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ENVIRONMENT AND CLIMATE CHANGE CANADA'S TECHNICAL REVIEW COMMENTS TO THE NUNAVUT WATER BOARD

RESPECTING THE PHASE 2 HOPE BAY BELT PROJECT PROPOSED BY TMAC RESOURCES INC.

MARCH 23, 2018

Canada

Executive Summary

TMAC Resources Inc. (the Proponent) is proposing to develop the Phase 2 Hope Bay Belt Project (the Project) approximately 153 km southwest of Cambridge Bay in the Kitikmeot Region of Nunavut. The Project would consist of the mining of three additional gold deposits, processing of the ore, deposition of wastes and final transport of the product.

Environment and Climate Change Canada (ECCC) has participated in the Water Licence (WL) process to date providing comments to the Nunavut Water Board (NWB) on the completeness check of the WL. ECCC is continuing its participation in this WL review process by way of this submission to the Nunavut Water Board.

This submission summarizes the results of ECCC's technical review of the Type A Water Licence Application package provided by the Proponent. ECCC provides specialist expert information or knowledge to the NWB in accordance with the expertise that ECCC has available, as required under Article 13 of the Nunavut Agreement. The comments and recommendations provided relate to ECCC's mandate in the context of the *Canadian Environmental Protection Act*, the pollution prevention provisions and the Metal Mining Effluent Regulations (MMER) of the *Fisheries Act*.

ECCC's comments and recommendations are in regards to seepage, the wastewater treatment plant, water management ponds capacity and contingencies, acid rock drainage, the Aquatics Effects Management Plan, water quality models, mitigations for in water-works, tailings pipeline catch basins, Site-Specific Water Quality Objectives for Copper and Arsenic, water quality predictions and nitrite levels in the receiving environment.

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1.0 List of Acronyms

AEMP – Aquatic Effects Monitoring Program
ARD – Acid Rock Drainage
CCME – Canadian Council of Ministers of the Environment
CEPA – *Canadian Environmental Protection Act*
CWP – Contact Water Pond
ECCC – Environment and Climate Change Canada
EEM – Environmental Effects Monitoring
MBR – Membrane Biological Reactors
MMER – *Metal Mining Effluent Regulations*
NIRB – Nunavut Impact Review Board
NWB – Nunavut Water Board
SSWQO – Site-Specific Water Quality Objective
TIA – Tailings Impoundment Area
TMA – Tailings Management Areas
TSS – Total Suspended Solids
WER – Water Effect Ratio
WL – Water Licence
WRP – Waste Rock Pile
WTP – Water Treatment Plant

2.0 Introduction

TMAC Resources Inc. (the Proponent) is proposing to develop the Phase 2 Hope Bay Belt Project (the Project) at the currently operating Doris North Mine in the Kitikmeot region of Nunavut approximately 153km southwest of Cambridge Bay. The Project consists of the construction, operation, and closure of the Madrid North, Madrid South and Boston deposits. Construction of the Project is proposed to last 5 years starting as early as 2019.

Environment and Climate Change Canada (ECCC) has participated in the Water Licence (WL) review process to date providing comments to the Nunavut Water Board (NWB) on the completeness check of the WL, which commenced January 17, 2018. The Proponent provided responses to the completeness check comments on February 21, 2018. The technical review of the WL commenced on February 23, 2018. ECCC is continuing its participation in the WL review process by way of this technical review comments submission to the NWB.

ECCC is responsible for leading the implementation of the Government of Canada's environmental agenda and is committed to contributing to the realization of sustainable development in Canada's North. Science plays a fundamental role in enabling ECCC to deliver on its mandate by informing environmental decision-making and regulations, and by supporting the delivery of services to Canadians. ECCC provides specialist expert information or knowledge to the NWB in accordance with the expertise that ECCC has available, as required under Article 13 of the Nunavut Agreement.

A brief summary of the legislation from which ECCC's mandate is derived is provided in Section 3.0. ECCC's comments on the outstanding issues are found in Section 4.0 and finally, a summary of ECCC's recommendations can be found in Section 5.0. Appendix 1 provides additional context on ECCC's legislation as well as other federal guidelines.

ECCC's technical review comments and recommendations are in regards to seepage, the wastewater treatment plant, water management ponds capacity and contingencies, acid rock drainage, the Aquatics Effects Management Plan, water quality models, mitigations for in water-works, tailings pipeline catch basins, Site-Specific Water Quality Objectives for Copper and Arsenic, water quality predictions and nitrite levels in the receiving environment.

3.0 ECCC's Mandate, Roles, and Responsibilities

The mandate of ECCC is determined by the statutes and regulations under the responsibility of the Minister of Environment and Climate Change. In delivering this mandate, ECCC is responsible for the development and implementation of policies, guidelines, codes of practice, inter-jurisdictional and international agreements, and related programs. ECCC's specialist advice is provided in the context of the *Canadian Environmental Protection Act* (CEPA) and the pollution prevention provisions of the *Fisheries Act*.

ECCC administers the pollution prevention provisions of the *Fisheries Act*, which prohibits the deposit of a deleterious substance into fish-bearing waters. ECCC also administers the *Metal Mining Effluent Regulations* (MMER), which apply to both new and existing metal mines and are used to regulate the deposit of mine effluent, waste rock, tailings, low-grade ore and overburden into natural waters frequented by fish.

ECCC also participates in the regulation of toxic chemicals and the development and implementation of environmental quality guidelines pursuant to CEPA. Additional information on ECCC's mandate is found in Appendix 1.

4.0 ECCC's Technical Review Comments

This technical report summarizes the results of ECCC's technical review of the WL application as well as the additional information that was submitted by the Proponent on February 21, 2018 in their response to ECCC's completeness check comments.

ECCC based its analysis on the principle that the Project should be constructed, operated, and decommissioned in a manner that ensures the highest level of environmental protection so that the well-being of Canadians is enhanced and the natural environment is conserved. To that end, ECCC has undertaken a science-based review of issues within ECCC's mandate with the aim of providing expert advice on the Proponent's assessment of the Project's potential effects and proposed mitigation. ECCC's technical review comments and recommendations are not to be interpreted as any type of acknowledgement, compliance, permission, approval, authorization, or release of liability related to any requirements to comply with federal or territorial statutes and regulations.

Subsection 36(3) of the *Fisheries Act*, administered by ECCC prohibits the discharge of deleterious substances to waters frequented by fish, or to a place where those substances might enter such waters. Therefore, the Proponent must ensure that, at all times during the Project, deleterious substances are prevented from entering into fish-bearing waters or any tributaries unless authorized by regulations under the Act or other federal legislation.

4.1 Freshwater Environment

4.1.1 Seepage Collection

References:

- Volume 1 Annex V1-7 Type A Water Licence Applications
- Package P4-10: Hope Bay Project Boston Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual
- Section: 3.4.3 Seepage Collection

Issue:

The Proponent states that post-closure seepage through the active layer will be limited to what may infiltrate through the low permeability cover. This volume of flow is considered negligible, and water quality modeling has confirmed there will be no environmental impact. As a result, no post-closure seepage collection is planned or required (SRK 2017b.)

ECCC is of the view that the impact of climate change on structures like dry stack tailings is unknown. As such, it is prudent to have a contingency plan for the potential increase in seepage as a result of changes to permafrost distribution as a result of climate change.

Recommendation(s):

ECCC recommends that the proponent develop a contingency plan to account for the potential impacts of climate change on structures like dry stack tailings post closure, and the increase to seepage that may occur should permafrost distribution change in the long-term.

4.1.2 Seepage Surveys

References:

- Package 4-7: Hope Bay Doris-Madrid Water Management Plan
- Package 4-8: Hope Bay Boston Water Management Plan
- Package 4-10: Hope Bay Boston Tailings Management Area Operations and Maintenance Plan

Issue:

Waste Rock Piles

No seepage monitoring is identified for any of the waste rock piles and it is instead stated that all waste rock seepage and runoff will report to contact water ponds. Although the Madrid South and Boston Waste Rock Piles do have designated contact water ponds, the Madrid North Waste Rock Pile (WRP) does not. Any seepage or runoff from the Madrid North WRP will flow across site infrastructure and will report to the Madrid North Contact Water Pond (CWP). This approach increases uncertainty of the volume and quality of runoff and seepage from the waste rock pile.

Seepage surveys should be conducted at spring and fall, as well as after rainfall events to inform the understanding of pile seepage and runoff quality and quantity. If higher than expected seepage and runoff is encountered, consideration could be made for collection at the toe of the pile and transport to the CWP.

Boston Tailings Management Area

Section 3.4.3 (P4-10) indicates that the dry stack will remain frozen and the *"tailings will freeze back soon after placement, save for the active layer. There is no concern related to potential deep groundwater seepage. Shallow groundwater seepage emerging from the active layer will be collected in the contact water ponds."* While ECCC acknowledges that seepage and runoff will be collected in the CWP, designated seepage surveys should be completed to identify volumes, locations and quality as well as to verify modelling predictions on freezing of the dry stack.

Seepage surveys will provide characterization of source water quality, which will inform closure planning as well as update inputs for ongoing water balance and contaminant load modeling.

Recommendation:

ECCC recommends that the Proponent develop a Seepage Survey plan (either as a separate document or as a section of the Water Management Plan) for all waste rock storage areas and tailings management areas. This should include, at a minimum, spring and fall surveys.

4.1.3 Wastewater Treatment Plant – Contingency and Required Upgrades

References:

- Package 4-4: Hope Bay Domestic Wastewater Treatment Management Plan

Issue:

Capacity

The existing Doris Camp Water Treatment Plant (WTP) is constructed of two modular membrane biological reactors (MBR), each of which are capable of managing the average waste volume for 150 people. This WTP setup is suitable for a camp capacity of 300 people if both MBRs are functional, which is adequate for the Doris Camp accommodations of 280 people. No details are provided on the upgrades to the WTP that would be put in place to manage the proposed accommodations increase to 400 people.

Contingency

TMAC employs several contingency options in the event that a wastewater treatment unit at Doris becomes inoperable or the plant is unable to discharge. The available contingency involves the use of holding tanks to store untreated wastewater, amounting to a total capacity of 27 m^3 (equivalent to 4 days of operational capacity). In addition to the holding tanks at the Doris Camp, a third MBR WTP is available in the event that one WTP malfunctions. There is no discussion on the additional contingency that could be put in place given the increase in accommodations at the Doris Camp.

Module D relating to the Boston Operations makes no mention of contingency storage relevant to the number of proposed persons to be housed at the camp, nor does it make mention of a contingency MBR WTP in the event that one of the WTP malfunctions. Contingency domestic water treatment is of specific concern at the Boston Camp because unlike Doris, during operations, the effluent will be discharged to the freshwater environment (rather than to the Tailings Impoundment Area) and any malfunction in the treatment system could cause releases to the receiving environment and directly cause environmental impacts.

Recommendation(s):

ECCC recommends that the Proponent

- Describe upgrades and modifications that are proposed for the Doris Water Treatment Plant, such that it has the capacity to treat the increase in camp capacity by 120 people.
- Describe any additional contingency measures for the Doris Camp Water Treatment Plan that may be needed to account for the additional capacity.
- Describe the contingency measures for the Boston Camp Water Treatment Plant that will be available to mitigate adverse effects to the aquatic environment.

4.1.4 Boston Contact Water Pond 2 and Surge Pond

References:

- Package 4-8: Hope Bay Boston Water Management Plan
- Package 5-3: Contact Water Pond Berm Design.
- Package 5-26: Boston Tailings Management Area Preliminary Design

Issue:

The process of water management, storage and discharge at Boston in relation to Contact Water Pond #2 (CWP#2) and the Surge Pond is unclear. The water management strategy presented by the Proponent indicates that a number of water collection structures all report to CP2 and the Surge Pond. As per Figure 1 (P4-8) there are multiple water sources reporting to CWP#2 and the associated Surge Pond, including: Contact Water Pond 1, the ore stockpile and process pad, 3 Tailings Management Areas (TMA) contact water ponds, quarries and ancillary facilities (landfarm, fuel facility, landfill). When CWP#2 fills to capacity it is designed to spill over into the lined Surge Pond. The water from the Surge pond is then used as makeup water for the Boston Process Plant or treated and discharged through the Water Treatment Plant.

As described in Package 5-3, all contact water ponds (CWP#1, CWP#2, Surge Pond, and TMA CWP's) have been designed to be normally empty (i.e. the pond will be kept in a dry state) and have been designed for a maximum residence time for ponded water of two weeks. While it is clear that most collection ponds will be kept in a dry state by pumping to the central CWP#2, it is unclear how CWP#2 will be kept in a dry state, given that it is receiving inputs from all other contact water ponds and is being used as make-up water for the plant. CWP#2 is in close proximity to Stickleback Lake.

Recommendation(s):

ECCC recommends that the Proponent

- Provide additional clarification on the water management at Contact Water Pond 2. Specifically, whether the intent is to operate CWP#2 and the Surge Pond as dry facilities.
- Clarify whether CWP#2 has been designed to retain water for increased residence times and describe the potential for seepage through the berms.

4.1.5 Water Management Ponds - Monitoring and Dewatering

References:

- Package 4-7: Hope Bay Doris-Madrid Water Management Plan
- Package 4-8: Hope Bay Boston Water Management Plan
- Package 5-26: Boston Tailings Management Area Preliminary Design

Issue:

Contact Water Pond Dewatering

Additional clarification on discharge of Contact Water Pond #1 (CWP#1), Madrid North Contact Water Pond, Madrid South Primary Contact Water Pond, and Madrid South Secondary Contact Water Pond is needed. When discharge is required, Boston CWP#1 is dewatered to CWP#2, Madrid South Primary and Secondary CWPs are dewatered to the Madrid North CWP, and the Madrid North CWP is dewatered to the concentrator, the tailings discharge line, or the mine water line. However, the subsequent monitoring sections contradict this by stating that *"if water meets the designed criteria for discharge, excess water may be discharged to tundra at an approved location."*

Boston Tailings Management Area Contact Water Pond Monitoring

Section 7.3 of Package P5-26 discusses monitoring of the contact water ponds within the TMA, but only in relation to the construction engineering criteria. There is no discussion of the proposed monitoring frequency of the seepage and runoff water collected in the contact water ponds. Although the 3 ponds are eventually pumped to CWP#2, characterization of the quality of the water coming off the TMA is important to inform ongoing water quality on site, achievement of effluent quality predictions and closure objectives.

Boston Non-contact Water Pond

The runoff from the Boston Overburden Stockpile will drain by gravity and collect in the Non-Contact Water Pond. The Madrid All-Weather Road will then act as a flow-through structure to filter out sediments from the water stored in the pond. However, an overflow culvert will be installed in the road for use during storm events to prevent water from overtopping the road. Proposed monitoring for the non-contact water pond includes annual water quality sampling to be completed during construction and operation. No monitoring is proposed for downstream of the Madrid All-Weather Road prior to water discharging into Stickleback Lake. In addition, the installation of an overflow culvert may allow for high Total Suspended Solids (TSS) water from runoff and storm events to directly discharge into Stickleback Lake. An alternative option for management of water in the non-contact water pond should be identified for use in situations where the TSS prevents use of the overflow culvert. This may include management through Contact Water Pond #2.

Recommendation(s):

ECCC recommends that the Proponent

- Clarify dewatering procedures for Contact Water Pond #1, Madrid North Contact Water Pond and the Madrid South Primary and Secondary Contact Water Ponds. If dewatering to the tundra is proposed, a description of location, monitoring and erosion control measures should be included.
- Discuss proposed frequency of water quality monitoring at the Boston Tailings Management Area Contact Water Ponds.
- Discuss water quality monitoring downstream of the Non-Contact Water Pond, prior to discharge into Stickleback Lake.
- Discuss contingency options in the event that TSS in the Non-Contact Water Pond exceeds criteria and cannot be discharged via the overflow culvert.

4.1.6 Quarries with High Risk of Acid Rock Drainage (ARD)

References:

- Package 4-17: Hope Bay Project Quarry Management Plan

Issue:

Section 2.1.1 discusses the characterization of quarry material and suitability as construction rock. In this analysis, 3 quarries (AD, Q, and Z) were identified as high risk for Acid Rock Drainage (ARD) and as such would not be suitable for construction, instead being designated for use of quarry rock as mine backfill only. Under this approach, quarried rock from these locations would be temporarily stored in the waste rock stockpile until such a time that it was needed for mine backfill. ECCC questions the use of quarries with high ARD for any use on the mine site. Storage of the high ARD potential rock in the waste rock stockpile prior to use as backfill would expose the rock to the atmosphere, potentially causing ARD and metal leaching. In addition, the exposed quarry walls may interact with the environment creating ARD runoff within the quarry requiring additional management.

Recommendation(s):

ECCC recommends that the Proponent

- Provide justification for the use of high Acid Rock Drainage (ARD) potential quarries for use as mine backfill
- Discuss mitigation measures to prevent ARD for high ARD potential rock stored in the waste rock piles and for the exposed quarry walls.

4.1.7 Aquatics Effects Monitoring Program (AEMP)

References:

- Package 4-18: Hope Bay Project Aquatic Effects Monitoring Program
- TMAC responses to Information Requests (February 2018), IR response #ECCC-FEIS-15
- Environment and Climate Change Canada's Final Written Submission to the Nunavut Impact Review Board, Section 4.3 Freshwater Environment, 4.3.10 Aquatic Effects Monitoring Plan Development

Issue:

During the completeness check, ECCC had identified several deficiencies with the proposed Aquatic Effects Monitoring Program (AEMP) for the Boston Mine. In their response, TMAC committed to providing an updated AEMP addressing the noted deficiencies in advance of the Nunavut Impact Review Board (NIRB) Final Hearings scheduled for May 8-12, 2018. In addition, in ECCC's March 19 2018 Final Written Submission to the NIRB, ECCC provided additional recommendations for the AEMP and overall aquatic monitoring which have not yet been responded to (see section 4.3.10 Aquatics effect Monitoring Plan Development). ECCC anticipates that additional technical discussions will be required on this program once the updated version has been provided.

Recommendation:

ECCC recommends that development of the AEMP be actioned as soon as possible, to allow lead time for any 2018 field work that may be required.

4.1.8 Post-Audit of Water Quality Modelling

References:

- P4-19: Hope Bay Project Boston Conceptual Closure and Reclamation Plan
- P4-21: Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan

Issue:

Section 7 of the Conceptual/Interim Closure and Reclamation Plan discusses the data that will be gathered and the potential research that will be undertaken to gain a better understanding of the specific site conditions at the Boston site. The Proponent lists the types of data that will be collected through their various monitoring programs and indicates that, if any of the data is found to be indicative of a problematic trend, a more detailed evaluation be undertaken. The Proponent identifies the updating of predictive models to be used as adaptive management to refine closure requirements.

As the majority of the water management on site relies on modelling data, the verification of the accuracy of this modelling data is an important step to reduce uncertainty during the life of the project. Ongoing audits of modelling predictions should be completed for effluent discharges at the Marine Mixing Box and Boston Mine and water quality in Roberts Bay and Aimaokatalok Lake at specific points within mine life relating to key mine events. Auditing will provide valuable information to verify the accuracy of predictions, identify and explain differences, improve future models, reduce uncertainties and adaptively manage issues. This information is useful not only to refine closure requirements but can inform ongoing operations by identifying potential future environmental issues.

Recommendation(s):

ECCC recommends that effluent and water quality audits be completed for Roberts Bay and Aimaokatalok Lake at specific time intervals relating to major milestones in the Madrid-Boston Project. ECCC recommends that modelling audits be completed at a minimum every 3-5 years.

4.1.9 Mitigation and Monitoring for In-Water Works

References:

- Package 4-8: Hope Bay Boston Water Management Plan

- Package 5-11: Hope Bay Madrid-Boston All-Weather Road Preliminary Design
- Package 5-14: Hope Bay Cargo Dock Access Road Memo
- Package 5-17: Madrid North Surface Infrastructure Memo
- Package 5-18: Madrid South Surface Infrastructure Memo
- Package 5-22: Madrid North TIA Road Memo
- Package 5-23: Windy Lake North Freshwater Intake Memo
- Package 5-28: Hope Bay Boston Infrastructure Memo

Issue:

Intake and Discharge Pipelines

With the expansion of the Hope Bay Project, several additional water intake and discharge pipelines will need to be constructed. This includes the Windy Lake North Freshwater Intake, Aimaokatalok Intake Pipeline, and the Boston Effluent Discharge Pipeline. Package P5-23 discusses that the Windy Lake North Intake Pipeline "*will be anchored to the lakebed beneath a rock berm until the lake depth is approximately 3m, estimated as approximately 20 m into the lake. The pipeline will continue along the base of the lake for an additional 20 m to a lake depth of 5 m."* However, the Proponent does not propose any mitigation measures to limit disruption to the aquatic environment. In addition, there are no details on construction or monitoring relating to the Aimaokatalok Lake intake or discharge pipeline in any of the packages provided.

The proponent has not provided the following additional information for in-water construction activities:

- Mitigation measures to limit TSS impacts to the aquatic environment and ongoing monitoring, including action levels to address potential issues
- Runoff management and monitoring to prevent sediment migration into surface waters

Road Construction

With the expansion of the Hope Bay Project to include Madrid and Boston there are several stream crossings required with the associated road construction, including:

- Madrid-Boston All-Weather Road: 16 Crossings
- Cargo Dock Access Road: 2 Crossings
- Madrid North Tailings Impoundment Area Road: 4 Crossings

No description is provided on how impacts to the aquatic environment will be mitigated during construction of stream crossings.

Recommendation(s):

ECCC recommends that the Proponent

- Develop a Sedimentation Management Plan (either as a separate document or as a section of the Water Management Plan) which outlines details of mitigation measures for sediment and erosion control and in-water works, including development of a turbidity-Total Suspended Solids (TSS) relationship and action levels for monitoring of TSS during construction and in-lake activities.
- Identify mitigation measures for sediment and erosion control during construction of stream crossings.

4.1.10 Tailings Pipeline Catch Basins

References:

- Package 5-22: Madrid North Tailings Impoundment Area All-Weather Road Preliminary Design

Issue:

The design for the Madrid North TIA all-weather road includes development of tailings catch basins, which are designed to provide *"locations where a controlled volume of tailings can be discharged into a contained area."* There are 7 tailings catch basins proposed along the all-weather road, including two in close proximity to a stream. The design memo indicates that the catch basins are for emergency use only and will be cleaned out after an emergency spillage. There is no elaboration on what circumstances may require use of the emergency catch basins or how they will be cleaned out to ensure the integrity of the geomembrane is not compromised and that potential impacts to the receiving environment are mitigated.

Recommendation(s):

ECCC recommends that the Proponent

- Clarify the circumstances that would require the use of the tailings catch basins
- Describe the process of cleaning out and disposing of tailings deposited in the catch basins

4.1.11 Necessity of the Site Specific Water Quality Objective for Copper

References:

- Volume 5, Section 4 – Freshwater Water Quality
- Section 4.5.1.3 – Site Specific water quality objective for Copper
- Table 4.5-6 – Predicted Water Quality Concentrations in the immediate Aimaokatalok Lake receiving environment related to the Boston Combine WTP-STP Discharge
- Appendix V5-4C – Hope Bay Copper Site Specific water quality objective
- Appendix V5-4D1 – Summary of screening effects to water quality in Stickleback Lake
- Appendix V5-4D4 - Summary of screening effects to water quality in Windy Lake

Issue:

The Proponent has indicated they would prefer to apply a site specific water quality objective (SSWQO) for copper of 0.009 mg/L, rather than apply the CCME guideline of 0.002 mg/L. This request is based on the following rationale:

1. Copper is naturally elevated above CCME water quality guidelines in certain waterbodies within the Madrid-Boston project area.
2. The Water and Load Balance predicts that copper concentrations will become elevated above baseline concentrations in Doris Creek, Wolverine Lake, and Stickleback Lake.

The Proponent chose to use a Water Effect Ratio (WER) procedure to develop a site specific guideline to account for the increases in the impacted creeks, rather

than a Background Procedure to account for naturally elevated copper concentrations. The Proponent derived the SSWQO of 0.009 mg/L and used it for characterization of effects for all water bodies in the Madrid-Boston Project.

As stated by the Proponent, "*for the characterization of potential effects to freshwater quality, the base case predictions of the Water and Load Balance model were screened against the predicted baseline concentrations, the assessment thresholds, and the range of observed baseline conditions. The assessment against predicted baseline was included because of the inclusion of climate change and lake evaporation into the model, as well as to provide an efficient conceptual screen between the effects of the Project Activities and the environment without the Project (predicted baseline).*"

When the observed baseline versus predicted baseline is analyzed, it appears that the model is a good fit for Doris Creek (concentrations of observed and predicted baseline are comparable). However, ECCC notes significant differences between the observed and predicted baseline copper concentrations in Stickleback Lake and Wolverine Lake.

For example, the copper concentrations listed below (taken from Appendix V5-4D) show the range of median copper concentrations that would be expected over life of mine (construction through post-closure).

Water Body	Observed (median values)	Predicted Baseline(Median values)	Predicted Base Case (Median values)
Stickleback Lake	0.00041 mg/L (open water) – 0.00057 mg/L(ice)	0.00127 mg/L (open water) – 0.00286 mg/L (ice)	0.00134 mg/L open water) – 0.00477 mg/L (ice)
Wolverine Lake	0.0007 mg/L (open water) – 0.0008 mg/L (ice)	0.0017 mg/L (open water) – 0.0038 mg/L (ice)	0.0017 mg/L (open water) – 0.0044 mg/L (ice)
Doris Creek	0.0015 mg/L (open water)	0.00149 mg/L – 0.00155 mg/L (open water)	0.00153 mg/L – 0.00181 mg/L (open water)

In Stickleback Lake and Wolverine Lake the observed median baseline concentrations are below the CCME water quality objective, however, the predicted baseline (median) concentrations approach and even exceed the CCME

water quality objective (an order of magnitude difference). These differences between observed and modelled baseline concentrations potentially indicate that the model is not a good fit, as it would be expected that the predicted baseline copper concentrations would be comparable to the observed baseline concentrations.

In addition, while the copper concentrations in Stickleback and Wolverine Lakes are quite different between the observed baseline and the predicted baseline, the concentrations are quite similar between the predicted baseline and the predicted base case.

ECCC questions the necessity for a copper SSWQO given that it appears that the modelling may be artificially inflating the predicted baseline copper concentrations and potentially the predicted base case predictions. Several lakes in the Madrid-Boston project area do have naturally elevated copper concentrations and a Background Procedure approach may be appropriate for those lakes; however, given the abnormally high predicted baseline concentrations in relation to copper in the observed baseline, additional justification for a SSWQO in these two impacted lakes is required.

Recommendation(s):

ECCC recommends that the Proponent

- Quantify and discuss the drivers behind the differences between observed baseline and predicted baseline in Stickleback Lake and Windy Lake.
- Provide rationale and discussion on the certainty associated with the predicted base case copper concentrations.
- Provide rationale for the necessity of a SSWQO given the additional details provided in the first two points.

4.1.12 Arsenic Site Specific Water Quality Objective

References:

- Volume 5, Section 4 – Freshwater Water Quality
- Section 4.5.1.2 – Site Specific Water Quality Objective for Arsenic
- Table 4.5-6
- Package 5-4: Hope Bay Water and Load Balance Report

Issue:

The modelling provided by the Proponent suggests that arsenic concentrations in Doris Creek during post-closure are expected to rise above baseline concentrations (0.00029 mg/L) and the CCME water quality guideline (0.005 mg/L). The increase is identified as an effect of restoring the natural Tail Lake Catchment through the TIA.

Total arsenic concentrations in Doris Creek in the base case modelling scenario are predicted to be an average concentration of 0.0042 mg/L (open water) and a maximum of 0.01 mg/L (under ice). The upper case modelling scenario predicts concentrations to be an average of 0.0052 mg/L (open water) and a maximum of 0.012 mg/L (under ice). Based on these results, the Proponent has indicated that they would use a site specific water quality objective of 0.028 mg/L that was developed for a site with similar Arctic habitat for the characterization of effects of the Madrid-Boston Project.

ECCC has several comments regarding the application of the SSWQO of 0.028 mg/L to Doris Creek during post closure and its use as a site-wide SSWQO.

1. The arsenic SSWQO of 0.028 mg/L that is referenced was developed for the Back River Project. However, the Proponent has referenced the February 2017 version of that document, which established an arsenic water quality guideline of 0.028 mg/L. This value underwent further scrutiny and was amended to exclude an ecologically irrelevant amphibian species and to ensure protectiveness of zooplankton. After this review a concentration of 0.025 mg/L was agreed upon by the parties as being more appropriate to that particular site.
2. The proposed objective is over 2 times higher than the maximum modelled concentrations of the post-closure upper case in Doris Creek and 77 times higher than the baseline upper case. While a similar SSWQO may have been deemed appropriate for a similar Arctic site, given the predicted concentrations, the SSWQO could be reduced to reflect reasonably achievable levels.
3. ECCC questions the necessity of a site specific water quality objective given that exceedances of CCME are only anticipated in maximum under ice, and upper case predictions. The highest predictions for total arsenic in Doris creek are still half of the threshold that is being proposed.
4. Given that the exceedances of the water quality objective are only anticipated to occur during the post-closure period the Proponent should investigate additional measures which could be used to reduce releases of

arsenic prior to closure, to meet closure objectives and reduce environmental impacts during the post-closure period.

Recommendation(s):

ECCC recommends

- that the SSWQO of 0.028 mg/L be reconsidered as ECCC notes that it is higher than accepted values at comparable projects.
- that the Proponent adopt a reasonably achievable SSWQO compared to predicted concentrations given that the proposed SSWQO is over 2x higher than the maximum predicted arsenic concentration.
- that the Proponent discuss how closure objectives will be achieved given the exceedances that are predicted during the post-closure period as well as discuss potential mitigation measures that could reduce the arsenic concentrations prior to closure and during the post-closure phase.

4.1.13 Water Quality Predictions

References:

- Volume 5, Section 4, Table 4.2-10

- P5-4: Hope Bay Water and Load Balance Report

Issue:

There are a number of discrepancies in the water and load balance for the Aimakatalok Lake Operational Water Quality Predictions as compared to observed baseline values in Aimaokatalok Lake.

ECCC notes that in Appendix C-1, Page C1.6 indicates CCME water quality guideline for nitrite of 10 mg/L NO_3-N, the correct concentration is 0.06 mg/L NO_3-N.

Furthermore, for the following parameters provided in the table below, operational average water quality predictions during discharge are lower than observed baseline data (as provided in V5-4, Table 4.2-10). While not all of these concentrations are significant, it brings into question the accuracy of the water quality model.

Parameter	Baseline Data Average Water Quality Concentration	Predicted Average Operational Water Quality Concentration
TDS	33.4 mg/L	16 mg/L
Total Phosphorus	0.011 mg/L	0.0091 mg/L
Chloride	10.1 mg/L	6.3 mg/L
Total Aluminum	0.045 mg/L	0.035 mg/L
Total Boron	0.0058 mg/L	0.0042 mg/L
Total Iron	0.08 mg/L	0.076 mg/L
Total Zinc	0.0021 mg/L	0.0017 mg/L

In addition, cadmium concentrations in Aimaokatalok Lake during operations (0.00016 mg/L) are higher than effluent quality predictions (maximum 0.000093 mg/L) and baseline data concentrations (0.0000030 mg/L)**.** The modelled average mercury concentration (0.00015 mg/L) seems high compared to a baseline average water quality concentration of 0.0000015 mg/L and a maximum discharge concentration of 0.00021 mg/L.

Recommendation:

ECCC recommends that the Proponent

- Explain the inconsistencies of the water quality model
- Identify options to refine and/or calibrate the model

4.1.14 Nitrite

References:

- P5-4: Hope Bay Water and Load Balance Report
- TMAC responses to Information Requests, #ECCC-FEIS-14 (February 2018)

Issue:

During the completeness check, ECCC had identified concerns with the predicted combined effluent concentration for nitrite of 30 mg/L (NO3-N) from the camp wastewater, process water and contact water treatment plants. In response, the Proponent identified that the concentration was based on the concentration provided by the water treatment plant supplier as a minimum guarantee and that average operating concentrations are expected to be lower but no additional detail

was provided. The Proponent should update the effluent concentration predictions with realistically expected nitrite concentrations.

Recommendation:

ECCC recommends that the Proponent review the input values used for nitrite and revise the Water and Load Balance model as appropriate.

5.0 Summary of Recommendations

5.1 Freshwater Environment

4.1.1 Seepage Collection

ECCC recommends that the proponent develop a contingency plan to account for the potential impacts of climate change on structures like dry stack tailings post closure, and the increase to seepage that may occur should permafrost distribution change in the long-term.

4.1.2 Seepage Surveys

ECCC recommends that the Proponent develop a Seepage Survey plan (either as a separate document or as a section of the Water Management Plan) for all waste rock storage areas and tailings management areas. This should include, at a minimum, spring and fall surveys.

4.1.3 Wastewater Treatment Plant – Contingency and Required Upgrades

ECCC recommends that the Proponent

- Describe upgrades and modifications that are proposed for the Doris Water Treatment Plant, such that it has the capacity to treat the increase in camp capacity by 120 people.
- Describe any additional contingency measures for the Doris Camp Water Treatment Plan that may be needed to account for the additional capacity.
- Describe the contingency measures for the Boston Camp Water Treatment Plant that will be available to mitigate adverse effects to the aquatic environment.

4.1.4 Boston Contact Water Pond 2 and Surge Pond

ECCC recommends that the Proponent

- Provide additional clarification on the water management at Contact Water Pond 2. Specifically, whether the intent is to operate CWP#2 and the Surge Pond as dry facilities.
- Clarify whether CWP#2 has been designed to retain water for increased residence times and describe the potential for seepage through the berms.

4.1.5 Water Management Ponds - Monitoring and Dewatering

ECCC recommends that the Proponent

- Clarify dewatering procedures for Contact Water Pond #1, Madrid North Contact Water Pond and the Madrid South Primary and Secondary Contact Water Ponds. If dewatering to the tundra is proposed, a description of location, monitoring and erosion control measures should be included.
- Discuss proposed frequency of water quality monitoring at the Boston Tailings Management Area Contact Water Ponds.
- Discuss water quality monitoring downstream of the Non-Contact Water Pond, prior to discharge into Stickleback Lake.
- Discuss contingency options in the event that TSS in the Non-Contact Water Pond exceeds criteria and cannot be discharged via the overflow culvert.

4.1.6 Quarries with High Risk of Acid Rock Drainage (ARD)

ECCC recommends that the Proponent

- Provide justification for the use of high Acid Rock Drainage (ARD) potential quarries for use as mine backfill
- Discuss mitigation measures to prevent ARD for high ARD potential rock stored in the waste rock piles and for the exposed quarry walls.

4.1.7 Aquatic Effects Monitoring Program (AEMP)

ECCC recommends that development of the AEMP be actioned as soon as possible, to allow lead time for any 2018 field work that may be required.

4.1.8 Post-Audit of Water Quality Modelling

ECCC recommends that effluent and water quality audits be completed for Roberts Bay and Aimaokatalok Lake at specific time intervals relating to major milestones in the Madrid-Boston Project. ECCC recommends that modelling audits be completed at a minimum every 3-5 years.

4.1.9 Mitigation and Monitoring for In-Water Works

ECCC recommends that the Proponent

- Develop a Sedimentation Management Plan (either as a separate document or as a section of the Water Management Plan) which outlines details of mitigation measures for sediment and erosion control and in-water

works, including development of a turbidity-Total Suspended Solids (TSS) relationship and action levels for monitoring of TSS during construction and in-lake activities.
- Identify mitigation measures for sediment and erosion control during construction of stream crossings.

4.1.10 Tailings Pipeline Catch Basins

ECCC recommends that the Proponent

- Clarify the circumstances that would require the use of the tailings catch basins
- Describe the process of cleaning out and disposing of tailings deposited in the catch basins

4.1.11 Necessity of the Site Specific Water Quality Objective for Copper

ECCC recommends that the Proponent

- Quantify and discuss the drivers behind the differences between observed baseline and predicted baseline in Stickleback Lake and Windy Lake.
- Provide rationale and discussion on the certainty associated with the predicted base case copper concentrations.
- Provide rationale for the necessity of a SSWQO given the additional details provided in the first two points.

4.1.12 Arsenic Site Specific Water Quality Objective

ECCC recommends

- that the SSWQO of 0.028 mg/L be reconsidered as ECCC notes that it is higher than accepted values at comparable projects.
- that the Proponent adopt a reasonably achievable SSWQO compared to predicted concentrations given that the proposed SSWQO is over 2x higher than the maximum predicted arsenic concentration.
- that the Proponent discuss how closure objectives will be achieved given the exceedances that are predicted during the post-closure period as well as discuss potential mitigation measures that could reduce the arsenic concentrations prior to closure and during the post-closure phase.

4.1.13 Water Quality Predictions

ECCC recommends that the Proponent

- Explain the inconsistencies of the water quality model
- Identify options to refine and/or calibrate the model

4.1.14 Nitrite

ECCC recommends that the Proponent review the input values used for nitrite and revise the Water and Load Balance model as appropriate.

APPENDIX 1: Relevant Legislation, Regulations and Guidelines

Introduction

The mandate of Environment and Climate Change Canada (ECCC) is determined by the statutes and regulations assigned to the federal Minister of Environment and Climate Change by Parliament or by the Government of Canada. Delivering this mandate requires ECCC, among other things, to develop and implement policies, guidelines, codes of practice, inter-jurisdictional and international agreements and related programs. The following lists specific legislation and national environmental policies and programs administered by ECCC that influence the content of Environmental Assessment (EA) submissions.

In EAs, ECCC generally carries out its responsibilities by providing recommendations, advice, and information within its mandate. This is provided to both the proponent and decision-makers and may be used in the development of potential conditions that may accompany an EA approval. This document is intended to summarize ECCC's mandate.

For purposes of reliability and accuracy and for interpreting and applying regulations or policy, it is recommended that the reader refer to the original document. Official versions of legislation can be found on the Department of Justice website (http://laws.justice.gc.ca/eng/).

Legislation

Department of the Environment Act

General responsibility for environmental management and protection is attributed to ECCC, through the Minister, under the *Department of the Environment Act* (DOE Act). This responsibility extends to and includes all matters over which Parliament has jurisdiction, which matters have not, by law, been assigned to any other department, board, or agency of the Government of Canada relating to:

- the preservation and enhancement of the quality of the natural environment (e.g., water, air, and soil);
- renewable resources including migratory birds and other non-domestic flora and fauna;
- water;
- meteorology; and
- co-ordination of policies and programs respecting preservation and enhancement of the quality of the natural environment.

The DOE Act requires the Minister to advise heads of federal departments, boards and agencies on matters pertaining to the preservation and enhancement of the quality of the natural environment.

Canadian Environmental Protection Act

The *Canadian Environmental Protection Act* (CEPA) is aimed at preventing pollution and protecting the environment and human health while contributing to sustainable development. CEPA shifts the focus away from managing pollution (after it has been created) to preventing pollution. CEPA provides the federal government with tools to protect the environment and human health, establishes strict deadlines for controlling certain toxic substances, and requires the virtual elimination of toxic substances, which are bioaccumulative, persistent and result primarily from human activity.

One of CEPA's major thrusts is the prevention and management of risks posed by harmful substances. CEPA manages impacts of environmental emergencies, vehicle engines and equipment emissions, fuels, hazardous wastes, disposal at sea, and other sources of pollution. Two CEPA sections, Environmental Emergencies and the National Pollutant Release Inventory Reporting Requirements, are described below.

Environmental Emergencies

Part 8 of CEPA related to environmental emergencies (sections 193 to 205) provides various authorities to address the prevention of, preparedness for, response to, and recovery from environmental emergencies caused by uncontrolled, unplanned or accidental releases and to reduce any foreseeable likelihood of releases of toxic or other hazardous substances listed in Schedule 1 of the Environmental Emergency (E2) Regulations. ECCC provides advice regarding emergency plans for projects it reviews to ensure they are consistent with the requirements of CEPA.

Fisheries Act - Pollution Prevention Provisions

ECCC administers Section 36(3) and (4) of the *Fisheries Act*, the purpose of which is to prevent pollution by prohibiting the deposit of harmful substances into waters frequented by fish, unless authorized by regulations under the Act or other federal legislation. The “general prohibition” in this section states, in part, that no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish, unless authorized by, and deposited in accordance with, regulations under the *Fisheries Act* or other federal legislation.

Meeting the requirements of the *Fisheries Act* is mandatory, irrespective of any provincial or territorial regulatory or permitting system. The release of substances with the potential to be “deleterious,” as identified in Subsection 34(1) of the *Fisheries Act*, from the construction, operation, reclamation or decommissioning stages of the project in any waters frequented by fish, may constitute violations of the *Fisheries Act*.

Metal Mining Effluent Regulations

Guidelines for the Assessment of Alternatives for Mine Waste Disposal

Using a natural water body frequented by fish for mine waste disposal requires an amendment to the *Metal Mining Effluent Regulations* (MMER), which is a federal legislative action. The MMER, developed under subsections 34(2), 36(5) and 38(9) of the *Fisheries Act* and enacted in 2002, are used to regulate the deposit of mine effluent, waste rock, tailings, low-grade ore and overburden into natural waters frequented by fish. Environment and Climate Change Canada administers MMER, which apply to both new and existing metal mines. MMER are available at http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/.

Schedule 2 of the MMER lists water bodies designated as tailings impoundment areas (TIAs). A project proponent seeking to use a natural water body as a TIA must conduct an assessment of alternatives for mine waste disposal. The alternatives assessment must objectively and rigorously assess all feasible options for mine waste disposal. The project proponent must demonstrate through the EA and the alternatives assessment that the proposed use of the water body as a TIA is the most appropriate option for mine waste disposal from environmental, technical and socio-economic perspectives. It should also be demonstrated that the option offers the greatest overall benefit to current and future generations of Canadians, as per the Cabinet Direction on Regulatory Management. Part 2 of the guidelines describes the requirements of an assessment of alternatives.

It is strongly recommended that this assessment be undertaken during the EA to streamline the overall regulatory review process and minimize the time required to proceed with the MMER amendment process. Generally speaking, at least one of these alternatives should not impact a natural water body that is frequented by fish. It is important to note that a decision by the proponent to conduct the alternatives assessment after the EA has been completed could more than double the target timeline that has been established for the processing of Schedule 2 amendments.

Environmental Effects Monitoring

The MMER regulate the quality of effluent discharged by mines producing base metals, precious metals, iron ore, uranium, and other metals. The MMER include limits on pH and concentrations of arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids and radium 226. The Regulations also require that effluent be non-acutely lethal to rainbow trout. Mines are required to conduct Environmental Effects Monitoring (EEM) to evaluate the effects of mining effluent on the aquatic environment, specifically fish, fish habitat, and the use of fisheries resources.

EEM is a science-based performance measurement tool used to evaluate the adequacy of the MMER in protecting fish, fish habitats and the use of fisheries resources. The metal mining industry is required to meet their regulatory requirements, which include conducting:

- water quality studies
- effluent characterization studies
- sublethal toxicity testing
- biological monitoring studies in the receiving environment

These biological monitoring studies and chemical/toxicological analyses are conducted to assess and investigate the effects caused by their effluent discharges.