead of co-disposed in the TIA, source terms have changed and metals levels in the TIA effluent will be significantly reduced. Based on the water and load balance (document P6-10 submitted with the Application), metals are not predicted to be of concern; routine analysis provided by an off-site laboratory is sufficient to confirm effluent quality.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

48.6 TMAC RESPONSE

No further response required.

48.7 ATTACHMENTS

Not Applicable

49. ID# AANDC 2

49.1 SUBJECT

Water Quality

Supporting document not included in the application

49.2 REFERENCE

Not Applicable

49.3 SUMMARY

Not Applicable

49.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

49.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide "Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay", dated April 2015 by SRK

TMAC Response: "Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay", dated June 2015 by SRK was provided with the Application as document P6-12. This is an updated version of the April 2015 version document; the document reference date should have been listed as June 2015, not April 2015. The primary differences between the April version and June versions are editorial, not technical.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

49.6 TMAC RESPONSE

No further response required.

49.7 ATTACHMENTS

Not Applicable

50. ID# AANDC 3

50.1 SUBJECT

Water Quality

Supporting document not included in the application

50.2 REFERENCE

P6-10, Site-Wide Water and Load Balance

50.3 SUMMARY

Not Applicable

50.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

50.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide "Hydrogeological Modeling of the Proposed Doris Mine, Hope Bay Project", dated May 2015 by SRK

TMAC Response: "Hydrogeological Modeling of the Proposed Doris Mine, Hope Bay Project", dated June 2015 by SRK was provided with the Application as document P6-3. This is an updated version of the May 2015 version document; the document reference date should have been listed as June 2015, not May 2015. The primary differences between the May version and June versions are editorial, not technical.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

50.6 TMAC RESPONSE

No further response required.

50.7 ATTACHMENTS

Not Applicable

51. ID# AANDC 4

51.1 SUBJECT

Water Quality

Supporting document not included in the application

51.2 REFERENCE

P6-14, Waste Rock and Ore Geochemistry, Static Testing

51.3 SUMMARY

Not Applicable

51.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

51.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide "Static Testing and Mineralogical Characterization of Waste Rock and Ore from the Doris Deposit, Hope Bay - Supporting Data", dated May 2015 by SRK

TMAC Response: "Static Testing and Mineralogical Characterization of Waste Rock and Ore from the Doris Deposit, Hope Bay - Supporting Data", dated June 2015 by SRK was provided with the Application as document P6-14. This is an updated version of the May 2015 version document; the document reference date should have been listed as June 2015, not May 2015. The primary differences between the May version and June versions are editorial, not technical

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

51.6 TMAC RESPONSE

No further response required.

51.7 ATTACHMENTS

Not Applicable

52. ID# AANDC 5

52.1 SUBJECT

Water Quality

Lack of document describing water inflow to underground mine

52.2 REFERENCE

P6-14, Waste Rock and Ore Geochemistry, Static Testing

52.3 SUMMARY

Not Applicable

52.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

52.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide the study describing the groundwater inflow predictions to the mine, including inflows from Doris Lake and groundwater.

TMAC Response: The groundwater inflow predictions to the mine, including inflows from Doris Lake and groundwater, can be found in document P6-3 provided with the application: "Hydrogeological Modeling of the Proposed Doris Mine, Hope Bay Project", SRK 2015.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

52.6 TMAC RESPONSE

No further response required.

52.7 ATTACHMENTS

Not Applicable

53. ID# AANDC 6

53.1 SUBJECT

Water Management & Treatment

53.2 REFERENCE

P4, Identification of Potential Environmental Effects and Proposed Mitigation,

Executive Summary

53.3 SUMMARY

Not Applicable

53.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

53.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide information describing how estimated the losses from the lake are determined; what will happen to the lake as a result of these loses.

TMAC Response: Information describing the groundwater inflow modelling is discussed in document P6-3, (Hydrogeological Model), submitted with the Application.

As presented in document P4-1 (Effects Assessment, pg. 2-26) included with the Application, water balance modelling indicates that water removal from Doris Lake for industrial use, combined with seepage from the lake into the under round mine while mining in the talik, will drop the surface water level of the lake and decease the flow in the lake outflow. The hydrologic assessment indicates a lake level decrease of up to 0.23 m during winter; this change is within the natural range of water level and ice

thickness and is not expected to result in adverse effects to fish and fish habitat in Doris Lake.

To confirm this assessment, TMAC completed a field study on Doris Lake in fall 2015 and included a detailed habitat survey around the entire perimeter of the lake, focusing on the 1.5 to 4 m zone, the primary area of concern immediately below natural lake ice, where eggs and larvae left by fall-spawning fish overwinter. If the lake is drawn down below the natural range, eggs and alevins close to the ice could perish. In addition, hydroacoustics, gillnetting, angling, underwater video, and visual observations were used to further categorize lake habitats and to identify spawning fish locations within the lake. These field data will be summarized in Q4 2015 as part of the self-assessment process to determine effects. The field information will be assessed in conjunction with existing fisheries and hydrological baseline data to accurately quantify potential effects and if the analysis of the field program results do in fact indicate that the drawdown of Doris Lake will cause serious harm that cannot be avoided or mitigated, an offsetting plan will be developed

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

53.6 TMAC RESPONSE

No further response required.

53.7 ATTACHMENTS

Not applicable

54. ID# AANDC 7

54.1 SUBJECT

Water Management & Treatment

54.2 REFERENCE

P6-7, Roberts Bay Discharge System: Surface Infrastructure, Section 4

54.3 SUMMARY

Not Applicable

54.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

54.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide an analysis of the hydrological effects on the design in wet and dry years and show how the system can handle the differing conditions.

TMAC Response: The SRK water and load balance does include a stochastic analysis of variable hydrologic conditions illustrating the system sensitivity (P6-10 Water and Load Balance) included in the amendment application

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

54.6 TMAC RESPONSE

No further response required.

54.7 ATTACHMENTS

Not Applicable

55. ID# AANDC 8

55.1 SUBJECT

Water Management & Treatment

55.2 REFERENCE

Multiple documents

55.3 SUMMARY

Not Applicable

55.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

55.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide a description of the management processes that will be in place to help ensure that sufficient early warning signals are built into the environmental management system such that the need for treatment, if required, can be pro-actively identified and installed before water quality criteria failures.

TMAC Response: Water treatment has been identified by TMAC as a contingency measure in the event that conditions develop and water quality is not suitable for discharge to Roberts Bay. Together, the MMER, Water Management Plan and the Tailings Operation and Maintenance Surveillance Manual will detail the sampling frequency that will be implemented to enable detection of changes in water quality over time so that appropriate adaptive management action can be taken. A revised Water Management Plan was submitted with the application (document P5-3): the current approved Plan has been updated to reflect the proposed project changes, and will be revised again should the need for treatment arise. The Tailings OMS manual (analogous to the Tailings Management Plan) will be submitted to the NWB prior to the commencement of TIA operations. Should water treatment of tailings effluent water be required, TMAC will design and commission a waste water treatment facility.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

55.6 TMAC RESPONSE

No further response required.

55.7 ATTACHMENTS

Not Applicable

56. ID# AANDC 9

56.1 SUBJECT

Report Presentation

56.2 REFERENCE

P5-4, Waste Rock and Ore Management Plan

56.3 SUMMARY

Not Applicable

56.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

56.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please provide the contents for Module B or indicate if this title page should be removed from the document.

TMAC Response: The title page for Module B of the Waste Rock and Ore Storage Management Plan refer to Type B Water Licence for Madrid. The application for Madrid water licence is currently undergoing review and is outside the scope of the Doris application. Once the BB licence is administered, Module B will be updated to address terms and conditions of the BB licence. The Module B title page was included in the Waste Rock and Ore Storage Management Plan to illustrate the new modularized format of the Hope Bay management plans.

Parties are directed to Module A for Doris-specific waste rock and management.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

56.6 TMAC RESPONSE

No further response required.

56.7 ATTACHMENTS

Not Applicable

57. ID# AANDC 10

57.1 SUBJECT

Groundwater Management

57.2 REFERENCE

P5-4 Waste Rock and Ore Management Plan & P5-2 Interim Closure and

Reclamation Plan

57.3 SUMMARY

Not Applicable

57.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

57.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Please explain why materials impacted by ANFO and hydrocarbon substances will not be remediated on surface (e.g., landfarm) or removed to a hazardous waste management facility.

TMAC Response: Placement of hydrocarbon-impacted materials underground is allowed for under the Current Water Licence 2AM-DOH1323 Part L, Item 6 (l). The 2015 Interim Closure and Reclamation Plan will be updated accordingly.

Placement of ANFO-impacted material underground has been standard practice in mining for many years. As stopes are excavated underground, adjacent pillars need to be supported so that other parts of the orebody can be safely excavated. This represents an environmentally and technically acceptable way to eliminate the possible surface impacts of rock containing blasting products, as in the case at Doris, or which are acid generating. It also represents a beneficial use of waste material that if it were left on the surface could have negative environmental effects.

AANDC Comment December 8th: The response from TMAC meets the information request requirements. No further action is required.

57.6 TMAC RESPONSE

No further response required.

57.7 ATTACHMENTS

Not Applicable

58. ID# AANDC 11

58.1 SUBJECT

Water Management Plan

Water quality criteria for any potential discharge into the marine environment is included within the Water Licence.

58.2 REFERENCE

P5-3 Water Management Plan, A 5.1 - Water Management During Operations

(Package 5, Part 6 Page 7 (pdf page 27)

58.3 SUMMARY

Not Applicable

58.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

58.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation: The proponent states, 'During operations, mill effluent, surface runoff water, precipitation and contact water accumulating in the sediment control pond, pollution control pond (PCP) 1, landfill sump and Pad U (PCP 2) will be pumped to the TIA.', and, 'Excess water will be pumped from the TIA to the Marine Outfall Mixing Box located in the mill building, and then be pumped via a pipeline along existing corridors to the Roberts Bay Discharge System.'

In order to discharge the effluent into the marine environment, water quality criteria should be the part of the Water Licence. In this regard, the proponent has used CCME water quality guidelines for marine aquatic life to evaluate the water quality requirements for the proposed discharge.

Information Request: Please provide proposed effluent discharge criteria for marine disposal both with respect to the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life as well as the Metal Mining Effluent Regulations.

TMAC Response: Effluent criteria are provided in Table 4.5-3 of document P4-1 (Effects assessment; 3rd column) for all considered marine Canadian Council of Ministers of the Environment (CCME) water quality (WQ) parameters. CCME guideline

concentrations were outlined in Table 4.5-1 of document P4-1 (3rd column). Metal Mining Effluent Regulations (MMER) WQ parameters were not presented explicitly in document P4-1.

Effluent discharge criteria are also presented in Table 5-2 of the water and load balance model (document P6-10) submitted with the Application, and Table A5 of the Water Management Plan (document P5-3).

AANDC Response: The proponent's response requires further consideration before setting effluent discharge criteria. For instance, the allowable concentration of Arsenic in the tailings impoundment area is 0.960 mg/L (Table 4.5-3 of document P4-1) and the MMER limit for Arsenic is 0.5 mg/L (Table A5 of document P5-3). The allowable concentrations of Cadmium and Mercury are greater than the CCME limits presented in Table A5.

58.6 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, specifically that the effluent will meet MMER requirements before being discharged and will meet CCME water quality guidelines for the protection of aquatic life at a compliance site downstream in the receiving environment. In Roberts Bay, TMAC proposes that CCME guidelines will be met at a near-field receiving water compliance site north of the diffuser terminus. The MMER discharge and CCME receiving water criteria are presented in Table 5-2 of the Water and Load Balance Report (SRK 2015; Package 6-3), and are updated in the table below (Table AANDC 11 - 1)

Table AANDC 11 - 1: MMER discharge limit and CCME guidelines

Water Quality Parameter	MMER End-of Pipe Criteria[a]		CCME Guideline to be met at Roberts Bay Compliance Point[b]
	Maximum Monthly Mean Concentration	Maximum Concentration of Any Grab Sample	Maximum Concentration of Any Grab Sample
pH			7.0-8.7
Nitrate-N			45
Phosphorus, total			guidance framework
Arsenic	0.5	1	0.0125
Cadmium			0.00012
Chromium (III)			0.056
Chromium (VI)			0.0015
Copper	0.3	0.6	
Lead	0.2	0.4	
Mercury Hg			0.000016
Nickel	0.5	1	
Silver			0.00075
Zinc	0.5	1	
Total Cyanide	1	2	
Radium	0.37 Bq/L	1.11 Bq/L	
Dissolved Oxygen			8.0 mg/L with narrative
Temperature			<1C change with narrative
Salinity			<10% in salinity
Total Suspended Solids	15	30	5 mg/L over background long-term (1-30 d); 25 mg/L over background short-term (<24 h)
Turbidity			2 NTU over background long-term (1-30 d); 8 NTU over background short-term (<24 h)

Note: all concentrations in mg/L unless otherwise noted.

[a] - Schedule 4 from MMER (SOR/2002-222)

[b] - accessed from http://st-ts.ccme.ca

58.7 ATTACHMENTS

Not Applicable

59. ID# AANDC 12

59.1 SUBJECT

Waste Rock and Ore Management Plan

Concern that the volume of the excavated material (waste rock) will be much larger than the available volume of the cavities for the underground disposal.

59.2 REFERENCE

P5-4 Waste Rock and Ore Management Plan, 2.1.Metal Leaching and Acid

Rock Drainage (ML/ARD) Potential-Waste Rock (Waste Classification) Package 5, Part 6

Page 5 (pdf page 41)

59.3 SUMMARY

Not Applicable

59.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

59.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation: The proponent states: 'Mine planning indicates there is sufficient capacity to place all waste rock underground at closure.' However, a large quantity of waste rock can be sent back in to the cavities as backfill but all the waste rock may not be sent underground.

Information Request: Please provide an explanation on how all the waste rock can be placed underground as backfill at closure taking into consideration that the volume of excavated material will be much larger than the volume of the underground cavities.

TMAC Response: Refer to Table A1 of document P5-4, Waste Rock and Ore Management Plan, submitted with the Application. This table illustrates the mining schedule including production of ore and waste rock. Over the life of mine, about 3.9 M tonnes of ore and waste rock will be extracted from the underground mine (2,399,000 tonnes of ore and 1,523,000 tonnes of waste rock).

The in-situ density of the rock is about 2.89 tonnes/m3 yielding a total available void space of about 1.4 Mm3. The 1.5 M tonnes of waste rock will be returned back underground as backfill, but will be subject to bulking during excavation, and subsequently compaction when placed underground. A reasonable swell factor of 1.34 can be assumed for this material which means that the waste rock will require a void space of 0.71 Mm3 which is 52% of the available space. About 6% of the tailings are leach tailings and will be used for backfill. They will be compacted to a density of 1.4 tonnes/m3 and will occupy a void space of about 0.10 Mm3. Therefore the total void space required for backfill in the mine is about 0.81 Mm3 which is 60% of the available void space.

AANDC Comment December 8th: AANDC is satisfied with the proponent's response.

59.6 TMAC RESPONSE

No further response required.

59.7 ATTACHMENTS

Not Applicable

60. ID# AANDC 13

60.1 SUBJECT

Tailings Management Plan

Concern that the strategy proposed by the proponent will accumulate a large volume of potentially acid generating (PAG) material and detoxified tailings underground. The detoxified tailings with acidic pH and elevated concentration of Cd, Co, Cu, Fe, Mn, Ni, Pb, and Zn can contaminate underground water.

60.2 REFERENCE

P6-13 Tailing Management System, 2.2 New Tailings Storage

Requirements

Package 6, Part 7

Page 4 (pdf page 104)

Geochemical Characterization of Tailings from the Doris Deposits, Hope Bay

60.3 SUMMARY

Not Applicable

60.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

60.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation: About 6% (i.e. 150,000 tonnes or 116,000 m^3) of the tailings are comprised of detoxified cyanide leach tailings, and this tailings stream will be sent underground where it will be mixed with underground waste rock for use as structural mine backfill.'

The proponent states, that 'The detoxified tailings also showed a propensity for leaching of several metals in the humidity cell tests. In addition to arsenic, neutral pH metal leaching of ammonia, cadmium, copper, iron, selenium and silver was reported in the Doris North detoxified tailings, and cadmium and selenium in the Doris Central detoxified tailings. Acidic conditions developed in the Doris Central detoxified tailings after 202 weeks of testing. At acidic pH, increased metal leaching of Cd, Co, Cu, Fe, Mn, Ni, Pb, and Zn was noted.' The potential leaching of contaminates under low pH conditions can be a significant source of underground water contamination.

Information Request: Please provide an analysis of the combined impact of detoxified tailings and backfilled PAG waste rock on groundwater.

TMAC Response: The project is not anticipated to have significant adverse effects to groundwater quality outside the underground mine zone, given that the mine is located in permafrost. During operations, the underground workings will intersect groundwater flow and act as a sink; i.e. the volume and/or pressure within the collected groundwater will not result in flow out of the working into the groundwater regime. This groundwater collected in the mine operations will be managed as outlined in document P5-3 (the Water Management Plan) section A.4 to ensure effects to surface and groundwater quality and quantity is mitigated. The Site Water Management Plan will be updated on a regular basis as per terms and conditions of the current Type A Water Licence incorporating ongoing data collection, mining planning and operational needs.

During operations, waste rock and detoxified tailings will be placed underground for mine stability and long term disposal. Depending on operational needs, these areas will be allowed to fill with groundwater to promote freeze back conditions and to get the reactive material under a water cover in a timely manner to minimize oxidation reactions. Time needed to fill the underground workings will depend on mine operations, and the remaining space after placement of waste rock and detoxified tailings. This timeframe is related to closure effort and will be part of technical discussions for the closure plan and ongoing effort during mine operations to revise and update the closure plan as per the current Type A Water Licence and KIA Commercial Lease Agreements.

At closure, all the mine workings will be flooded and those areas outside the talik will freeze and those areas within the talik will go through a seasonal freeze/thaw cycle. The mine geometric design is such that the final expected groundwater elevation is well below any surface openings and therefore mine water outflow to the environment cannot occur.

AANDC Comment December 8th: The proponent must ensure that the backfilling of acid generating materials with elevated concentrations of the contaminants will not contaminate groundwater. Evidence for non-contamination should also be provided in annual reports.

60.6 TMAC RESPONSE

Comment noted.

Further analysis of the potential sources of loading within the underground mine is presented in the response to AANDC TC-2. Based on this information, TMAC is confident that groundwater discharges from the underground mine will meet the discharge criteria set for the project.

Groundwater discharges from the underground mine will be monitored to ensure that they meet the criteria for discharge to the marine environment and the results will be provided in the annual reports.

Post closure, once the mine has re-flooded oxidation products that have accumulated in the backfilled materials and on the mine walls will be released into the flooded mine pool. Solubility limits and attenuation reactions are expected to sequester part of this load, but some sulphate and metals will be released into solution. The concentrations are not expected to be particularly high because the backfill is expected to have a neutral pH. The groundwater is also not considered to be a groundwater resource due to the low permeability of the surrounding bedrock and the naturally occurring groundwater salinity. Additionally, all of the openings to the underground workings are

above the potentiometric surface, so there will be no discharges from the reflooded mine.

Total flows from the underground mine pool into Doris Lake are expected to be very low due to the limited hydraulic gradient at closure, and the low permeability of the lake sediments. However, further evaluation of water quality in the reflooded mine, and the potential flux of groundwater into Doris Lake will be prepared and made available at the Technical Meeting in Cambridge Bay in January 2016.

60.7 ATTACHMENTS

Not Applicable

61. ID# AANDC 14

61.1 SUBJECT

Tailings Management Plan

61.2 REFERENCE

P6-13 Tailings Management System, Doris North Project: Tailings

Management Strategies Alternatives Assessment, 2.1 Tailings Make-up

Package 6, Part 8

Page 1 (pdf page 11)

61.3 SUMMARY

Not Applicable

61.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

61.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation: The proponent states, that 'This containment would be in the form of a thermal cover that would ensure that the tailings surface remain perpetually frozen, or a synthetic cover such as a High Density Polyethylene (HDPE) or Geosynthetic Clay Liner

(GCL). Preliminary thermal modeling suggests that a thermal cover constructed from quarry rock would have to be in the order of 4 to 5 m thick.

Information Request: Please provide a detailed design of the final cover system(s) to deal with potential acid generation and metal leaching processes. Measures to control surface and underground water contamination due to potential precipitation and possible temperature rise should also be documented.

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, already submitted with the application). 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.

AANDC Comment December 8th: AANDC recommends that the final cover system design be provided to the NWB for approval prior to its construction in light of the Proponent's commitment.

61.6 TMAC RESPONSE

TMAC agrees and commits to submitting the final cover system design to the NWB prior to its construction.

61.7 ATTACHMENTS

Not Applicable

62. ID# AANDC 15

62.1 SUBJECT

Interim Closure and Reclamation Plan

Concern about the assumed percentages for the cost estimate.

62.2 REFERENCE

Interim Closure and Reclamation Plan, July 2015 – Detailed Cost

Estimate, Appendix A. Cost Estimate

Page 3 (pdf page 11)

62.3 SUMMARY

Not Applicable

62.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

62.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Observation: The proponent has assumed the following percentages in the cost estimates without supporting justification:

- re-slope to 3H:1V (30%);
- grade top for positive drainage (60%); and
- install erosion protection measures (10%)

Information Request: Please provide the basis for the assumed percentages.

TMAC Response: Assumptions used in the development of the cost estimate for the Interim Closure and Reclamation plan are included in the document appended to the Application as P5-2. TMAC is willing to address any specific questions the reviewer may have, as appropriate during the Technical Review.

AANDC Comment December 8th: The proponent's response will be taken into account in light of the department's Independent Reclamation and Closure Cost Estimate.

62.6 TMAC RESPONSE

The reviewer is referring to the assumptions in Supporting Document P5-2, Interim Closure and Reclamation Plan provided with the Amendment application, specifically relating to the reclamation of the Overburden dump.

The Overburden Dump, has been constructed as a wedge shaped structure, with gentle slopes toward south and west to allow unrestricted haul truck access and flexibility in the deposition scheme. As a result relatively small portions of the north and west slopes will require regrading to a 3H:1V final slope. Based on SRK's visual inspection of the facility, supported with measurement of areas from as-built surveys, the re-sloping requirement is likely about 20% of the overall surface area; however, a value of 30%

have been assumed for conservatism, as this re-sloping cost is the more expensive component of the Dump reclamation. The remaining 70% (as opposed to 60% as erroneously reported by the reviewer) of the Dump would then require basic regrading to promote positive drainage.

Erosion protection measures may be required in areas found to develop deep rilling and erosion post-closure. The value of 10% was based on engineering judgement supported by field observation based on the performance of the Dump since its construction in 2010.

62.7 ATTACHMENTS

Not Applicable

63. ID# AANDC 16

63.1 SUBJECT

Madrid Advanced Exploration

Impact of Madrid Advanced Exploration Project to Doris North Facilities

63.2 REFERENCE

Application for a new type B water licence, No. 2BB-MAE

63.3 SUMMARY

Not Applicable

63.4 IMPORTANCE OF ISSUE TO IMPACT ASSESSMENT

Not Applicable

63.5 DETAILED TECHNICAL COMMENT/ INFORMATION REQUESTED

Information Request: Explain whether the proposed amendment to the Doris North Gold Project's type A water licence considers the impact of developing the Madrid Advanced Exploration Project.

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, including

the Madrid Advanced Exploration Project, and their associated impacts should be considered as either a separate application or a future amendment to an existing licence, as appropriate. Accordingly, TMAC respectfully requests that the consideration of Madrid use of Doris infrastructure be considered in the Madrid Type B water licence process.

AANDC Comment December 8th: The proponent's application for a new type B water licence specific to the Madrid Advanced Exploration Project should only be processed if the proposed activities are included in the scope of an application to amend the current type A water licence specific to the Doris North Project. Because Doris North Project facilities will be utilized by the Madrid Advanced Exploration Project, the potential impacts of this shared use should be assessed under the type A water licence.

63.6 TMAC RESPONSE

In order to optimize footprint, human and financial resources, the Doris facilities have historically been utilized by Hope Bay proponents as much as possible to support exploration, remediation and environmental baseline activities across the Hope Bay Belt. Similar to other past, present and future TMAC exploration projects in the Hope Bay Belt, the Madrid Advanced Exploration Project will use some existing Doris infrastructure (as an example, the main Doris camp and existing transportation corridors).

TMAC's proposed Madrid Advanced Exploration Project is currently under environmental assessment by the NIRB pursuant to section 12.10.2 of the NLCA. Should the NIRB make a positive decision, the NIRB would refer the Madrid Advanced Exploration Project to the NWB water licencing stage.

As TMAC has explained in the 12.10.2 NIRB environmental assessment process as well as in its Type B Water Licence application, the Madrid Advanced Exploration Project is focused on the Madrid deposit. The Madrid and Boston areas are part of the Phase 2 Project for which NIRB has issued EIS Guidelines (NIRB December 2012). The Madrid Advanced Exploration Project does not include any exploration activities relating to the Doris deposits and is not part of the Doris Mine.

For clarity, all of the changes to the Doris North mine facilities and activities requested in the Type A Amendment application are required in order to develop the Doris North mine. None of the changes in this application are triggered by the proposed shared use of certain Doris facilities between the Doris Mine and the Madrid Advanced Exploration Project. TMAC has not identified any changes to the shared Doris facilities or to the Type A Water Licence that would be required as a result of the proposed shared facility use between the Doris Mine and Madrid Advanced Exploration Project. TMAC can present further details regarding its analysis of the potential for environmental effects of

the shared use of certain Doris facilities by the Doris Mine and the Madrid Advanced Exploration Project at the NIRB and NWB technical meetings to be held in January 2016.

63.7 ATTACHMENTS

Not Applicable