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October 11, 2019

Derek Donald
Technical Advisor
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU,
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Sent via Email: licensing@nwb-oen.ca

Re: TMAC Responses to 2018 Nunavut Water Board Annual Report Response Comments

Dear Mr. Donald

TMAC Resources Inc (TMAC) is pleased to present to the Nunavut Water Board (NWB) responses to comments received on the 2018 NWB Annual Report comment responses.

On October 2, 2019 TMAC received comments from the following interested parties:
1. Kitikmeot Inuit Association (KIA); and
2. Environment and Climate Change Canada (ECCC).

All responses to comments can be found in Attachment A of this submission.

Should you have any questions please feel free to contact me at Oliver.curran@tmacresources.com

Sincerely,

Oliver Curran
Vice-President, Environmental Affairs TMAC Resources Inc.
Cc:
Kyle Conway / Sarah Warnock (TMAC)
Ashley Mathai (TMAC)/Adam Grzegorczyk (TMAC) /Shelley Potter (TMAC)

Attachments
- Attachment A – Proponent's Response to Comment Responses Received on the 2018 NWB Annual Report

Attachment A – Proponent's Response to Comment Responses Received on the 2018 NWB Annual Report

TMAC Resources Inc.

HOPE BAY PROJECT

Proponent's Response to Comment Responses Received on the 2018 NWB Annual Report

October 2019

Prepared by:

TMAC Resources Inc.
Toronto, Ontario

Citation:
TMAC. 2019. *Hope Bay Project: Proponent's Response to Comments Received on the 2018 Annual Report*: Toronto, Ontario.

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HOPE BAY PROJECT

Proponent's Response to Comments Received on the 2018 Annual Report

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1. KIA-NWB-4

1.1 SUBJECT

Missing or incorrect contact information for external reporting audiences.

1.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Key Government Contacts, page iii;
- Section 3.3; and
- Conformity Tables (Modules A, B, C, D).

1.3 SUMMARY

The Plan states that a marine spill report will be submitted to a Transport Canada (TC) Marine Safety Inspector if required. There is no further information regarding these reporting requirements; and the table showing Key Government Contacts does not include the TC Inspector's contact information. In addition, the CIRNAC Inspector's phone number in the Key Government Contacts table is different from the number listed in the Type A/B Water License conditions within the Conformity Tables.

1.4 DETAILED REVIEW COMMENT

Section 3.3 of the Hope Bay Spill Contingency Plan states that in the event that a spill has occurred to the marine environment, a written report will be submitted within 24 hours to the Canadian Coast Guard, and a copy of this report will be submitted to a Transport Canada Marine Safety Inspector "if required". There are no further details regarding the situation(s) in which a TC Marine Safety Inspector will need to be notified. There is also no contact information for the TC Marine Safety Inspector within the table of Key Government Contacts on p. iii of the Plan.

The Conformity Tables within Modules A, B, C, and D include conditions of the Type A and B Water Licenses that the Spill Contingency Plan is intended to address. Among these conditions is the reporting of any unauthorized deposits or foreseeable unauthorized depots of waste and/or discharges of effluent to "the Inspector at (867) 975-4295" (in addition to the 24-Hour NT-NU Spill Reporting Line and the KIA). However, the phone number listed in Key Government Contacts (p. iii of the Plan) for the CIRNAC Inspector is (867) 983-5115. Please confirm which phone number is correct and update the list of key contacts, if needed.

1.5 RECOMMENDATION/REQUEST

The KIA requests additional information about spill reporting requirements for Transport Canada, and that contact information be included in the Plan for TC's Marine Safety Inspector.

The KIA also recommends that TMAC confirm the correct contact information for the CIRNAC Inspector and update the table of Key Government Contacts, if needed.

1.6 TMAC RESPONSE TO KIA-NWB-4

TMAC will ensure the correct contact information for the CIRNAC inspector is up to date with key Government Contacts in the next annual update of the Spill Contingency Plan.

1.7 KIA RESPONSE TO TMAC

TMAC's response is partially satisfactory. They will confirm and include the correct contact information for the CIRNAC inspector in the next update of the Spill Contingency Plan. However, TMAC did not address the KIA's comment regarding marine spills and reporting requirements to a Transport Canada Marine Safety Inspector.

Request to TMAC: Please include contact information for the Marine Safety Inspector in the list of Key Government Contacts and indicate the situation(s) in which the Marine Safety Inspector needs to be notified in the next update of the Spill Contingency Plan.

1.8 TMAC RESPONSE TO KIA

Contact information for the Marine Safety Inspector and the situation(s) in which the Inspector would be contacted are detailed in the Hope Bay Ocean Pollution Prevention Plan/Oil Pollution Emergency Plan (OPPP/OPEP). The OPPP/OPEP is the main document of reference for spill control actions in a marine environment and is directly referenced in section 2.2.8 – Spill in a Marine Environment of the Spill Contingency Plan. The next revision of the Hope Bay Spill Contingency Plan is expected to be submitted no later than March 31, 2020 in the 2019 NWB Annual Report.

2. KIA-NWB-8

2.1 SUBJECT

Stronger wording needed for spill-related monitoring.

2.2 REFERENCES

Hope Bay Project Spill Contingency Plan (Mar 2019):

- Section 3.4; and
- Appendix 4, KIA Comment 4 (KIA-9), page 26.

2.3 SUMMARY

TMAC has made some revisions to the Spill Contingency Plan regarding spill-related monitoring. However, the wording is weak and does not reflect a commitment by TMAC to conduct monitoring activities.

2.4 DETAILED REVIEW COMMENT

In response to previous KIA review comment KIA-9, TMAC responded that more details on spill related monitoring have been included in Section 3.4 of the Spill Contingency Plan. However, the revisions to Section 3.4 do not fully address the KIA's concerns. While TMAC has deleted the phrase "completely removed" and has added more information about monitoring triggers and locations for spills to water, the wording in this section still needs to be stronger. The current wording throughout Section 3.4 is that "monitoring may be triggered". TMAC should commit to conducting monitoring activities for spills that potentially have negative environmental impacts, and that are unlikely to be (completely) recovered, whether or land or in water. While monitoring for all spills may not be feasible, especially for small spills with little expected impact, TMAC could develop spill thresholds for various substances or situations for which "monitoring will be triggered".

Without a strong commitment from TMAC to monitor the potential effects of spilled substances that cannot be recovered, there is no guarantee that monitoring will occur at all. The KIA's right to compensation for damages to their lands and waters makes prompt and effective monitoring important to both TMAC and the KIA in the event of a spill or unplanned discharge.

2.5 RECOMMENDATION/REQUEST

The KIA recommends that TMAC use stronger wording within Section 3.4 of the Spill Contingency Plan, i.e. "monitoring will be triggered" rather than "monitoring may be triggered" for various spill response scenarios.

2.6 TMAC RESPONSE TO KIA-NWB-8

TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.

2.7 KIA RESPONSE TO TMAC

TMAC's response is partially satisfactory. Please see detailed KIA review comments for KIA-NWB-9 below.

2.8 TMAC RESPONSE

Please see detailed response as part of KIA-NWB-9 below.

3. KIA-NWB-9

3.1 Subject

Triggered Monitoring of spills to water.

3.2 References

Hope Bay Project Spill Contingency Plan:

- Section 3.4 Monitoring and Restoration P. 18.
- Appendix 4: Responses to comments on Previous Plan Versions P. 26.

3.3 Summary

Conditions for triggering of monitoring of spills into water is unclear.

3.4 Detailed Review Comment

TMAC states that *"monitoring may be triggered in the event of spills to water of substances that dissolve or sink where substance recovery unlikely"* and that *"monitoring may also be triggered in the event of externally reportable spills to land for which recovery of spilled material is unlikely or may be incomplete"*.

In Appendix 4, under Comment #4 (KIA-9), the KIA requested that *"TMAC should include triggers which require monitoring activities, and provide details of the type of monitoring that will be undertaken as part of adaptive management to spills and unplanned discharges…the discussion should be specific to the type of spill, volume, mobility of the spilled material and proximity to various habitat features. Triggered monitoring should be implemented as quickly as possible"*.

TMAC responds that it *"has provided more detail on spill related monitoring in Section 3.4"*.

We do not believe TMAC has satisfactorily responded to our original concern regarding monitoring spills. We are concerned with the use of discretionary language in the guidelines for monitoring spills under Section 3.4 ("may be triggered"). Furthermore, it is not clear what conditions will actually trigger monitoring under the two scenarios presented in this section (e.g., type of spill? volume? mobility? proximity to sensitive environmental features?). TMAC also has not indicated how soon after a spill triggered monitoring would be implemented, or what parameters will be collected.

3.5 RECOMMENDATION/REQUEST

Please remove the discretionary language in Section 3.4 to so that monitoring is required for (i) all spills to water of substances that dissolve or sink which are unlikely to be recovered and (ii) all externally reportable spills to land of substances unlikely to be fully recovered.

Please specify under what conditions monitoring will be triggered for spills (i) and (ii) (e.g., type of spill, volume, mobility, proximity to sensitive environmental features), what parameters will be collected, and how soon after a spill triggered monitoring will be implemented.

3.6 TMAC RESPONSE TO KIA-NWB-9

TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many, and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.

3.7 KIA RESPONSE TO TMAC

TMAC's response is the same as for KIA-NWB-8, which is partially satisfactory. The proponent states that "where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA." As evidenced by comments KIA-NWB-8 and -9, the KIA believes that monitoring and restoration programs should be developed prior to spill events as part of spill response planning and preparedness and to show an understanding of the potential effects of spills on land and in water. These programs can then be adapted, in a timely manner, to each spill response scenario on a case-by-case basis. We appreciate that TMAC's monitoring and restoration programs will be developed in consultation with the KIA; however, we recommend that consultation about spill response and triggered monitoring occur as soon as possible.

KIA acknowledges that spill response varies depending on numerous factors (including type of substance, location of spill, volume, proximity to sensitive environmental features etc.), all spills need to be monitored to help determine what response is appropriate. Furthermore, in the case of spills to water and land that are unlikely to be recovered, it is paramount that monitoring be conducted to track whether these spills cause any adverse environmental effects, so that effective mitigation measures can be implemented. Consequently, the discretionary language in the guidelines for monitoring spills under Section 3.4 should be removed and replaced with wording stating that monitoring is required for all spills described under (i) and (ii) in our prior recommendation.

The KIA also requests clarification about situations in which TMAC would deem it appropriate to develop appropriate monitoring and restoration programs in consultation with the CIRNAC Inspector and the KIA (e.g., compared to when it would be inappropriate to do so).

3.8 TMAC RESPONSE

TMAC appreciates KIA's intent to understand spill preparedness however TMAC does not feel predetermining every possible scenario, response, follow up monitoring, including parameters to be measured, and reclamation actions, is practical or effective. If TMAC were to attempt to address these requests it would result in an extremely voluminous document with thousands of iterations and combinations that account for every possible factor at Hope Bay. TMAC has explored this approach in the past and determined it would be unreasonable to maintain but more importantly, unnecessary. Including these details up front in the management plan is not the intent of the Spill Contingency Plan. The Spill Contingency Plan was developed for the efficient and effective management of activities at site by ensuring the people responsible have the information required to make informed decisions that consider key factors. TMAC has evaluated this approach as being more effective than predetermined responses to a copious amount of scenarios. That said, TMAC would welcome discussing this matter further with the KIA to understand if there are opportunities for improvement that TMAC can incorporate into its approach to spill response.

4. KIA-NWB-13

4.1 Subject

Measurement of water conductivity under ice.

4.2 References

2018 Aquatic Effects Monitoring Program Report:

- Appendix A; and
- Section A.1.4 Physical Limnology P. 9 of 47.

4.3 Summary

Water conductivity under ice is not being used as a measure of water quality.

4.4 Detailed Review Comment

Only temperature and dissolved oxygen were measured for physical limnology parameters under ice. Specific conductivity is a useful indicator parameter to detect changes in water quality due mine related influences in Doris Lake, specifically under-ice to assess cryo-concentration.

4.5 Recommendation/Request

Please add specific conductivity to the physical limnology parameter list specifically for under-ice conditions or provide a rationale as to why this parameter was not included.

4.6 TMAC Response to KIA-NWB-13

Although field measurements of conductivity were not always collected due to the type of profiling Sonde used, conductivity was consistently included in the suite of water quality parameters analyzed by the laboratory (ALS). Therefore, conductivity data are available for any future assessment of mine-related effects or cryo-concentration.

4.7 KIA Response to TMAC

TMAC has indicated that conductivity is consistently measured under ice and update their monitoring plan accordingly. TMAC should further commit to reporting these data in future annual reports. This response is only partially satisfactory.

4.8 TMAC RESPONSE

According to the approved Hope Bay Project Aquatic Effects Monitoring Plan (TMAC 2018), conductivity is included in the list of parameters to be measured/analyzed as part of the suite of water quality parameters, therefore conductivity results will always be included in the appendices of the annual AEMP reports. However, as there is no CCME guideline for conductivity, it was not selected as an evaluated parameter and therefore would not be subject to statistical/graphical analysis in the main report body.

5. KIA-NWB-17

5.1 Subject

Triggers for low action level.

5.2 References

2018 Aquatic Effects Monitoring Program Report:

- Section 2.2.3.2 Water Quality;
- Page 2 of 7;
- Appendix B; and
- Section 3.1 Water Quality Page 14 of 95.

5.3 Summary

Statistical analysis is not performed for Reference Lake B when parameter measures fall below CCME guidelines.

5.4 Detailed Review Comment

In Section 2.2.3.2 of the Aquatic Effects Monitoring Program TMAC states: "*The benchmarks applied to water quality are the CCME freshwater water quality guidelines for the protection of aquatic life (Table 2.2-2; CCME 2018). CCME guideline values are meant to be protective of all aquatic life, including the most sensitive organisms (CCME 1999). Exceedance of these benchmarks could adversely affect the most sensitive freshwater organisms; therefore, the trigger for a low action level is defined as 1) identification of a statistically significant increase in the AEMP effects analysis, 2) exceedance of 75% of the benchmark or CCME guideline, and 3) the absence of a similar change at the reference location (TMAC 2016).*"

In Appendix B of the 2018 Aquatic Effects Monitoring Program Report TMAC states, "*Analysis not performed if greater than 60% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2018) were censored.*"

In situations where parameter measurements in Reference Lake B are below the detection limit for over 60% of the samples statistical analysis was not performed. Therefore, comparison between Doris North and Reference B cannot be performed and qualification 3 for triggering a low action level will not be completed. In such instances concentrations at Doris North may be increasing due to mine influences, but not recognized due to low concentrations at the reference site.

5.5 RECOMMENDATION/REQUEST

Please, provide an alternate method of triggering a low action level when concentrations of a parameter at Reference B are below detection for more than 60% of samples and statistical comparison between Doris North and Reference B cannot be performed.

5.6 TMAC RESPONSE TO KIA-NWB-17

In a situation where the analysis cannot proceed for the reference lake because of the high proportion of censored data, a trend analysis would still proceed for Doris Lake North provided that less than 60% of the dataset was censored for this exposure lake; however, it would not be possible to compare the trend in Doris Lake North to the reference lake trend.

If the trend analysis shows that there is an observed increase in a parameter concentration in Doris Lake North and it is not possible to compare this trend to the reference lake because of the high proportion of non-detects, the conservative approach of not ruling out a mine effect is taken. In this case, condition 3 of the low action level trigger would me met (the absence of a similar change at the reference location) simply because the analysis could not be undertaken for the reference station. This was the case for total molybdenum concentrations in the 2018 AEMP (see Section 3.3-19). There was evidence of an increase in total molybdenum concentration in Doris Lake North (so condition 1 was met), more than 60% of the reference lake concentrations were below detection so it could not be confirmed that a similar change occurred at the reference location and a mine-effect could not be ruled out (so condition 3 was met); however, since total molybdenum concentrations remained far below 75% of the CCME guideline, condition 2 was not met, and the low action level was not exceeded.

This example demonstrates that the conditions for triggering a low action level are robust to situations where concentrations are mostly below detection limits in the reference lake, but are potentially increasing at the exposure lake. A low action level can still be exceeded if the reference site data are highly censored and cannot be included in the analysis.

5.7 KIA RESPONSE TO TMAC

TMAC has demonstrated that conditions for triggering low action levels are maintained when parameter concentrations are mostly below detection limits in the reference lake. TMAC should include these explanation in future annual reports. This response is partially satisfactory.

5.8 TMAC Response

Additional discussion will be added to future AEMPs to clarify how analysis would proceed when parameters are mostly below detection limit in the reference lake but not in the exposure lake.

6. KIA-NWB-19

6.1 SUBJECT

Variation in under ice nitrate concentrations in Doris North Lake.

6.2 REFERENCES

2018 Aquatic Effects Monitoring Program Report:

- Section 3.3.7 Nitrate; and
- Figure 3.3-7 P. 3-12 and 3-16.

6.3 SUMMARY

Under-ice nitrate concentrations appear to be increasing.

6.4 DETAILED REVIEW COMMENT

TMAC states: "*Under-ice season nitrate concentrations in Doris Lake North were variable over time, but were generally similar to concentrations in Reference Lake B (Figure 3.3-7). Although the trend over time in under-ice nitrate concentrations was significantly different from a slope of zero ($p < 0.0001$) and from the trend in Reference Lake B ($p = 0.0001$), there was no indication of an increase in concentrations over time as 2018 concentrations were similar to baseline concentrations (Figure 3.3-7), suggesting that Project activities have not adversely affected under-ice nitrate concentrations in Doris Lake North.*"

Based on the Figure 3.3-7 under-ice nitrate concentrations in Doris North decreased between 2007 and 2013, but have been increasing since 2015, with 2018 having the highest concentrations measured. Therefore, there is graphical evidence to suggest nitrate concentrations are increasing at the exposure site. This should be assessed as a possible change in water quality due to mine related activities (construction and operation).

6.5 RECOMMENDATION/REQUEST

Please provide text describing the possible source of nitrate at the mine in the context of increased under-ice nitrate concentration at Doris North and mitigation measures that may be implemented if concentrations continue to increase.

6.6 TMAC Response to KIA-NWB-19

We disagree that the graphical evidence suggests that nitrate concentrations are increasing at the exposure site. Although the concentration of nitrate in the deep sample from Doris Lake North in April 2018 was the highest recorded nitrate concentration to date (0.201 mg/L), this concentration was only slightly higher than the deep water concentration in Doris Lake North in May 2007 (0.187 mg/L). Furthermore, the average water column nitrate concentration in April 2018 (0.115 mg/L) was nearly identical to the average for May 2007 (0.117 mg/L). Looking only at the data form the last three years, deep water nitrate concentrations appear to be increasing, but looking more broadly at the trend from 2006 to 2018, concentrations seem to oscillate and are highly variable among years and between depths. Recent data from April 2019 (top: 0.0230 mg/L; bottom: 0.0266 mg/L; unpublished) show that deep-water concentrations have dropped by nearly an order of magnitude between April 2018 and April 2019, further supporting the observation that concentrations are variable and there is no increasing trend.

6.7 KIA Response to TMAC

TMAC has demonstrated that under-ice nitrate concentrations are highly variable in Doris Lake North, and that maximum and average values in 2018 are similar to baseline maximum and average values from 2007. However, given that the reference lake under-ice nitrate concentrations show far less variation, we still request that TMAC discuss possible reasons for the fluctuating trend at Doris North in comparison to the reference sites, and to identify mitigation measures to be implemented should concentrations continue to rise. This issue is partially resolved.

6.8 TMAC Response

Doris is a more productive lake (high nutrient, high chlorophyll) than Reference Lake B, so it is expected that nutrient concentrations would show greater fluctuation in Doris Lake. High nitrate and phosphate concentrations in Doris Lake in winter/spring would stimulate high productivity in the open-water season, and these nutrients would be taken up by the large standing stock of phytoplankton, leading to nitrate concentrations being below detection limits in August. Over the winter, nutrients are re-mineralized by microbial decomposition and grazers, leading to a return of organic nitrogen to the inorganic pool (e.g., nitrate), and driving up concentrations of nitrate in the winter (April sampling). There is less nitrate/phosphate in the Reference B lake system, which results in chlorophyll concentrations remaining low, and smaller fluctuations in nutrients.

The discussion in the AEMP will be expanded to include the explanation above.

TMAC/ERM will continue to monitor nitrate concentrations and fluctuations, and will consider mitigation measures if/when an increase in concentrations is detected by the AEMP analysis and the conditions for a low action level response are met.

7. ECCC-6

7.1 SUBJECT

Seepage Monitoring

7.2 REFERENCE

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project. Section 6 Conclusions

7.3 ISSUE/RATIONALE

In the Waste Rock, Quarry and Tailings Monitoring Report Appendix F, Section 6 the Proponent concludes that the monitoring of the seepage from the camp pad and the ore stockpiles indicates that the water quality for the contaminants of concern are within the range of the historical data. However, the Proponent did not indicate whether they comply with the required limits.

The Proponent also indicates that "some contaminants of concern are not attenuated by the tundra as predicted", but then further states that "the concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred." The tundra is part of the environment, so it is not clear how the tundra is being used to attenuate the contaminants of concern, and whether the tundra is being used as a treatment option, or as an alternative to treatment.

7.4 RECOMMENDATION/REQUEST

ECCC recommends that the Proponent clarify the apparent contradicting statements about the water quality and contaminants of concern

ECCC recommends that the proponent provide an explanation of why the tundra is being used or relied on to attenuate contaminants of concern rather than using an actual treatment option.

7.5 TMAC RESPONSE TO ECCC-6

TMAC notes that the IR is in reference to Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 6 (Conclusions).

The majority of the seepage and runoff from the camp pad flows along poorly defined ephemeral drainages. As part of the annual geochemical monitoring program, seepage samples are collected at the toe of the camp pad with the objective of monitoring the near source "contact water" or flushing of oxidation products from ore and waste rock whereas the objective of the ephemeral sampling program is to monitor the seepage that are upstream of the receiving environment. Sections 4 and 5 of Appendix G present the results of the seepage and ephemeral monitoring programs, respectively.

The seepage and ephemeral monitoring programs were designed in the context of validating a water and load balance (WLB) model for the Boston camp pad (SRK 2009). The objective of the WLB was to evaluate potential impacts of seepage from the ore and waste rock at key locations downstream of the Boston camp pad. The geochemical inputs to the WLB were seepage samples collected in 2009, with contaminants of concern (e.g. modelled parameters) identified based on review of the seepage data.

In support of the WLB, an aquatic specialist from Rescan (now ERM) assessed the downstream environment of the Boston Camp to define environmental receptors and where water quality guidelines should be applied. The ephemeral drainage locations were concluded not to be fish habitat and Aimaokatalok Lake was defined as the receiving environment. The WLB indicated that modelled concentrations for contaminants of concern in the receiving environment were below CCME water quality guidelines for the protection of aquatic life. Accordingly, the trend analysis of contaminants of concern and comparisons to the WLB in Appendix G is a method of assessing potential impacts to the downstream environment.

Attenuation of the parameters in the tundra is not presented as a treatment option but as a geochemical mechanism that explains the decrease in concentrations of arsenic and other contaminants of concern in the ephemeral drainage compared to seepage at the toe of the camp pad.

7.6 ECCC Response

The use of the tundra to attenuate contaminants of concern may not have been specifically presented as a treatment option; however, that is what it appears to serve as given the following two statements by the proponent:

a) "some contaminants of concern are not attenuated by the tundra as predicted"

b) "the concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred."

Additionally, in the response to ECCC's recommendations, the proponent stated "the majority of the seepage and runoff from the camp pad flows along poorly defined ephemeral drainages. As part of the annual geochemical monitoring program, seepage samples are collected at the toe of the camp pad with the objective of monitoring the near source "contact water" or flushing of oxidation products from ore and waste rock". It should be noted, that seepage (contact water) out of the camp pad, and or the ore stockpiles is defined as effluent in the MDMER that should be collected, treated if necessary and discharged through a final discharge point (FDP).

Furthermore, the response provided by the proponent raises other questions:

I. Whether attenuation ability or characteristic of the tundra was accounted for in the model?

II. What is the estimated time of breakthrough given that the proponent stated that "the breakthrough of the effectiveness of the attenuation process has not occurred"?

III. If the breakthrough occurs, what would be the impact of that breakthrough on the model?

IV. Was the breakthrough loading included in the model?

V. If the breakthrough is included in the model, then what is the loading from the tundra?

The responses to these questions are necessary because the tundra may then become a secondary point source of contaminants, which may reach Aimaokatalok Lake or any other water body, which is frequented by fish.

7.7 ECCC Recommendations

ECCC recommends that the Proponent provide the study that concluded that the ephemeral drainage locations are not waters that support to contributing to waters that are fish habitat to ECCC.

ECCC recommends that the Proponent provide responses to the following questions:

I. Was the attenuation ability or characteristic of the tundra was accounted for in the water and load balance model?

II. What is the estimated time of breakthrough given that the proponent stated that "the breakthrough of the effectiveness of the attenuation process has not occurred"?

III. If the breakthrough occurs, what would be the impact of that breakthrough on the water and load balance model?

IV. Was the breakthrough loading included in the water and load balance model?

V. If the breakthrough is included in the model, then what is the loading from the tundra?

7.8 TMAC RESPONSE

TMAC would like to point out that ECCC misinterpreted the previous response where TMAC stated "The ephemeral drainage locations were concluded not to be fish habitat and Aimaokatalok Lake was defined as the receiving environment." There is no study, as suggested by ECCC, that concluded the ephemeral drainage locations are not waters that support to contributing to waters that are fish habitat to ECCC. The purpose of the water and load balance is to estimate water quality at the shoreline of the drainage locations and at various points in the downstream environment. The ephemeral drainage locations were characterized as having no stream channelization, no substrate/stream bed, and no aquatic vegetation. Therefore, they were considered not to be fish habitat.

I. No, the water and load balance model used a mass balance approach and therefore did not include attenuation capacity of the tundra. Accordingly, the model is conservative.

II. The time and extent to which attenuation in the tundra will continue, is not known, however if increasing trends of constituents of concern are observed in ephemeral streams, this may suggest that the attenuative capacity of the tundra could be decreasing. The existing ephemeral streams sampling program monitors the attenuation capacity of the tundra.

III. The attenuation capacity of the tundra was not included in the model, therefore there would be no impact on the water and load balance model if decreasing attenuation were to occur.

IV. Reduced tundra attenuation was not included in the water and load balance model. Instead, the model assumed that no attenuation is occurring which makes the model conservative.

V. The term breakthrough is referring to the effectiveness of attenuation processes in the tundra and is not in reference to tundra becoming a loading source. If attenuation were to be reduced or stop, e.g. adsorption sites filled, it is not anticipated that the geochemical conditions would change such that the tundra would become a loading source.

8. ECCC-7

8.1 SUBJECT

Sample Testing Program

8.2 REFERENCE

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section: 5.2 Sampling and Testing Program; 5.2 Results

8.3 ISSUE/RATIONALE

The Proponent states that "This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, copper and selenium may be attributed to the presence of ore, which has higher sulphide content than waste rock." Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria; however, this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

Colloid is defined as "A homogeneous noncrystalline substance consisting of large molecules or ultramicroscopic particles of one substance dispersed through a second substance. Colloids include gels, sols, and emulsions; the particles do not settle, and cannot be separated out by ordinary filtering or centrifuging like those in a suspension. Or simply a mixture in which one substance of microscopically dispersed insoluble particles is suspended throughout another substance."

If this definition is correct, it is unclear how the higher concentration of arsenic and iron in the analysed seepage can be attributed to the presence of colloids. Even if these metals are adsorbed to the surfaces of the colloids, they are still present in the water columns it is unclear how their increase would be because of the presence of colloids.

It is also unclear what is meant by the following statement "When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

8.4 RECOMMENDATION/REQUEST

ECCC recommends that the Proponent explain why the higher concentration of arsenic and iron in the waste rock has been attributed to colloids and provide rational for this conclusion including how these high concentrations occur.

ECCC recommends that the Proponent provide the source of the colloids present in the seepage.

ECCC recommends that the proponent clarify what is meant by "when the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable

8.5 TMAC Response to ECCC-7

The definition of colloid as stated above is out of context. Dissolved metals is an operational definition, whereby a water sample is passed through a 0.45 micron filter prior to trace element analysis. A colloid in the context of operationally defined dissolved metals is a suspended particle that can pass through a 0.45 micron filter. Sampling turbid waters can result in elevated concentrations of operationally defined dissolved metals due to the presence of colloids.

Seepage samples concluded to contain colloids had the following characteristics: i) high TSS concentrations indicating that seepage samples contained sediment prior to filtration through the 0.45 micron filter. This was further supported by visual observations of turbid seepage; ii) dissolved iron and aluminum concentrations above mineral solubility limits for pH neutral and oxygenated samples, and iii) high arsenic and iron concentrations. Arsenic concentrations are controlled by adsorption to ferric iron hydroxide therefore elevated concentrations of both iron and arsenic suggest colloids. On this basis, selected samples were interpreted to contain colloidal materials (i.e. dirt).

The objective of seepage monitoring is to assess potential metal leaching due to sulphide oxidation. Accordingly, each sample was assessed or "screened" for the presence of colloids, as defined above, as colloids in the seepage samples are not indicative of sulphide oxidation and metal leaching processes. The screened samples had concentrations that are consistent with historically measured concentrations of iron and arsenic.

8.6 ECCC Response

ECCC understands the operational definition of colloids provided, however, the visual turbidity and total suspended solids (TSS) are not indicators of colloidal concentrations in the water as TSS is indicative of solids in water that can be trapped by a filter. In addition, colloidal concentrations can be high in waters with low apparent TSS concentrations, as they are soluble. However, the proponent stated that dissolved iron and aluminum concentrations are above mineral solubility limits for pH neutral and oxygenated samples. Which implies that total dissolved solids (TDS) concentration in exceedance of mineral solubility limits is a better indication of colloids in the system. Furthermore, the proponent states "The objective of seepage monitoring is to assess potential metal leaching due to sulphide oxidation". Accordingly, each sample was assessed or "screened" for the presence of colloids, as defined above, as colloids in the seepage samples are not indicative of sulphide oxidation and metal leaching processes.

ECCC notes that colloids, in particular those comprised of Fe-oxy-hydroxides, can be indicative of sulphide oxidation in a circum-neutral, oxidizing environment. In the oxidation process of iron sulphides, Fe(II) is formed and readily oxidized to Fe(III). As the Fe(III) complexes and oxidizes other nearby metals can form complex Fe minerals and further Fe(II). As this is an acid generating process, in a neutral oxidizing system with buffering capacity, localized enhancement of mineral dissolution is possible. Therefore, iron-oxy-hydroxide colloids may be formed by sulphide oxidation and readily adsorb contaminants of concern such as arsenic within the system, and sulphide oxidation in the system can not be ruled out due to the presence of iron-oxy-hydroxide colloids.

8.7 ECCC Recommendations

ECCC recommends that:

a) The Proponent determine the source of colloids present in the seepage.

b) The Proponent determine an alternate method for identifying whether sulphide oxidation is occurring within the waste rock pile than the presence or absence of colloids.

c) The Proponent consider the distances at which colloids, in particular those comprised of iron-oxy-hydroxides can travel in the system and the potential for these iron-oxy-hydroxides colloids to transport contaminants of concern (not just those in excess of solubility limits) downstream and have potential environmental effects.

d) The Proponent consider that once colloids flocculate downstream of the seepage source and precipitate as sediments or move into the dissolved phase, how concentrated metals from adsorption may be eventually released downstream in the dissolved phase due to changes in water chemistry.

8.8 TMAC Response

a) The source of colloids is very fine grained quarry rock, which was used to construct the waste rock pad. The colloids are the fine fraction (<0.45 microns) of sediment or dirt in the pad.

b) The dissolved metals from seepage data is indicative of sulphide oxidation processes. Seepage flows are sufficiently small in volume and flow rate that samples are typically collected using a syringe. In the case of the seep shown in Photo 1, it was necessary to dig a small hole in the pad to allow a sufficient volume of seepage to collect for sample collection. The TSS in any given samples represents sediments that were entrained during sample collection. The shallow nature of the seepage flow path (often 1 to 2 cm) coupled with the suction of the syringe can entrain sediments into the syringe during sampling (refer to Photo 1).

c & d) The colloids is an operational size fraction of small particles (<0.45 microns) represented by dirt / sediment with mineralogical composition of quarry rock. As shown in Photo 1, the fines are dirt and not secondary minerals such as red-brown oxyhydroxides and/or flocculants as suggested. As noted in the Photos, there seepage flows into a downstream collection pond that is part of the overall site water management system.

Photo 1: Seepage sampling station showing the small flow volume and fine grained sediments.

9. ECCC-8

9.1 Subject

Rock Sampling Depths

9.2 Reference

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section: 3 Ore Stockpiles Rinse Survey; 3.1 Sampling and testing Program

9.3 Issue/Rationale

The Proponent indicates that rock samples were collected from approximately 25 cm depth. If waste rock samples have been exposed to the elements of the environment for a long time a sampling depth of 25 cm may not be deep enough to collect a representative samples, given that the contaminants in the top layer of that waste rock would have been flushed out and washed away. The rinse testing of samples from the top layer (25 cm) will yield results that do not accurately reflect the state of the waste rock oxidation in the ore and waste rock.

9.4 Recommendation/Request

ECCC recommends that the Proponent provide clarification on the rationale that led to not selecting samples from a depth deeper than 25 cm and why these samples are considered representative.

9.5 TMAC Response to ECCC-8

Sulphide oxidation is due the reaction of sulphide minerals with air (oxygen). Samples collected are considered representative of sulphide weathering based on the following:

- Visual observations of secondary minerals on the surface of the selected stockpiles indicates that weathering products are present (not flushed from the stockpile).
- The ore stockpiles contain fine material that physically limit oxygen ingress into the deeper stockpile materials. Samples and sulphides located near the surface of the stockpile are exposed to the highest concentrations of oxygen and therefore are the most weathered.
- Values of rinse conductivity for the sample set ranged from 99 to 4,100 µS/cm in the 2018 survey. Rinse conductivity in this case indicates the presence of soluble oxidation products in the samples collected. Lower values of rinse conductivity do not necessarily indicate that flushing of oxidation products, but rather, low sulphide content within the sample.

9.6 ECCC Response

ECCC agrees that Samples and sulphides located near the surface of the stockpile are exposed to the highest concentrations of oxygen and therefore are the most weathered". However, it is important to note that oxidation does not stop at the surface, it goes deeper. ECCC also agrees that the lower values of rinse conductivity on the surface sample indicates that there is lower sulphide content at this depth. This is because some or most of the sulphides have oxidized and/or depleted at the surface, and some oxidation products are removed by seepage or carried away with any drainage out of that depth, leaving behind evidence of oxidation products that are observed visually. An accurate state of oxidation of the pile may be best determined by sampling at different depths (depth profile) that will reflect how deep the oxidation is and how deep oxygen and water has migrated (penetrated) into the pile. ECCC also agreed that fine materials might limit the oxygen and water ingress into the deeper stockpile. However, unless

the fine materials are made of non-permeable material, it does not completely prevent ingress of oxygen and water, which will cause oxidation below 25cm depth to continue.

Therefore, a rinse result of the surface materials does not provide an accurate oxidation profile or potential ARD/ML of the pile.

9.7 ECCC Recommendation

ECCC continues to recommends that the Proponent provide clarification on the rationale that led to not selecting samples from a depth deeper than 25 cm and why these samples are considered representative.

9.8 TMAC Response

The sampling program design for previous geochemical studies of the ore stockpiles at Boston targeted materials within the upper 25 cm because this horizon represents the most conservative (worst case) geochemical conditions for the overall stockpile and therefore represents the highest risk material with respect to MLARD. TMAC would like to highlight that Section 2 of the memo summarizes the geochemical studies and understanding of Boston waste rock and ore, which form the basis of the rinse test monitoring program.

The objective of the rinse test monitoring program is to validate previous interpretations, including a comparison of data for samples that are collected using the same sample collection methods. Data for samples collected from depth would in this case not be comparable to previous data sets and characterizing a profile within the stockpile where deeper materials are less oxidized provides no additional information related to the geochemical performance of the stockpile.

TMAC would like to remind ECCC that the sampling and monitoring programs executed in 2018 are based on previous studies and past submissions that have been reviewed by stakeholders and regulators, including ECCC.

10. ECCC-9

10.1 SUBJECT

2018 Waste Rock Monitoring and Ore Monitoring Report, Boston Camp, Hope Bay Project

10.2 REFERENCE

Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project; Section 3.2 Results

10.3 ISSUE/RATIONALE

ECCC notes that the "tarnishing of the sulphide crystals" mentioned in Appendix F-Section 3.2 of the Waste Rock and Ore Monitoring Report is likely evidence of oxidation of the sulphide minerals, which will lead to Acid Rock Drainage/ Metal Leaching (ARD/ML). It is not clear why the Proponent has compared the monitoring results from 2008 to the results from

2018, and not compared the results for any of the years in between where seepage samples may have indicated ARD/ML activities

10.4 RECOMMENDATION/REQUEST

ECCC recommends that the Proponent analyse the monitoring results of the years in between 2008 and 2018 in order to check for evidence of ARD/ML or verify trends, if any.

ECCC also recommends that the Proponent provide an explanation as to why the only the 2018 monitoring results are being compared to that of 2008 and not the years in between.

10.5 TMAC RESPONSE TO ECCC-9

TMAC notes that the IR is in reference to Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 3.2 (Ore Stockpile Rinse Survey – Results).

The rinse test survey of the waste rock pad and ore stockpiles is conducted every ten years, i.e. 2008 and 2018. Geochemical characterization of the waste rock and ore indicates that all waste rock and the majority of the ore is non-PAG with a small proportion of ore having an uncertain potential for ARD. However, there is a low risk of acidic seepage developing due to the high carbonate content in the underlying pad.

The objective of the rinse test survey is to assess if locally acidic conditions are developing in the ore stockpiles. The 2018 rinse test survey confirmed that all stockpile are pH neutral and consistent with the initial survey conducted in 2008.

TMAC would like to clarify that seepage monitoring is conducted and results reviewed annually, e.g. Appendix G - 2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project, Section 4.2 (Monitoring of Boston Seepage – Results). Annual seepage monitoring has consistently indicated pH neutral drainage from the ore stockpiles and waste rock.

10.6 ECCC Response

ECCC notes that annual seepage monitoring data has consistently shown neutral pH drainage, and that the objective of the rinse test survey is to assess if locally acidic conditions are developing in the ore stockpiles. However, The Proponent did not provide rationale to support why the rinse test is conducted every 10 years and not at shorter intervals. In order to be able to detect any locally developing acid rock drainage (ARD) conditions (hot spots), a shorter time

interval between sampling and sampling over a breadth of temperature and seasonal conditions should be considered. In addition, it is not clear to ECCC how the rinse results compare to the annual seepage survey.

10.7 ECCC Recommendation

ECCC recommends that the Proponent clarify how the rinse results compare to the annual seepage survey.

10.8 TMAC Response

The stockpiles are the potential source of any ML and/or ARD. The ore stockpiles and camp pad contain high levels of carbonate minerals that provide buffering capacity, as indicated by geochemical studies. Accordingly, in the unlikely scenario that acidic conditions were to develop in a localized area of the stockpile, the resulting acidity would be neutralized by the underlying rock. Therefore, the purpose of the rinse test survey is to monitor if acidic conditions are developing on the stockpiles so that any required mitigative action can be taken while there is still sufficient buffering available within the stockpiles.