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October 1, 2018

Karén Kharatyan
Director of Technical Services
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0

Sent via Email: licensing@nwb-oen.ca; karen.kharatyan@nwb-oen.ca

Re: TMAC Response to Final Written Submissions for Applications for 2AM-BOS---- and Amendment No. 2 of 2AM-DOH1323

Dear Mr. Kharatyan,

TMAC Resources Inc. (TMAC) is pleased to provide to the Nunavut Water Board (NWB) the attached response to Final Written Submissions on the Water Licence applications for 2AM-BOS---- and Amendment No. 2 of 2AM-DOH1323 (the Phase 2 Project).

Final Written Submissions were received from the Kitikmeot Inuit Association (KIA), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), and Environment and Climate Change Canada (ECCC) on September 28, 2018. Fisheries and Oceans Canada confirmed it would not be submitting a further written submission as all technical information requests were resolved.

Submissions from the KIA did not indicate a response was requested from TMAC. TMAC would like to confirm however that it is in agreement with the KIA in regard to security quantum, land/water split and allocation for staged bonding 'tranches'. TMAC would like to clarify that although it is supportive of ensuring it is clear when the security increments must be provided by TMAC, the triggers should be based on events, not dates, as suggested by the KIA. TMAC proposes to provide further information on TMAC's position regarding financial security for NWB's consideration no later than October 5, 2018.

Of the remaining submissions, CIRNAC provided eight (8) comments and ECCC provided three (3) comments. This submission and attachments intend to provide responses to 10 of the 11 comments provided by CIRNAC and ECCC as shown in Table A.

Table A: Status of Final Written Submissions from CIRNAC and ECCC

ID	Status
CIRNAC-1	Response included in Attachment A
CIRNAC-2	Response included in Attachment A
CIRNAC-3	Response included in Attachment A
CIRNAC-4	Response included in Attachment A
CIRNAC-5	Response included in Attachment A
CIRNAC-6	Response included in Attachment A
CIRNAC-7	Response included in Attachment A
CIRNAC-8	*Response deferred to no later than October 5, 2018*
ECCC-WL-1	Response included in Attachment A and Attachment B
ECCC-WL-2	Response included in Attachment A
ECCC-WL-3	Response included in Attachment A

As noted in Table A, TMAC would kindly request that the NWB grant an extension to responding to CIRNAC-8 to no later than October 5, 2018. CIRNAC-8 relates to TMAC's position regarding financial security and TMAC is not in the position to respond to it on October 1, 2018 due to the limited timeframe available for responses due to the extension granted to submissions of final written comments to September 28, 2018.

TMAC also notes that CIRNAC did not seek nor were they granted any permission by the Board to hold their comments on the draft water licenses submitted by TMAC on September 4, 2018 until the public hearing. TMAC therefore requests that CIRNAC be required by the Board to present its comments on the draft water licences on or before **Wednesday, October 10, 2018**. TMAC undertook significant effort to circulate the licences well in advance of the public hearing, and in this case it is not efficient for CIRNAC to hold its comments until that time.

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

Sincerely,

Oliver Curran
Vice President, Environmental Affairs, TMAC

Cc:

Stephanie Autut (NWB)
Derek Donald (NWB)
Richard Dwyer (NWB)
Ida Porter (NWB)

Attachments:

Attachment A: Proponent's Response to Final Written Submissions on the 2AM-BOS and 2AM-DOH1323 Water Licence Applications, October 2018.

Attachment B: Revised Aquatic Effects Monitoring Plan for Phase 2 (dated: October 1, 2018)

Attachment A

Proponent's Response to Final Written Submissions on the 2AM-BOS and 2AM-DOH1323 Water Licence Applications

TMAC Resources Inc.

HOPE BAY PROJECT

Proponent's Response to Final Written Submissions on the 2AM-BOS and 2AM-DOH1323 Water Licence Applications

October 2018

Prepared by:

TMAC Resources Inc.
Toronto, Ontario

Citation:
TMAC. 2018. *Hope Bay Project: Proponent's Response to Technical Comments on the 2AM-BOS and 2AM-DOH1323 Water Licence Applications*: Toronto, Ontario.

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HOPE BAY PROJECT

Proponent's Response to Final Written Submissions on the 2AM-BOS and 2AM-DOH1323 Water Licence Applications

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1. CIRNAC-1

1.1 Subject/Topic

Scope of Licences

1.2 Comment

Presently TMAC hold four water licences regulating their activities in the Hope Bay belt: an exploration licence (2BE-HOP1222), two bulk sample licences (Boston>2BBBOS1727 and Madrid>2BB-MAE1727), and a type A water licence for the Doris mine (2AM-DOH1323). CIRNAC submitted one comment on this topic as presented in Table 1.

Table 1 Status of comment pertaining to scope of licences

Comment #	Issue	Status
IR1, R16	Water licences for Hope Bay belt	Unresolved

Water licences for Hope Bay belt: We have had several exchanges as to what activities should be regulated in which licences when considering the possible addition of a type A licence at Boston (2AM-BOS----) and the amendment of the Doris type A (2AM-DOH1323) to include Madrid. **IR1** sought clarification on whether TMAC wished to keep its 2BB-MAE1727 licence in addition to a possible amended type A incorporating Madrid, and they confirmed they do. **R16** was regarding the incorporation of the scope of 2BB-BOS1727 into any new type A for Boston.

TMAC's latest submission regarding the scope of water licences is a memo to the Board dated July 25, 2018, in which they re-iterate their justifications for requesting 5 water licences, should the applications under considerations be successful. We note that in the changes of scope requested for the type A licences at Doris-Madrid (Table 1) and Boston (Table 2), the industrial water treatment plants for removal of arsenic, cadmium and ammonium are not included. This appears to be an omission.

The principle arguments used by TMAC for keeping their 2BB licences alongside type A licences covering mining activities at the same location is to maintain procedural flexibility of type B licences and to do bulk samples and production mining in parallel.

CIRNAC is of the opinion that licences should cover distinct undertakings with as little overlap as possible for clarity on the proponent's authorizations, obligations and responsibilities. Our arguments are:

- Issuing both type B and type A licences for similar activities at the same location will make it difficult for Inspectors to determine what activities are occurring under which licences. In the event of non-compliance issues, the overlapping authorizations could lead to mining work being continued under their bulk sample or production licence if work was stopped under the other licence.

- There would be some physical overlap between the existing 2BB-BOS1727 infrastructure and different infrastructure proposed for 2AM-BOS----, in particular the vent raise and air strip. This raises complications for closure and reclamation which could be avoided by incorporating the 2BB-BOS1727 licence into a type A.
- Including the scope of the 2BB licences in the type A licences would allow for bulk samples to be taken, and incorporating the extra water sources in the type A would help keep some of the operational flexibility. Should areas outside those defined at Boston, Madrid North and Madrid South become targets for further bulk samples, an application or amendment for a type B licence would be required anyway.
- The 2BE-HOP1222 exploration licence covers the Hope Bay belt and allows for surface exploration across the belt, including the watersheds where 2BBMAE1727 and 2BB-BOS1727 are located.

CIRNAC recommends the scope of 2BB-BOS1727 be incorporated into any new 2AMBOS---- licence in order to cancel the type B when the type A comes into effect. Likewise, we recommend the scope of 2BB-MAE1727 be incorporated into an amended 2AM-DOH1323 licence in order to cancel the type B when the type A comes into effect.

Draft water licences: TMAC submitted draft water licences, which the Board circulated and requested comments on. We are still having discussions between the different divisions of CIRNAC on the drafts and will present our recommendations at the public hearing.

1.3 TMAC Response to CIRNAC-1

TMAC would like to clarify that TMAC's Phase 2 proposal initially requested amendment to 2AM-DOH1323 to include the entirety of the Madrid-Boston project, and did not request to hold two separate Type A Licences for Phase 2. Subsequently, the Nunavut Water Board directed that TMAC was to proceed in applying for amendment to 2AM-DOH1323 to include the Roberts Bay, Doris, Madrid and All Weather Road portions of the Phase 2 project and also apply for a separate Type A for the Boston portion.

Further to TMAC's memo to the Board dated July 25, 2018, TMAC confirms that Industrial Water Treatment plants for Doris-Madrid and Boston should be included as part for the scope of licence(s) (a Doris-Madrid treatment plant may only be required as a contingency in future years of operation).

Regarding CIRNAC's request that the NWB cancel 2BB-BOS1727 and 2BB-MAE1727 when any new 2AMBOS---- licence or amended 2AM-DOH1323 licence, respectively, comes into effect, TMAC reiterates that this approach is unnecessary, inconsistent with the approach taken for other production mines in Nunavut and is not a requirement of the legislation. Although there is some physical overlap of project components, construction and operation of the Madrid-Boston project is a distinct undertaking from the exploration undertaking governed under the existing Type B Licences. It is important that the licences continue to reflect that distinction.

CIRNAC raises concerns regarding the ability of Inspectors to determine what activities are occurring under which licences. TMAC disagrees – the fundamental question will be whether the activities in question are exploration or production activities. Inspectors are professionals who are familiar with the site, familiar with project history and have an ongoing understanding of site operations. Even in the limited cases where a new Inspector is assigned to a file, project assessment forms are provided in advance, engagement with the Proponent is conducted and project history is determined prior to an Inspector mobilizing to site. The determination of requirements is not something that happens 'on-the-fly' and therefore it should be very manageable for an Inspector to be able to inspect the site with full understanding of what the requirements are, and the scope of activities that are being undertaken on site at the time of inspection.

With respect to the concern raised by CIRNAC that work could continue under a Type B water licence in the event of a stop work order under its Type A Water Licence, this is not a valid concern. If work was being undertaken for exploration purposes, it would appropriately proceed under the Type B. If there was a non-compliance requiring the issuance of stop work orders, then it would be open to the Inspector to issue such orders under both the Type A and the Type B.

CIRNAC also raises concerns that there would be "complications" for closure and reclamation which could be avoided by incorporating the 2BB-BOS1727 licence into a Type A Water Licence. It is true that TMAC has designed the project to build from existing infrastructure. This is part of TMAC's sustainable development approach and will limit the overall disturbance caused by the project as development proceeds. No project components will be constructed until a Closure and Reclamation Plan, and associated financial security estimate, is approved by the NWB. The NWB requires adequate security to be in place in advance of construction of each component, regardless of whether it is constructed and operated under a Type A or Type B. The respective Closure and Reclamation Plans, and associated financial security estimates, provide explicit details and activities that will be undertaken to close and reclaim each component of the Project and objectives that must be met. It is irrelevant whether the project component is bonded under the Type A or the Type B, as long as there is sufficient reclamation security in place for that project component. The example given is that there would be some physical overlap between the two licences, such as the air strip. The initial air strip will service the Type B exploration and site capture activities. The bonding for the airstrip will reside under the Type B. Requiring additional bonding for the facility under the Type A would be double bonding. Should a production decision be made, TMAC anticipates requiring a new airstrip which is required for production mining only, and that would be included under the Type A only.

CIRNAC also raises the fact that the 2BE-HOP1222 exploration licence covers the Hope Bay belt and allows for surface exploration across the belt, including the watersheds where 2BBMAE1727 and 2BB-BOS1727 are located. TMAC would like to clarify that the 2BE-HOP1222 exploration licence does not fully cover the watersheds where 2BB-BOS1727 is located, nor does it permit advanced exploration activities.

In summary, TMAC disagrees with CIRNAC's position. As stated previously, exploration activities inherently are less predictable than production mining activities. There is a very high likelihood that amendments and modifications will be required in respect of each of the bulk sample projects. TMAC should not be subject to the more restrictive administrative regime under the Type A water licence prematurely when it is undertaking exploration work below the water and waste thresholds set out in the *Nunavut Waters Regulations*. The procedural flexibility permitted under the Type B water licences is essential to proceeding with our exploration activities. TMAC has confidence in the inspector's abilities and NWB's technical and administrative abilities, to administer exploration licences at Hope Bay while enabling TMAC to continue with commercial production at Doris and undertake commercial production at Madrid and Boston deposits under Type A Licences.

Further to the draft water licences that were submitted on Sept. 4, 2018, TMAC has the following additional comments.

- With respect to the discharge of contact water at Madrid, TMAC is proposing to add an additional clause that would permit TMAC to discharge such waters to the TIA, or if compliant, to the tundra. The criteria for such discharge would be the same as was previously included in DOH-1323, as follows:

23. The Licensee shall operate and maintain the Sedimentation Pond and Reagent and Cyanide Storage Facility sumps in accordance with the following:

a. Water discharged from the Sedimentation Pond and Reagent and Cyanide Storage Facility Sumps at monitoring stations ST-1 and ST-11 respectively shall not exceed the following Effluent quality limits:

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration in any Grab Sample (mg/L)
pH	Between 6.0-9.0	9.0
Total Suspended Solids	15.0	30.0
Total Ammonia –N	2.0	4.0
Total CN	1.0	2.0
Total Oil and Grease	5 and no visible sheen	10 and no visible sheen on pond
Total Aluminum – T-Al	1.0	2.0
Total Arsenic – T-As	0.05	0.10
Total Copper – T-Cu	0.02	0.30
Total Iron – T-Fe	0.30	0.60
Total Lead – T-Pb	0.01	0.02
Total Nickel – T-Ni	0.05	0.10
Total Zinc – T-Zn	0.01	0.02

b. The Licensee shall establish compliance with the Effluent quality limits prior to discharge;

c. Water from the Sedimentation Pond that is acceptable for discharge under PART GPART G, Item 23(a), if directly discharged to the tundra, shall be discharged immediately south of the facility approximately 500m upstream of Doris Lake, or as designated by an Inspector; and

d. Sedimentation Pond Water that does not meet criteria in PART G, Item 23(a) shall be directed to the Tailings Impoundment Area.

TMAC notes that CIRNAC did not seek nor were they granted any permission by the Board to hold their comments on the draft water licenses until the public hearing. TMAC requests that CIRNAC be required by the Board to present its comments on the draft water licences on or before **Wednesday, October 10, 2018**. TMAC undertook significant effort to circulate the licences well in advance of the public hearing, and in this case it is not efficient for CIRNAC to hold its comments until that time.

2. CIRNAC-2

2.1 Subject/Topic

Terms of Licences

2.2 Comment

During the technical meeting, TMAC requested the longest term possible, 25 years, but stated they would leave the term duration to the Board's discretion.

CIRNAC recommends that the licence terms match the duration of activities scheduled to occur under the licences. However, we consider the duration of post-closure monitoring proposed by TMAC to be inadequate. Lengthening the duration of post closure monitoring would require those activities to be carried out after the project schedule presented by TMAC.

2.3 TMAC Response to CIRNAC-2

CIRNAC is in agreement with TMAC in that the duration of the Licences should be issued for 25 years. Any extensions required beyond this time would be evaluated by the NWB as required. TMAC does not agree with CIRNAC's opinion that post closure monitoring will be required for 25 years, as no evidence has been provided to support that contention, however TMAC's closure and reclamation plan(s) provide for the ability to extend the duration of post closure monitoring if required.

3. CIRNAC-3

3.1 Subject/Topic

Water Supply

3.2 Comment

TMAC is requesting authorization for use of 120 m3/day from Windy lake for potable water and 7 270 m3/day from Doris Lake for industrial water use under an amended Doris water licence. For the Boston water licence, the request is for 1323 m3/day from Aimaokatalok Lake for both potable and industrial uses.

CIRNAC submitted a single comment regarding water supply, as summarised in Table 2. It has been resolved.

Table 2 Status of comment pertaining to water supply

Comment #	Issue	Status
IR9	Requested water volumes	Resolved

Requested water volumes: IR9 was to sort out water quantities which seemed inconsistent between different parts of the application. TMAC clarified that the maximum camp size proposed for Doris is 400 people and the maximum daily withdrawal from Doris Lake is 7 270 m3/day.

3.3 TMAC Response to CIRNAC-3

TMAC confirms the maximum daily withdrawal from Doris Lake is 7 270 m3/day. However, TMAC does not agree that the Water Licence should restrict the number of beds that may be included in the camp. The Nunavut Waters Regulations do not set licencing thresholds by bed space but instead, bases the thresholds on water use and waste. While TMAC has currently estimated 400 persons may be present at Doris camp, it is possible that more beds could be occupied provided the domestic water use threshold is not exceeded.

4. CIRNAC-4

4.1 Subject/Topic

Water Management

4.2 Comment

Water Management infrastructure includes contact water ponds on all four sites (Doris, Madrid North, Madrid South, and Boston), the tailings impoundment area (TIA), and pipelines. Saline groundwater is expected at all mines except Boston, and will be discharged to the marine environment in Roberts Bay. Five comments were provided and they are resolved, as presented in Table 3.

Table 3 Status of comment pertaining to water management

Comment #	Issue	Status
IR3	Water & load balance model validation	Resolved
IR6	Contact water pond design	Resolved
IR12	Mine water at Boston	Resolved
IR13, R19	Madrid mine water transport	Resolved
IR15	Effect of saline water in tailings impoundment area on frozen core dam	Resolved

Water & load balance model validation: IR3 asked what data were used to validate the water and load balance model, since it was not clear if the same data had been used for both calibration and validation. TMAC specified that although the calibration and validation data span the same periods, data from different measurement locations were used.

Contact water pond design: IR6 asked for more information on the overburden thickness at the planned locations for contact water ponds, since the pond design relies on the low permeability of a sufficiently thick layer of marine clays and silts. TMAC does not yet have the information, but proposed three mitigation strategies, should overburden thicknesses be insufficient.

Mine water at Boston: IR12 was for contingency measures should groundwater be encountered in the Boston mine. The current model predicts the Boston mine will be located entirely within permafrost; however the model was created with limited data and required localized modifications, increasing the uncertainty. TMAC responded they would seal any point sources and use any water encountered in the mine. Should greater volumes be encountered, the water would be trucked to Doris for disposal in the TIA or Roberts Bay.

Madrid mine water transport: IR13 and **R19** were regarding groundwater at the Madrid mines. Volumes of 1 180 m3/day and 550 m3/day are predicted for the Madrid North and Madrid South mines respectively. The water management proposed is disposal in Roberts Bay, either directly or via the TIA, but insufficient information had been provided on the method of transport between the Madrid mines and the bay. TMAC explained the groundwater would be trucked to the Doris site until ingress volumes are sufficient to warrant building a pipeline. They have updated the Groundwater Management Plan to refer to both methods of transport.

Effect of saline water in tailings impoundment area on frozen core dam: IR15 was to verify if the design of the North Dam of the TIA took into account the thermal effects of retaining saline groundwater in the TIA. TMAC confirmed saline groundwater storage would not alter the dam's performance.

4.3 TMAC Response to CIRNAC-4

TMAC thanks CIRNAC for clearly outlining the exchange of information, their evaluation of the additional information provided and consensus with our responses.

5. CIRNAC-5

5.1 Subject/Topic

Waste Management

5.2 Comment

Waste in water will be managed with two sewage treatment plants (Doris & Boston), two industrial water treatment plants (Doris & Boston) and through ocean discharge. As well, flotation tailings will be disposed of in a TIA at Doris and a tailings management area (TMA) at Boston, whereas detoxified tailings will be disposed of in the mines' permafrost zones. The mine workings will also be used for disposal of waste rock and hydrocarbon impacted soils. Two landfills are proposed (Doris & Boston) for nonhazardous waste.

As outlined in Table 4, all CIRNAC's comments are considered resolved, with one requiring follow-up.

Table 4 Status of comment pertaining to waste management

Comment #	Issue	Status
R11	Water treatment plant effluent quality	Resolved
IR10	Waste rock volumes in relation to void volumes	Resolved
IR11	Detoxified tailings deposition at Madrid	Resolved
IR14, R20	Non-hazardous waste disposal	Resolved. Follow-up required.

Water treatment plant effluent quality: R11 is about the water treatment process proposed for the Boston industrial water treatment plant to remove arsenic and cadmium. The treated effluent arsenic concentration assumed (0.01 mg/L) is highly optimistic for a field scale plant and it was used in the water and load balance model for Aimaokatalok Lake. The examples of plant effluent concentrations from other sites cited by TMAC did not provide sufficient confidence they could achieve the target. TMAC chose to use a 0.1 mg/L treated effluent target, which is more achievable and meets the Metal and Diamond Mining Effluent Regulations requirements. They also revised their hydrodynamic mixing model using the new effluent discharge concentrations and found arsenic concentrations in Aimaokatalok Lake to be protective of aquatic life.

Waste rock volumes in relation to void volumes: IR10 aimed to verify that sufficient space would be available in the mine workings, since they will be used as permanent disposal sites for waste rock, detoxified tailings and industrial water treatment plant sludge. TMAC stated where they had provided most of the information requested and gave estimates of the yearly sludge production.

Detoxified tailings deposition at Madrid: IR11 is about the availability of permafrost zones in the Madrid mine for disposal of detoxified tailings underground. TMAC confirmed the mine plan was such that there would always be space available in permafrost zones.

Non-hazardous waste disposal: IR14 asked about the expected timing of the landfill construction at Boston, and TMAC replied it would be early in the Boston mine life. R20 suggested that operational details for the landfills be incorporated into the Non-Hazardous Waste Management Plan, which TMAC has committed to.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

5.3 TMAC Response to CIRNAC-5

TMAC thanks CIRNAC for outlining their evaluation and consensus with our responses to R11, IR10 and IR11. In regards to IR14, R20, at present, there is no Landfill Management Plan for the Hope Bay Project as there is no existing landfill on the Project site. TMAC has approval under the existing Type A Water Licence 2AM-DOH1323 to construct a landfill at the Doris Site in the approved location at Quarry #3. At present, Quarry #3 has not been accessed and is not in position to provide a suitable landfill location for the Project. TMAC anticipates that due to project execution timelines, operational practicalities and site suitability, moving the location of the approved Landfill to Quarry site #2 may be required.

In line with the existing NWB water licencing requirements 2AM-DOH1323 Part G Item 7, a Landfill Management Plan for the Hope Bay Project will be developed in consultation with interested parties six (6) months prior to the development of a landfill, and that landfilling will only include non-hazardous materials which are not wildlife attractants. This plan will include details on locations of both the Doris and Boston Landfill and shall consider operational details.

TMAC notes that all Management Plans are subject to annual review and are revised as necessary. The updates to these plans will build on the existing plans and will be adopted by Project post-permitting.

TMAC would request that the Board issue its approval of the plan within 60 days of its submission to the Board, so that an approved plan is in place prior to construction of the landfill. If the Board does not comment within the 60 day Board review period, TMAC has requested that the plan be deemed approved by the Board.

6. CIRNAC-6

6.1 Subject/Topic

Management Plans and Reports

6.2 Comment

Management plans describe how concepts and strategies will be implemented. Table 5 lists all the comments and their status.

Table 5 Status of comment pertaining to management plans and reports

Comment #	Issue	Status
R12	Backfill materials	Resolved
R15	Release of saline minewater to the tundra	Resolved
IR2, R17	Industrial water treatment plant at Doris	Resolved. Follow-up required.
IR7	Cyanide testing	Resolved
IR8	Maximum camp size at Doris	Resolved
IR16	Crown pillar recovery at Doris North	Resolved

Backfill materials: R12 asked for rational for using quarried rock instead of filtered flotation tailings to fill in the mine workings voids. TMAC explained that the filtered tailings do not have the strength characteristics required for structural backfill.

Release of saline minewater to the tundra: R15 requested an evaluation of failure modes of saline groundwater during its transport from Madrid to Doris, and consequences of accidental discharge to the tundra. TMAC provided a memo with the requested information and a proposed mitigation measure.

Industrial water treatment plant at Doris: IR2 is about the Doris industrial water treatment plant to remove arsenic from contact water, on which insufficient information had been provided. TMAC responded with the information requested, and following **R17**, they will integrate the relevant information in the Doris-Madrid Water Management Plan.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

Cyanide testing: IR7 pertained to cyanide testing described in the Quality Assurance and Quality Control Plan. TMAC provided clarifications which they committed to integrating in the next version of the Plan.

Maximum camp size at Doris: IR8 sought clarification on two possible maximum camp sizes for Doris contained in the application materials, and the capacity of the wastewater treatment plant. TMAC confirmed the maximum camp size is 400 people and there will be sufficient sewage treatment capacity.

Crown pillar recovery at Doris North: IR16 asked about missing information of the excavation necessary for crown pillar recovery at Doris. TMAC replied it was no longer being considered for this application.

6.3 TMAC RESPONSE TO CIRNAC-6

TMAC thanks CIRNAC for clearly outlining their evaluation and consensus with our responses.

In regards to integration of the relevant information regarding the Doris industrial water treatment plant into the Doris-Madrid Water Management Plan, TMAC proposes to provide details to the NWB no later than 60-days prior to the commissioning of the facility. As per the above, TMAC would request that the NWB issue its approval of the plan within 60 days of submission and that it be deemed approved in the absence of Board comment within that period.

For clarity, TMAC notes that it is providing the current draft of the Doris-Madrid Water Management Plan for approval with the issuance of the Licences, and is of the view that upon issuance of the Licences, TMAC would be permitted to proceed with all activities included in the Licence scope of work under the current version of the Doris-Madrid Water Management Plan. TMAC should not be required to delay undertaking any activities under the Licences while the Board is considering the details of the industrial water treatment plant in the revised Doris-Madrid Water Management Plan.

With respect to CIRNAC's question regarding camp size, TMAC refers CIRNAC to TMAC's response at CIRNAC-3 above.

7. CIRNAC-7

7.1 Subject/Topic

Monitoring Program

7.2 Comment

Monitoring allows us to check that management measures are performing as planned and the project is not having any unintended consequences. A single comment was submitted, as presented in Table 6, and it has been deferred.

Table 6 Status of comment pertaining to monitoring program

Comment #	Issue	Status
IR4, IR5, R18	Aquatic effects monitoring plans	Deferred. Follow-up required.

Aquatic effects monitoring plans: Two Aquatic Effect Monitoring Plans (AEMP) were submitted, one for each Madrid-Doris and Boston. **IR4** asked for more information on methodology used for hydrological measurements, and **IR5** was about the duration of "before" water quality analyses for Before-After Control-Impact analysis. TMAC provided satisfactory responses for both of these. **R18** was for a single AEMP integrated both projects, with some specific suggestions. TMAC has deferred producing the AEMP until after the public meeting.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

7.3 TMAC Response to CIRNAC-7

TMAC has filed the updated AEMP with this submission. TMAC requests that the NWB issue its approval of the AEMP with the issuance of the licence(s).

8. CIRNAC-8

8.1 Subject/Topic

Closure and Reclamation Planning

8.2 Comment

The Doris Interim Closure and Reclamation Plan has been updated to include proposed amendments, and a Conceptual Closure and Reclamation Plan has been provided for Boston. These describe how the sites will be cleaned up after the mining has finished, and they were used to develop reclamation cost estimates. Table 7 lists the comments on this topic and their status.

Table 7 Status of comment pertaining to closure and reclamation planning

Comment #	Issue	Status
R1, R2	Doris Tailings Impoundment Area	Resolved
R3, R4, R5, R6	Boston Tailings Management Area seepage	Resolved
R7, R8, R9, R10	Closure planning and requirements	Resolved
R13, R14	Long-term climate change effects	Resolved
R21	Reclamation cost estimate	Unresolved

Doris Tailings Impoundment Area: R1 and **R2** are about plans for closure of the Doris TIA. The first was about the site specific water quality objectives (SSWQO) TMAC was proposing to use after closure, and this issue has been deferred to the Aquatic Effects Monitoring Plan. The second recommendation was for field trials of the proposed cover design for closure to confirm that none of the potential issues identified would compromise its performance. TMAC has provided a discussion of potential performance issues and concluded deficiencies could be covered by the 20% contingency of the reclamation cost estimate.

Boston Tailings Management Area seepage: R3, R4, R5 and **R6** are all related to the Boston TMA closure plan which includes cover of a geomembrane under 1 m of aggregate. R3 is on the effect on arsenic loading from a 1% geomembrane failure, as will occur in the future, likely in between 100-500 years. TMAC provided a memo with modelling results of arsenic loading calculations demonstrating that even at 10% cover failure, concentrations would remain below criteria. The last three recommendations covered: the anticipated design life of the TMA components; post-closure mitigation actions that could be taken in event of non-compliant seeps; and field trials of the proposed cover design. These were addressed in TMAC's discussion of potential performance issues with mitigation measures.

Closure planning and requirements: Though adequate for the current level of project definition, the Boston Conceptual Closure and Reclamation Plan and the Doris-Madrid Interim Closure Plan do not follow many of the requirements in the Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB & AANDC, 2013). The recommendations were about: following the applicable closure planning guidance (**R7**), establishing a stakeholder working group for closure planning (**R8**), defining long term post-closure maintenance and monitoring requirements (**R9**), and specifying post-closure land uses (**R10**). TMAC provided a closure design and performance uncertainties table detailing different failure modes and concluded there would be no post-closure maintenance requirements, addressing **R9**. They also committed to considering the other recommendations in future plan updates.

Long-term climate change effects: R13 sought confirmation that the geochemical source terms used to assess project impacts accounted for anticipated climate change effects, which TMAC provided. **R14** was for a sensitivity analysis projecting climate change effects 200 years post-closure using predicted climate data for 2100, because permafrost response to climate change can be delayed until cumulative thresholds are reached. TMAC stated the model response past 2100 would remain unchanged, which is due to simplifications in the thermal model used.

Reclamation cost estimate (R21): CIRNAC developed two estimates for the closure plans at Doris-Madrid and at Boston. Following discussions with TMAC and the Kitikmeot Inuit Association, we have revised the estimate. Our current reclamation costs are in Table 8 for Doris-Madrid and in Table 9 for Boston. The detailed RECLAIM spreadsheets will be submitted with this document.

Table 8 Reclamation cost estimate for Doris-Madrid

Cost Category	**Total Cost ($)**	**Land**		**Water**	
		%	**Cost ($)**	**%**	**Cost ($)**
Capital Costs					
Underground	312 868	98	306 351	2	6 517
Tailings Facility	18 850 158	50	9 425 079	50	9 425 079
Rock Pile	170 371	100	170 371	0	-
Buildings and equipment	13 641 928	91	12 346 309	9	1 295 619
Chemicals and Contaminated Soil Mgmt	2 873 934	50	1 436 967	50	1 436 967
Surface and Groundwater Mgmt	660 059	0	-	100	660 059
Interim Care and Maintenance	5 597 400	0		100	5 597 400
Subtotal: Capital Costs	***42 106 717***	*56*	***23 685 077***	*44*	***18 421 640***
Indirect Costs					
Mobilization/Demobilization	9 180 540	56	5 164 064	44	4 016 476
Post-Closure Monitoring and Maintenance	1 855 177	56	1 043 539	44	811 638
Engineering	2 105 336	56	1 184 254	44	921 082
Project Management	2 105 336	56	1 184 254	44	921 082
Contingency	8 421 343	56	4 737 015	44	3 684 328
Sub-Total: Indirect Costs	***23 667 732***	*56*	***13 313 126***	*44*	***10 354 605***
Total Costs	**65 771 118**		**36 998 203**		**28 776 246**

Table 9 Reclamation cost estimate for Boston

Cost Category	Total Cost ($)	Land		Water	
		%	Cost ($)	%	Cost ($)
Capital Costs					
Underground	60 847	100	60 847	0	-
Tailings Facility	15 195 574	50	7 597 787	50	7 597 787
Rock Pile	57 143	100	57 143	0	-
Buildings and equipment	5 313 366	95	5 070 137	5	243 229
Chemicals and Contaminated Soil Mgmt	636 123	50	318 061	50	318 061
Surface and Groundwater Mgmt	46 772	0	-	100	46 772
Interim Care and Maintenance	4 786 320	0		100	4 786 320
Subtotal: Capital Costs	***26 096 144***	*50*	***13 103 974***	*50*	***12 992 170***
Indirect Costs					
Mobilization/Demobilization	5 041 005	50	2 531 301	50	2 509 704
Post-Closure Monitoring and Maintenance	1 577 877	50	792 318	50	785 558
Engineering	1 304 807	50	655 199	50	649 609
Project Management	2 105 336	50	655 199	50	649 609
Contingency	5 219 229	50	2 620 795	50	2 598 434
Sub-Total: Indirect Costs	***14 447 725***	*50*	***7 254 812***	*50*	***7 192 913***
Total Costs	**40 543 869**		**20 358 786**		**20 185 083**

We are still in discussions on three aspects of the estimates.

1) Costs: The biggest differences between the CIRNAC and TMAC estimates are because of the duration of interim care & maintenance and post-closure monitoring. CIRNAC is looking to standardize the duration of interim care & maintenance to 5 years and post-closure monitoring to 25 years, as described in the guideline in Annex A. Since the current Doris water licence has a 1.5 year interim care & maintenance period, we are using 3 years as a transition. Our discussion with TMAC on costs is ongoing, and the difference between our estimates is approximately 10%.

2) Land-water split: The Kitikmeot Inuit Association is looking to hold security for what they consider predominantly land liabilities, which would leave CIRNAC to hold water related liabilities. There are significant differences between the Kitikmeot Inuit Association's and CIRNAC's land-water allocations, principally due to how the tailings reclamation costs are distributed. Rational for the landwater split used by CIRNAC is provided in Annex B.

   If the site were to be abandoned, CIRNAC's reclamation efforts would be in collaboration with the Kitikmeot Inuit Association. Security would be accessed following the Mine Site Reclamation Policy for Nunavut (INAC, 2002).

   Discussions are also ongoing with the Kitikmeot Inuit Association regarding the land-water split.

3) Phased bonding: TMAC has proposed posting security in phases for both projects. The current proposal has 6 phases for Boston and 15 for Doris-Madrid. Some concerns we are presently discussing with TMAC are:

    - There are too many phases. With the current project schedule 1-4 phases would be posted each year, with the possibility for more. This is an administrative burden and might lead to re-evaluations of security more frequently than necessary as different people handle the file. We would recommend limiting changes to posted security once per year by lumping together phases in that year's workplan, and believe this would not pose undue constraints given the advanced planning necessary for each phase.
    - Mobilization, interim care & maintenance, and post-closure monitoring costs need to be in the first phase for each licence. These costs will be necessary almost in their entirety once the project is started, so it is not logical to distribute them proportionally.
    - Dividing the tailings reclamation costs according to the tonnage deposited as proposed would require further work. For the Boston TMA, we have spoken about how the stacking of tailings could be done in cells or areas, so that only the proportion of the footprint for which security was held was being used. This would require modifying the Boston Tailings Management Area – Operations, Maintenance and Surveillance Manual and possibly the Conceptual Closure and Reclamation Plan, as well as clearly delineating the areas on the ground so Inspectors could identify them. Similarly, at Doris, markers allowing Inspectors to assess what surface area extent of the TIA was secured were discussed.

CIRNAC agrees with the principle of phased bonding and continuing discussions should allow us to come to an agreement.

8.3 TMAC Response to CIRNAC-8

TMAC proposes to provide response to CIRNAC-8 and further information on TMAC's position regarding financial security for NWB's consideration no later than October 5, 2018.

9. ECCC-WL-1

9.1 Subject/Topic

Aquatic Effects Monitoring Program

9.2 References

- P4-18: Hope Bay Aquatic Effects Monitoring Plan
- V5-4B: Near Field Plume Mixing Model for Discharges to Aimaokatalok Lake
- V5-4E: Far Field Hydrodynamic Mixing Model for Discharges to Aimaokatalok Lake

9.3 Issue

The Aquatic Effects Monitoring Program (AEMP) has been undergoing development and refinement in consultation with ECCC throughout the water licensing process. The Proponent has held meetings with ECCC, in order to ensure satisfaction with the AEMP, and work is progressing to harmonize the AEMP with the Environmental Effects Monitoring Program (EEM) that is required under the Metal and Diamond Mining Effluent Regulations (MDMER). The AEMP and EEM are both aquatic monitoring programs; however, the programs differ in frequency of sampling and reporting, required components, and the overall program goals.

While significant progress has been made to develop the AEMP, further work is required to finalize the details including study design, data analysis, the aquatic response framework, and baseline sampling. ECCC acknowledges the work undertaken by TMAC and looks forward to ongoing participation and collaboration in further development of the program.

9.4 Recommendation(s)

ECCC recommends that the AEMP be submitted for Board approval following the issuance of the water licence, prior to construction.

9.5 TMAC Response to ECCC-WL-1

TMAC has continued to engage with ECCC on the development of the Hope Bay AEMP since the May 2018 NWB technical meeting in Cambridge Bay, including four conference calls to refine and finalize the plan. During this time, TMAC developed an MDMER/EEM-based gradient sampling design within the predicted discharge region of Aimaokatalok Lake with input from ECCC, updated the MDMER/EEM design to a before-after-control-impact (BACI) design at ECCC's request, as well as adding an AEMP sampling site downstream of the projected discharge in Aimaokatalok Lake (beyond the required MDMER/EEM requirement) that links to an Aquatic Response Framework, also at ECCC request. TMAC has worked with ECCC throughout the Nunavut Impact Review Board and Water Licence processes to refine the AEMP and feels it is suitably designed to assess potential effects from the Project, validate model and FEIS predictions, and ultimately be protective of the freshwater environment surrounding the Hope Bay Project.

TMAC has filed the updated AEMP with this submission. TMAC requests that the NWB issue its approval of the AEMP with the issuance of the Type A Water Licences.

10. ECCC-WL-2

10.1 Subject/Topic

Effluent Quality Criteria

10.2 References

- P5-4: Hope Bay Water and Load Balance

10.3 Issue

The Proponent has provided extensive modelling to predict the quality of the effluent to be discharged at Aimaokatolok Lake as part of the Boston Project and has modelled how effluent quality in the Tailings Impoundment Area (TIA) will change with the addition of the Madrid Project. The Proponent primarily compares predicted effluent quality to the authorized limits for deleterious substances that are regulated under the MDMER; however, it is unclear whether TMAC is proposing any additional effluent quality criteria. The MDMER include national minimum standards for effluent quality monitoring. They would not reflect site specific considerations, such as the sensitive nature of Northern aquatic ecosystems.

10.4 Recommendation(s)

Given the sensitive nature of the local aquatic ecosystems, ECCC suggests that lower limits than those set by the MDMER be considered. This is consistent with what has been indicated to be achievable by the Proponent's modelling. ECCC also suggests that the proponent consider including additional water quality parameters.

10.5 TMAC Response to ECCC-WL-2

The MDMER were very recently updated and amended by ECCC in June 2018. According to the Regulatory Impact Analysis Statement that accompanied the MDMER, the amendments "strengthen effluent quality standards with the goal of reducing risks to fish and fish habitat." TMAC is of the strong view that the Water Licence should be consistent with and should not vary from effluent water quality concentrations legally set by the MDMER, and in particular, the NWB should not vary from these legal standards given that they have been subject to recent and comprehensive review by ECCC.

TMAC also notes that the proposed limits for the Licences are consistent with licences issued by the NWB for other production mines in Nunavut.

TMAC is of the view that the modelling has shown that the proposed discharge will be protective. TMAC is very confident in its modelling, but they are predictions only and the modelling is not designed for the purposes of setting effluent limits. It would be inappropriate for the NWB to rely on the modelling for this purpose. Extensive and conservative near-field mixing modelling and far-field hydrodynamic modelling have shown that all predicted effluent quality concentrations, and authorized MDMER discharge concentrations, will be rapidly diluted in the Aimaokatalok Lake receiving environment such that all CCME water quality criteria for the protection of aquatic life will be met within metres of the discharge diffuser; therefore, it is unnecessary to set effluent criteria for unauthorized water quality parameters. Further, this effluent must continually pass acute lethal and chronic sublethal toxicity testing on multiple organisms, with the effects of the effluent being monitored in the receiving environment under the MDMER/EEM program and the AEMP program. In consultation with ECCC, the MDMER/EEM sampling sites were specifically sited to determine potential effects to aquatic life, and the AEMP links to an Aquatic Response Framework that would trigger management actions if the effluent significantly affected the water quality, sediment quality, phytoplankton biomass, and benthic invertebrates downstream of the outfall. TMAC is confident that the MDMER and the AEMP will act as they are intended and will ensure that the effluent quality is protective of aquatic life in Aimaokatalok Lake, and if significant effects are found, management decisions can be quickly made to reduce or eliminate the potential effect.

11. ECCC-WL-3

11.1 Subject/Topic

Mitigation and Monitoring of In-water Construction Activities

11.2 References

- ECCC Technical Review Comments Submission (March 23, 2018)
- TMAC Letter to NWB re. Technical Meeting Commitments (June 19, 2018)

11.3 Issue

In ECCC's technical comments and during the technical sessions, ECCC had expressed concern with the lack of information provided on monitoring of water quality during in-water construction and mitigation of potential effects. Based on discussions at the technical sessions, TMAC has provided a preliminary draft of an Environmental Protection Plan that outlines the components that will be included in this plan. However, specific monitoring/management requirements are not stated. ECCC acknowledges that design specifics of in-water construction works are not finalized at this early stage in mine development; however, a more detailed management/monitoring plan should be provided prior to construction of any in water works to ensure that the aquatic environment is protected.

11.4 Recommendation(s)

ECCC recommends that a design-specific in-water construction plan be submitted to the Nunavut Water Board for approval prior to any in-water construction. The plan should include the components outlined in the TMAC's commitment to ECCC-WL-4.1.9.

11.5 TMAC Response to ECCC-WL-3

TMAC does not agree that a separate Board approved design-specific in-water construction plan should be required prior to in-water construction. This is not consistent with the existing 2AM-DOH1323 and there is no reason to impose this requirement in respect of this Project.

Preliminary draft procedures (with specific consideration of key matters such as avoiding release of TSS) were provided to the Board on June 19, 2018. These procedures form part of an overarching Environmental Protection Plan (EPP) which will be finalized and submitted to the NIRB prior to construction in line with NIRB Guidelines 9.2. The content of the EPP is developed in recognition of applicable permits, authorizations, approvals, and Inuit Knowledge to ensure that appropriate and adequate environmental protection are in place for construction activities at all construction sites. The EPP is a working document for use in the workplace by Project personnel and contractors, as well as at the corporate level for ensuring commitments made in policy statements are implemented and monitored.

Additionally in-water works in fish-bearing or potentially fish-bearing habitats on the Project site are subject to the requirements of the *Fisheries Act*, including where necessary Fisheries and Oceans Canada (DFO) authorizations that outlines design specific mitigation and monitoring requirements. As committed to during the Project Certificate Final Hearings and documented in the NIRB Final Hearing Report, TMAC will work with DFO, KIA and Inuit Environmental Advisory Committee (IEAC) during the regulatory phase to gain consensus on acceptable construction monitoring and reporting requirements which will be documented in the EPP. TMAC notes that protection of the marine and freshwater environment is a specific requirement for Project approval and subject to regular monitoring and reporting for both the NIRB and the NWB.

Attachment B

Revised Aquatic Effects Monitoring Plan for Phase 2
dated October 1, 2018

HOPE BAY PROJECT

AQUATIC EFFECTS MONITORING PLAN

October 2018

PLAIN LANGUAGE SUMMARY

This Hope Bay Project (the Project) Aquatic Effects Monitoring Plan (the Plan) describes the comprehensive aquatic monitoring program that will be implemented to monitor potential effects on the freshwater environment of all projects operating along the Hope Bay Belt, including the Madrid-Boston Project and the Doris Project.

The Plan provides details of the sampling plan for various abiotic and biotic components of the aquatic ecosystem (i.e., water and sediment quality, phytoplankton, benthic invertebrates, and fish) to determine the potential effects of mining activities on the freshwater receiving environment. The Plan also summarizes the key mitigation measures that will be used to reduce the potential for Project effects to the freshwater environment in the Project area.

REVISION RECORD

Date	Section	Summary of Changes	Author	Approver
December 2016	Throughout	Initial Plan	TMAC	TMAC
December 2017	Throughout	Update to FEIS	ERM	TMAC
April 2018	Throughout	Update to comprehensive plan that includes Doris and Madrid-Boston, and that includes non-point source AEMP sampling as well as MMER-EEM monitoring requirements for lakes receiving permitted discharge.	ERM	TMAC
September 2018	Throughout	Update to incorporate new MDMER requirements and technical comments.	ERM	TMAC

GLOSSARY AND ACRONYMS

Term	Definition
AEMP	Aquatic Effects Monitoring Program
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
BACI	Before-after-control-impacts
The Belt	Hope Bay Belt
CCME	Canadian Council of Ministers of the Environment
CoC	Chain of custody
DELTs	Deformities, erosion, lesions, and tumours
DFO	Fisheries and Oceans Canada
DOE	Department of Environment
DEIS	Draft Environmental Impact Statement
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
FEIS	Final Environmental Impact Statement
GN	Government of Nunavut
INAC	Indigenous and Northern Affairs Canada
ISO	International Organization for Standardization
KIA	Kitikmeot Inuit Association
MDMER	Metal and Diamond Mining Effluent Regulations
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
the Plan	Aquatic Effects Monitoring Plan
the Project	Hope Bay Project
QA/QC	Quality assurance and quality control
RTK	Real Time Kinematic
TIA	Tailings Impoundment Area
TMAC	TMAC Resources Inc.
TSS	Total Suspended Solids
WLWB	Wek'èezhìi Land and Water Board

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1. INTRODUCTION

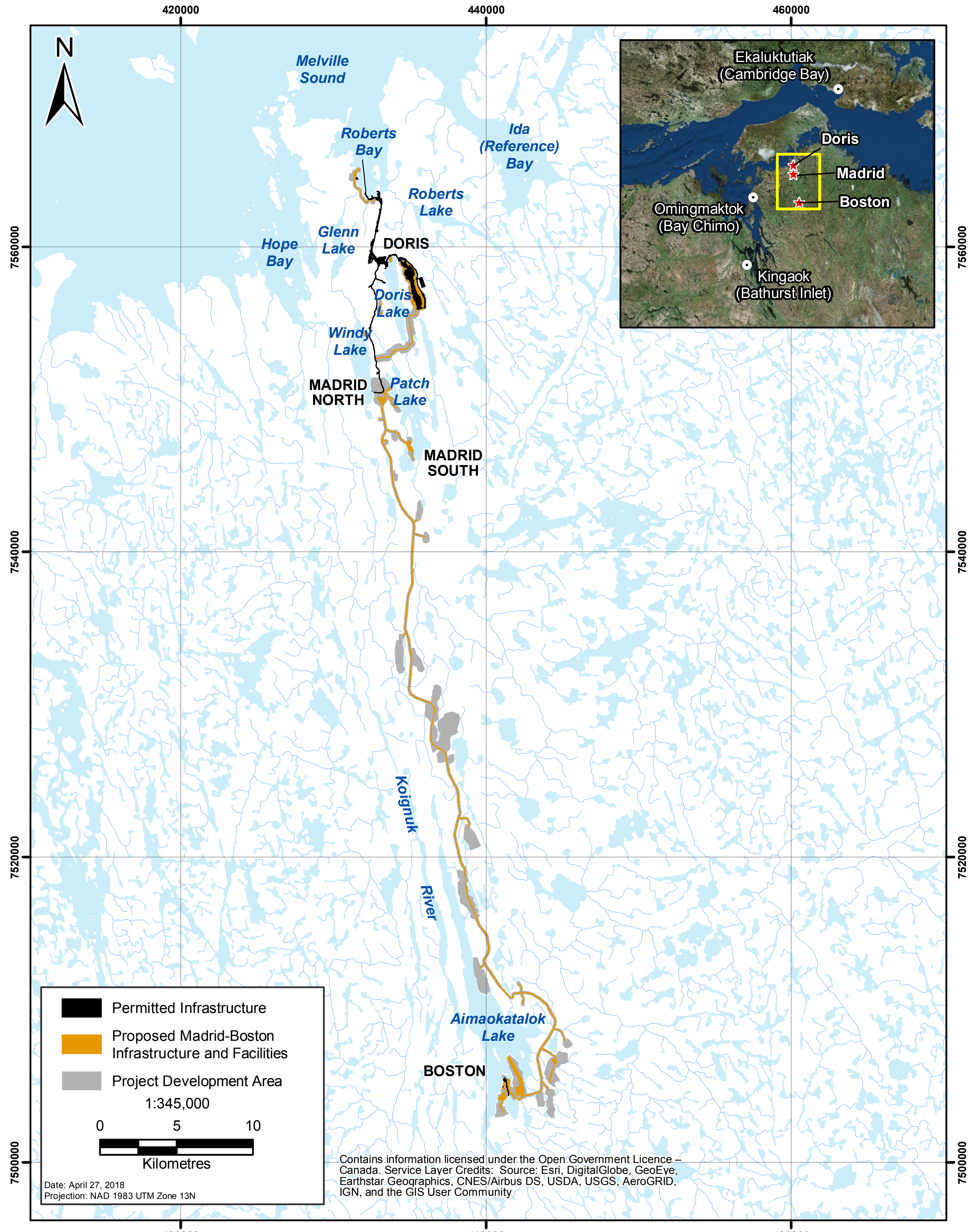
The Hope Bay Project (the Project) is a gold mining development owned by TMAC Resources Inc. (TMAC) in the West Kitikmeot region of mainland Nunavut. The Project property is approximately 153 km southwest of Cambridge Bay on the southern shore of Melville Sound and contains a greenstone belt (the Belt) that runs 80 km in a north-south direction varying in width between 7 km and 20 km.

The Project area has been actively explored and developed since the late 1980s and consists of three developments: Doris, Madrid, and Boston (Figure 1-1). Doris is the northernmost development situated near Roberts Bay and contains the operating Doris Mine that TMAC received an amended Project Certificate (No. 003) in September 2016 and an amended Type A Water Licence (2AM-DOH1323) in December 2016. The Madrid and Boston developments are in the north-central and southernmost parts of the Belt. TMAC is seeking to develop these areas jointly having recently submitted the *Madrid-Boston Final Environmental Impact Statement* (FEIS; TMAC 2017) to the Nunavut Impact Review Board (NIRB) and corresponding application for a Type A Water Licence to the Nunavut Water Board (NWB) in December 2017.

This Aquatic Effects Monitoring Plan (the Plan) describes the Aquatic Effects Monitoring Program (AEMP) for the freshwater environment to be conducted and evaluated over the entire Project area and integrates the monitoring proposed for the Madrid-Boston Project with the monitoring currently being conducted as part of the Doris Aquatic Effects Monitoring Plan (TMAC 2016) under the approved Type A Water Licence (2AM-DOH1323) for the Doris Project. The Plan was originally submitted as part of the *Madrid-Boston Final Environmental Impact Statement* and focused on monitoring related to the Madrid-Boston Project. The Plan is now Belt-wide in scope, including freshwater monitoring and effects evaluation for the Doris, Madrid, and Boston developments, based on technical comments received and conversations with interveners during the Madrid-Boston FEIS and Type A Water Licencing processes (e.g., INAC-TC-11). This Belt-wide Plan will supersede the Doris Aquatic Effects Monitoring Plan (TMAC 2016) if and when Amendment No. 2 for Doris Type A (2AM-DOH1323) and Boston Type A Water Licences are issued.

The primary goals of the AEMP described by the Plan are to evaluate potential Project effects on the surrounding freshwater environment during the construction and operation of the Project, verify predictions from the Madrid-Boston FEIS (TMAC 2017), support current and future Fisheries Authorizations, and provide a mechanism to respond to potential Project effects in the freshwater environment through mitigation and management actions. The Plan focuses on Aimaokatalok Lake, which will receive treated discharge from the Project, and lakes adjacent to proposed infrastructure that have the greatest potential to receive non-point-source inputs such as runoff (e.g., Doris, Patch, Stickleback, and Wolverine lakes) and could be affected by water loss due to permitted water withdrawal and groundwater seepage into the mines through underground workings (e.g., Doris, Imniagut, Ogama, P.O., Patch, P.O., Wolverine, and Windy lakes). The Plan is harmonized with the Environmental Effects Monitoring (EEM) of the Metal and Diamond Mining Effluent Regulations (MDMER; SOR/2002-222) under the *Fisheries Act* (1985) to provide a comprehensive AEMP that assesses point and non-point inputs into the Project lakes.

Figure 1-1
Hope Bay Project Location



This Plan considers information from technical comments received following the Madrid-Boston FEIS Final Hearing and Type A Water Licence technical meetings (Cambridge Bay, May 2018), the Madrid-Boston FEIS submission (December 2017), the draft Environmental Impact Statement (DEIS) technical meetings (Cambridge Bay, Nunavut, June 2017), and the Doris Project Type A Water Licence technical meetings (Cambridge Bay, September 2016). The Plan further considers guidance outlined in the *Metal Mining Technical Guidance for Environmental Effects Monitoring* (Environment Canada 2012), the *Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories: Overview Report* (INAC 2009), and the *Guidelines for Adaptive Management - a Response Framework for Aquatic Effects Monitoring* (WLWB 2010). The monitoring, evaluation of effects, and the management response framework described in the Plan have been adapted from the Doris Aquatic Effects Monitoring Plan (TMAC 2016) that was developed in consultation with and approved by the NWB, the Kitikmeot Inuit Association (KIA), the NIRB, Environment and Climate Change Canada (ECCC), Indigenous and Northern Affairs Canada (INAC), and Fisheries and Oceans Canada (DFO).

This Plan is intended primarily for use by TMAC and its contractors to guide appropriate freshwater effects monitoring associated with the Project. The monitoring and the evaluation of the potential Project effects are designed to confirm if mitigation measures are performing as planned, and if not, then management responses will be developed to eliminate or reduce the potential for downstream environmental effects. The Plan is a “living document” and may be updated based on regulatory changes, Project-related changes, or changes to existing mitigation measures. All updates to the Plan will be submitted to the NWB.

1.1. OBJECTIVES

The purpose of this Plan is to assess the potential effects of Project activities on the freshwater environment, assess predictions of the Madrid-Boston FEIS (TMAC 2017), and comply with requirements set forth in the Project permitting and licensing processes. The objectives of the Plan are aligned with the definition of the “Aquatic Effects Monitoring Plan” as outlined in the Doris Water Licence (2AM-DOH1323).

The main objectives of the Plan are to demonstrate that Project activities are not adversely affecting the aquatic environment by:

- detecting potential short- and long-term changes in lakes potentially influenced by activities of the Project;
- meeting the conditions of the applicable Type A Water Licences for the Project;
- comparing the results of the program to predictions made in the *Madrid-Boston Final Environmental Impact Statement* (TMAC 2017);
- assessing the efficacy of mitigation measures applied to the Project activities;
- developing a management framework that provides a mechanism to respond to potential Project-related effects in select Project lakes; and
- using the management framework to identify additional mitigation measures that will avert or reduce Project-related effects in Project lakes.

This Plan is designed to address these objectives by monitoring the receiving environment in the short-term (annually) and the long-term (during construction and operation). The sampling design allows for the detection of potential changes in the receiving environment, which would inform whether management and mitigation measures are effective. The Plan contains an aquatic response framework such that if potential effects are detected in the freshwater environment, they can be investigated and additional mitigation measures considered to eliminate or reduce the effect. Together, these measures form an effective strategy to achieve environmental protection in the Project area by limiting the potential for adverse effects in the freshwater environment.

1.2. RELEVANT LEGISLATION AND GUIDANCE

Table 1.2-1 provides a summary of federal and territorial regulations governing this Plan and associated guidelines. Additional TMAC plans and standards designed to manage sources of potential compounds to the freshwater environment were submitted as part of the Madrid-Boston FEIS (TMAC 2017) and the Doris Project amendment (TMAC 2015), including the Hope Bay Project Spill Contingency Plan, the Hope Bay Project Doris-Madrid Water Management Plan, the Hope Bay Boston Water Management Plan, the Hope Bay Air Quality Monitoring Plan among others.

Table 1.2-1. Regulations and Guidelines Pertinent to the Aquatic Effects Monitoring Plan

Regulation	Year	Governing Body	Relevance
Environmental Protection Act	1988	Government of Nunavut	Governs the protection of the Nunavut environment including land, air, water, and organisms therein.
Nunavut Land Claim Agreement Act	1993	Government of Nunavut	Grants Inuit rights to land, water, and land-fast ice in the Nunavut settlement area.
Environmental Rights Act	1988	Government of Nunavut	Grants all Nunavut residents the ability to launch an investigation.
Nunavut Waters Regulations	2013	Nunavut Water Board	Licence for mining and milling undertaking to use water and deposit of waste in relation to the construction, operation, closure, and reclamation.
Fisheries Act	1985	Fisheries and Oceans Canada	Prohibits any work or undertaking that would cause the harmful alteration, disruption, or destruction of fish habitat.
Metal and Diamond Mining Effluent Regulations (Section 36 of *Fisheries Act*)	2002	Environment and Climate Change Canada	Prohibits the deposit of deleterious substances into waters frequented by fish, unless authorized by regulations under the *Fisheries Act* or other federal legislation.
Guideline	**Year**	**Issued by**	**Relevance**
Canadian Environmental Quality Guidelines	1999 – as amended to date	Canadian Council of Ministers of the Environment (CCME)	Provides guidance on water quality for the protection of aquatic life.

1.3. PLAN MANAGEMENT AND EXECUTION

The Plan will be reviewed regularly and updated as necessary with approvals from the NWB. Personnel responsible for implementing and updating the Plan and undertaking the AEMP sampling and reporting are identified in Table 1.3-1.

Table 1.3-1. Roles and Responsibilities

Role	Responsibility
VP Environmental Affairs	• Overall responsibility for and implementation of the Plan; • Provide the on-site resources to operate and maintain the monitoring program in accordance with this Plan; and • Provide input on modifications to design and operational procedures to improve operational performance.
Environmental Manager	• Review and update this Plan as required; • Support implementation of this Plan; and • Ensure staff conducting monitoring are trained in AEMP monitoring and quality assurance and quality control procedures.
Environmental Supervisor / Environmental Consultants	• Conduct AEMP sampling; • Report issues, irregularities, and non-compliances with the AEMP sampling program to the Environmental Director; • Ensure sampling gear is safe and operational; • Ensure monitoring is conducted safely; • Maintain and review AEMP records; and • Complete required AEMP reporting.

2. RATIONALE FOR AEMP DESIGN

The AEMP is a comprehensive program that considers Project-related effects on the freshwater environment and reflects the potential Project effects assessed in the *Madrid-Boston Final Environmental Impact Statement* (TMAC 2017) and *Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003 and Water Licence 2AM-DOH1323* (TMAC 2015). The monitoring program design, environmental indicators, and sampling methodologies and frequencies are based on potential effects related to Project development, and the program considers past baseline data sampling locations, methodologies, and sample collection timing. Where possible, the AEMP has been harmonized with MDMER requirements (SOR/2002-222) and EEM guidance (Environment Canada 2012) so the monitoring data can be used by both the AEMP and MDMER EEM programs to more robustly assess potential Projects effects to the surrounding freshwater environment.

2.1. POTENTIAL PROJECT EFFECTS ON FRESHWATER ENVIRONMENT

The Project includes the current (Doris) and future (Madrid and Boston) mining of ore deposits in the Project area, and use of existing Doris Project infrastructure such as the mill, tailings impoundment area (TIA), and ocean discharge pipeline. New infrastructure on the Belt will include underground mines at Madrid North, Madrid South, and Boston, processing plants and crown pillar recovery at Boston and

Madrid North, a tailings management area for subaerial deposition of dry stack tailings near Boston camp, and the associated water management features that will reduce the interaction of site and mine contact water with the surrounding freshwater environment. The Madrid-Boston Project will result in additional water use and groundwater inflow into the Doris, Madrid North, and Madrid South mines. The greatest potential for effects in the freshwater environment due to Project activities are predicted to be changes in surface water quantity and quality and are discussed below.

2.1.1. Surface Water Quantity

The Project has the potential to affect surface water quantity by direct water withdrawal for site and processing (domestic and industrial) activities, and through water inflow into the mines. Water for industrial purposes will be drawn from Doris and Aimaokatalok lakes, and water for domestic purposes will be drawn from Windy and Aimaokatalok lakes. Four underground mines will be developed as part of the Project: Doris, Madrid North, Madrid South, and Boston. Crown pillar recovery will occur at Doris, Madrid North and Boston. Doris, Madrid North, and Madrid South will mine within a portion of the taliks beneath Doris, Patch, and Wolverine lakes in the Doris Watershed. Groundwater within these taliks will be saline and is expected to seep into the underground mines. This inflow will be intercepted and conveyed to the marine environment, with the groundwater predicted to be recharged with water from the overlying lakes. This will remove these water quantities from the freshwater systems, which could affect lake levels and stream flows, and by extension, fish habitat. The Boston mine will remain in permafrost and is not expected to intercept taliks. Further, water withdrawn from Aimaokatalok Lake for domestic and industrial use at Boston will be treated and returned to the lake or its watershed, reducing the potential for effects on water quantity in this lake and its watershed.

2.1.2. SURFACE WATER QUALITY

The Project has the potential to affect freshwater surface water quality directly due to the discharge of treated water during operations and indirectly due to runoff of site and mine contact water and the use of explosives (i.e., nitrogen inputs) during the construction and operations phases (TMAC 2017). The direct discharge of treated water will only occur in western Aimaokatalok Lake during Boston operations and will be discharged in compliance with MDMER requirements.

Project infrastructure and activities that may cause indirect inputs to nearby freshwater during construction and operations include:

- mining activities at Boston, Madrid, and Doris sites;
- waste rock and ore storage;
- sediment and pollution control ponds;
- explosives storage and use;
- quarry crushing;
- fuel storage and fuelling stations;
- road construction and use; and
- tailings deposition and storage.

Changes to surface water quality in the Project lakes also have the potential to affect sediment quality and biological organisms such as primary producers, secondary producers, and fish.

2.2. MITIGATION OF POTENTIAL EFFECTS

TMAC has several management and monitoring plans that prevent or minimize potential effects to the freshwater environment (Table 2.2-1). To date, the water and air management practices outlined in the various plans have been effective in mitigating effects to the freshwater environment during the construction and operation of the Doris Mine; no effects to water, sediment, or aquatic life have been attributed to Project activities in any of the waterbodies monitored under the current Doris (TMAC 2016) and former Doris North (Rescan 2010) Aquatic Effects Monitoring Plans. Based on this success, similar mitigation measures will be adopted for the Madrid and Boston developments.

Table 2.2-1. TMAC Documents and Programs Related to the Aquatic Effects Monitoring Plan

Document Title	Relevance
Hope Bay Project Doris-Madrid Water Management Plan *Hope Bay Project Boston Water Management Plan*	Management of contact water from the site, TIA and underground
Hope Bay Project Air Quality Management Plan	Management of dust and air-borne emissions
Hope Bay Project Groundwater Management Plan	Management and minimization of groundwater inflow to the mine
Hope Bay Project Waste Rock and Ore and Mine Backfill Management Plan *Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site*	Management of waste rock and ore contact water
Hope Bay Project Domestic Wastewater Treatment Management Plan	Management of treated domestic wastewater discharge
Hope Bay Project Spill Contingency Plan	Spill response procedures to minimize spill effects
Hope Bay Project, Phase 2, Doris Tailings Impoundment Area - Operations, Maintenance, and Surveillance Manual *Hope Bay Project, Boston Tailings Management Area - Operations, Maintenance, and Surveillance Manual*	Management of treated TIA discharge
Quality Assurance and Quality Control Plan	Approved sampling practices
Hope Bay Project Hazardous Waste Management Plan	Describes proper handling, storage and disposal procedures for hazardous wastes
Hope Bay Project Non-Hazardous Waste Management Plan	Describes proper handling, storage and disposal procedures for non-hazardous wastes

The efficacy of the mitigation measures pertaining to aquatic effects outlined in the various Project management plans will be evaluated through this Plan. These management plans are continuously updated to reflect improvements to mitigation measures identified through the Plan implementation process.

Mitigation measures protective of aquatic life implemented at the Project are outlined in the Madrid-Boston FEIS and the Doris Project amendment and include:

- Sediment control measures for works in or near waterbodies and watercourses, such as use of silt fences or coconut matting at drainage points;
- Minimizing vegetation clearing;
- Implementation of erosion control measures, such as capping of soils exposed during construction activities with rock;
- Implementation of blasting restrictions near water outlined in DFO's *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998);
- Treatment of discharges where necessary to maintain compliance with MDMER and/or Water Licence discharge criteria;
- Screening of water intakes to prevent impingement or entrainment of fish;
- Construction of stream crossings in a manner that does not interfere with fish passage, constrict channel width, or reduce flows and in accordance with DFO recommendations;
- Reuse of water where possible and practical; and
- Minimizing groundwater inflows.

2.3. AEMP MONITORING COMPONENTS

The management and mitigation measures outlined above prevent or reduce the potential for, and magnitude of, effects to the freshwater environment. However, the potential remains for Project activities to affect aquatic habitat through changes to lake levels and stream flows, and changes to surface water quality from treated discharge to Aimaokatalok Lake and runoff to other lakes in the Project area. These potential Project contributions could affect other aquatic components such as sediment quality and the biota that reside in these freshwater systems. This, in combination with regulatory requirements and guidance, has informed the selection of aquatic components that will be monitored under this Plan.

2.3.1. Water Quantity

Changes to lake water levels and stream flows may affect the quantity and quality of fish habitat. Water levels and streams flows in Doris, Ogama, P.O., Patch, Wolverine, Imniagut, and Windy lakes and their outflows may decrease through permitted water use and if lake water moves into the groundwater to replace the talik water that has seeped into underground mines. If this occurs, lower water levels downstream in Little Roberts and Glenn lakes may occur. To confirm these potential effects are not greater than those predicted following mitigation, lake water levels and selected stream flows will be monitored and results will be compared to baseline information and FEIS predictions, and will be used to inform potential habitat offsetting under applicable Fisheries Authorizations.

2.3.2. Water Quality

Water quality in the Project lakes could be affected by point (treated discharge) and non-point (runoff) sources, and if concentrations of particular water quality variables increase above certain levels (e.g., CCME guidelines for the protection of aquatic life), aquatic life could be affected. Treated water discharged to Aimaokatalok Lake will meet MDMER discharge criteria, which will be confirmed by end-of-pipe monitoring prescribed under the MDMER. EEM water quality monitoring related to this treated discharge will be conducted in the Aimaokatalok Lake receiving environment as required under the MDMER (Environment Canada 2012; SOR/2002-222).

Runoff from Project activities is predicted to mainly affect Stickleback, Wolverine, and Aimaokatalok lakes during construction and operations (TMAC 2017), while Doris and Patch lakes are immediately proximal to Project infrastructure. Given this, water quality will be monitored in these lakes and results will be evaluated against CCME guidelines for the protection of aquatic life and assessed to determine if concentrations are increasing in these lakes due to Project activities.

2.3.3. Sediment Quality

Treated discharge and site runoff may contribute particulate matter and other constituents to the water of lakes near Project activities, and these may interact with the sediments where they could affect aquatic life if concentrations increase above a certain level. Sediment quality will therefore be monitored in the same lakes as water quality to determine if concentrations are increasing due to Project activities. All CCME sediment parameters will be evaluated to ensure that Project activities are not affecting freshwater life.

2.3.4. Phytoplankton Biomass

Treated discharge and site runoff may contribute nutrients to lakes near Project activities, and if particular nutrients (e.g., nitrogen and phosphorus) naturally limit primary production in these lakes, alteration of water quality could lead to increased primary production. Phytoplankton are the dominant primary producers in lakes, and phytoplankton biomass levels are estimated using the main photosynthetic pigment, chlorophyll *a*. Chlorophyll *a* concentrations will be measured in the same lakes as water and sediment quality to evaluate potential Project effects through nutrient inputs.

2.3.5. Benthic Invertebrates

Treated discharge and site runoff have the potential to contribute particulate matter and associated constituents to the waterbodies near the Project. This could affect the water and sediment chemistry, and potentially the health of benthic invertebrates (benthos) that are in contact with the water and sediments. As a result, benthos will be monitored as part of the AEMP program to determine if potential changes to water and sediment quality are affecting the benthic biota of lakes near the Project.

Under MDMER, a benthic invertebrate community study related to treated discharge will be required in Aimaokatalok Lake if the concentration of the discharge in the exposure area is greater than 1% at 100 m from the final discharge point (Schedule 5, subsection 9(1)(b)).

2.3.6. Fish

Treated discharge has the potential to affect fish populations by decreasing fish health and affecting the biological resources used by fish. Under MDMER, a fish population study related to treated discharge will be required in Aimaokatalok Lake if the concentration of the discharge in the exposure area is greater than 1% at 250 m from the final discharge point (Schedule 5, subsection 9(1)(a)). Further, MDMER requires fish tissue monitoring if the annual mean end-of-pipe total mercury (Hg) or total selenium (Se) concentrations in the treated discharge exceed 0.1 µg/L or 5 µg/L, respectively, or if a single concentration of total selenium exceeds 10 µg/L (Schedule 5, subsections 9(1)(c) and (d)). Should these studies be required, an appropriate monitoring program following sampling recommendations in the *Metal Mining Technical Guidance for Environmental Effects Monitoring* (Environment Canada 2012) will be developed in the MDMER First Study Design and carried forth under the Plan.

3. MONITORING

This chapter describes the study areas, monitoring schedule, sampling methods, analysis, and the quality assurance and quality control (QA/QC) procedures used to fulfil the objectives outlined in Section 1.1.

3.1. STUDY DESIGN

3.1.1. Study Areas

AEMP monitoring will be conducted in exposure lakes where Doris, Madrid, and Boston activities are most likely to occur. Monitoring will take place in Aimaokatalok, Doris, Patch, Stickleback, Windy, and Wolverine lakes (Figures 3.1-1a and 3.1-1b) as these lakes are adjacent to or downstream of most Project activities and the associated taliks in which mining will occur. Ogama, P.O., Imniagut, Glenn, and Little Roberts lakes will also be monitored for water level and ice thickness to verify predictions made in the Madrid-Boston FEIS (TMAC 2017) and to support applicable Fisheries Authorizations. Stream flows at select lake outflows will also be monitored to support applicable Fisheries Authorizations.

Doris Lake will continue to be monitored as in the approved Doris Aquatic Effects Monitoring Plan (TMAC 2016), since the nature of potential effects to this lake remain the same as those considered in the Doris Project amendment (TMAC 2015). Doris Lake monitoring, along with monitoring at Aimaokatalok, Patch, Stickleback, Wolverine, and Windy lakes will provide information needed to assess potential non-point-source aquatic effects related to the Project, including runoff and water drawdown. Ogama, P.O., Imniagut, Glenn, and Little Roberts lakes will be monitored specifically for potential effects related to water drawdown. Water, sediment, and biological communities will be sampled at the deep basins of each lake (Aimaokatalok [Aim-Deep], Stickleback, Wolverine, Patch, and Doris Lake) to characterize potential non-point-source effects and/or align with historical sampling locations (Figures 3.1-1a and 3.1-1b). An additional sampling location in Aimaokatalok Lake (Aim-West) downstream of the treated water discharge will also be monitored (Figure 3.1-1b).

Monitoring in Aimaokatalok Lake will also be aligned with MDMER requirements (SOR/2002-222) and EEM guidance (Environment Canada 2012) as sampling will be conducted within the near-field discharge exposure area (Aim-EEM) as predicted by the hydrodynamic mixing model results (TMAC 2017; Appendix V5-4E; Figure 3.1-1b).

Figure 3.1-1a
AEMP and MDMER EEM Study Areas, and MDMER EEM Replicate Stations, Northern Hope Bay Belt

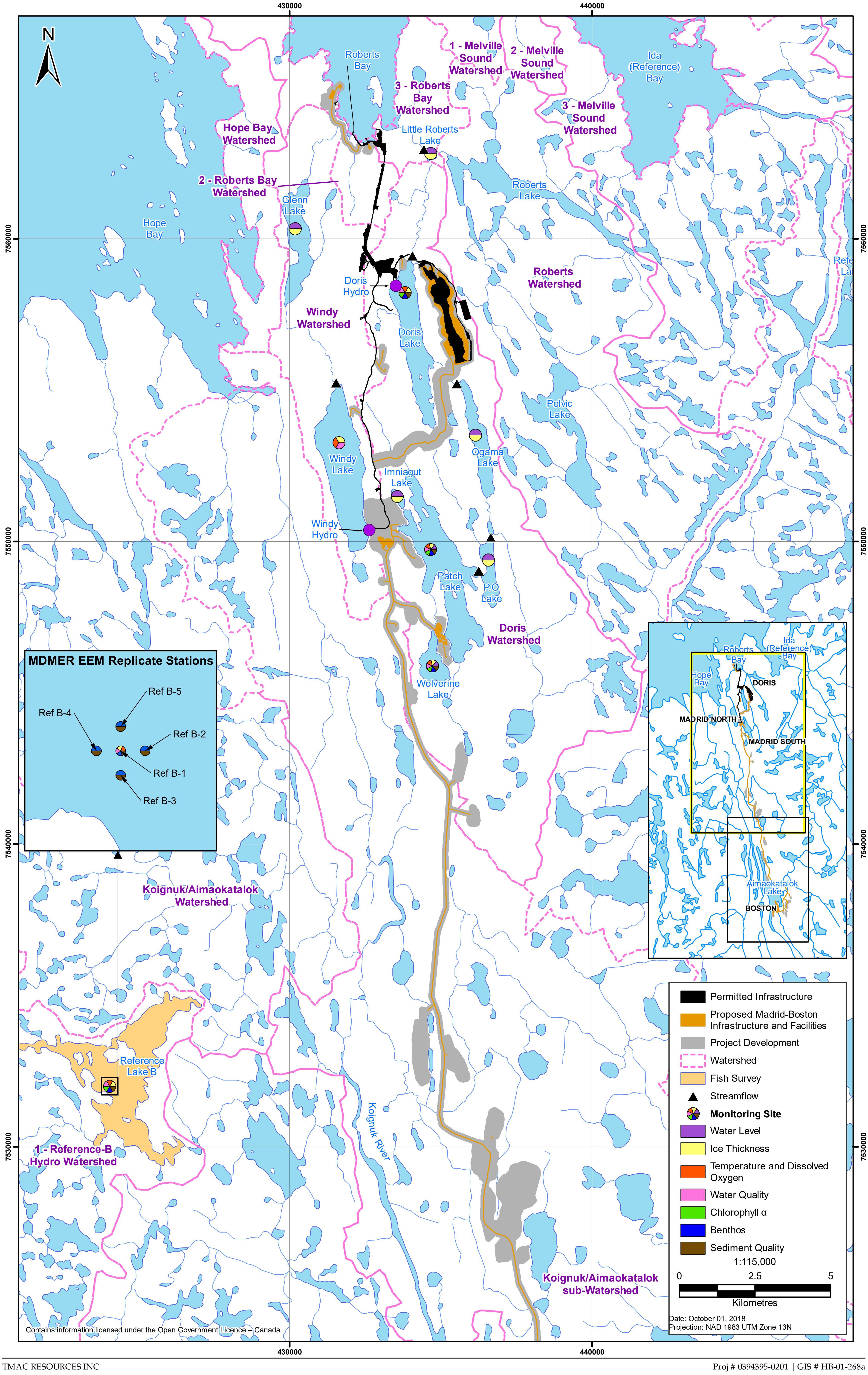
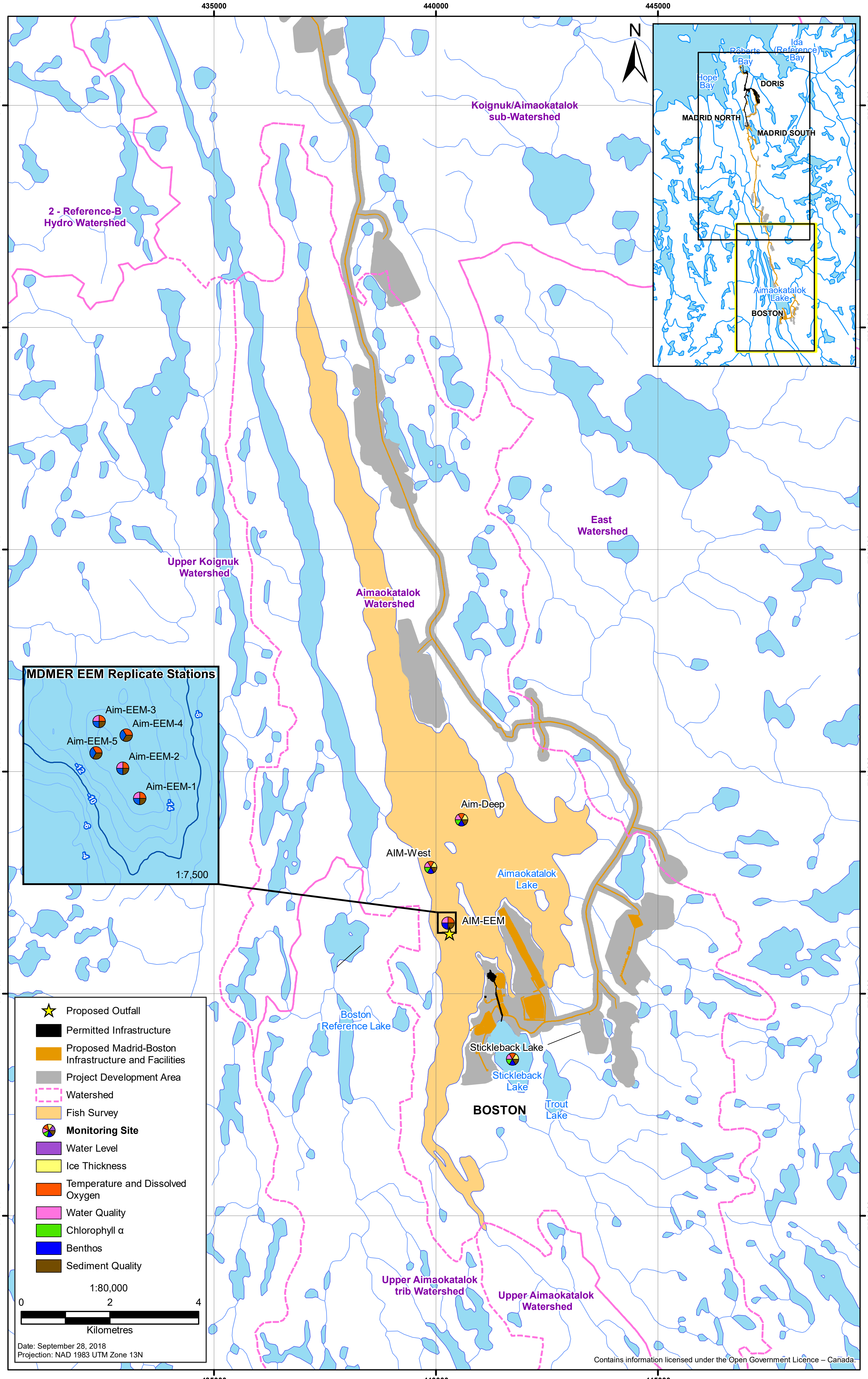


Figure 3.1-1b
AEMP and MDMER EEM Study Areas, and MDMER EEM Replicate Stations, Southern Hope Bay Belt



Monitoring for the AEMP and MDMER EEM will also occur in the deep basin of a reference lake (Reference Lake B) beyond the influence of Project activities. Reference Lake B has been sampled annually since 2009 using methods consistent with MDMER EEM guidance, and will provide information on regional changes that may be occurring in the aquatic environment (Figure 3.1-1a).

3.1.2. Monitoring Schedule

Aquatic effects monitoring components have been selected to address the potential Project effects as described in Section 2. Similarly, the monitoring schedule has been tailored to address the Project development and operational sequence, and is tied to periods during which Project effects may occur. Table 3.1-1 outlines the Project-specific monitoring triggers (such as water level changes, non-point-source inputs, and/or permitted discharge) that will initiate and drive the monitoring schedule.

Table 3.1-1. Study Area Descriptions and Monitoring Triggers

Watershed	Study Area	Description	Monitoring Trigger	Reason
Windy Watershed	Windy Lake	Windy hydrological monitoring station	Doris, Madrid North, and Madrid South Construction and Operations	Direct potable water withdrawal (increased accommodation at Doris)
	Glenn Lake	Accessible location near exposed bedrock	Doris, Madrid North, and Madrid South Construction and Operations	Indirect potable water withdrawal; downstream of Windy Lake
Doris Watershed	Wolverine Lake	Deep basin representative of lake and accessible location near exposed bedrock	Madrid South Construction and Operations	Groundwater inflows; Indirect inputs due to proximity
	Patch Lake	Deep area in center of lake representative of lake and accessible location near exposed bedrock	Madrid North and South Construction and Operations	Groundwater inflows; Indirect inputs due to proximity
	Imniagut	Accessible location near exposed bedrock	Madrid North and South Operations	Groundwater inflows
	P.O. Lake	Accessible location near exposed bedrock	Madrid North and South Operations	Groundwater inflows
	Ogama Lake	Accessible location near exposed bedrock	Madrid North and South Operations	Groundwater inflows
	Doris Lake	Deep basin representative of lake and Doris hydrological monitoring station	Doris, Madrid North, and Madrid South Construction and Operations	Direct water withdrawal; groundwater mine inflows; Indirect inputs due to proximity
			Boston Operations	Direct water withdrawal

Watershed	Study Area	Description	Monitoring Trigger	Reason
Doris Watershed *(cont'd)*	Little Roberts Lake	Accessible location near exposed bedrock	Doris, Madrid North, and Madrid South Construction and Operations	Indirect water withdrawal and mine inflows; downstream of Doris Lake
			Boston Operations	Indirect water withdrawal; downstream of Doris Lake
Aimaokatalok Watershed	Stickleback Lake	Deep basin representative of lake	Boston Construction and Operations	Indirect inputs due to proximity
	Aimaokatalok Lake – Deep (Aim-Deep)	Deep basin representative of lake	Boston Construction and Operations	Indirect inputs due to proximity
	Aimaokatalok Lake – West (Aim-West)	Basin in western Aimaokatalok Lake	Boston Construction and Operations	Permitted discharge
	Aimaokatalok Lake – EEM (Aim-EEM)	MDMER EEM sampling area	Discharge to Aimaokatalok Lake - MDMER	Permitted discharge
Reference	Reference Lake B	Deep basin representative of lake, reference area for AEMP and MDMER EEM programs	Doris, Madrid, and Boston Construction and Operations	Reference area for AEMP and MDMER EEM

During Madrid North construction and operations, Project activities have the potential to affect Windy and Glenn lakes (direct and indirect potable water use); Patch Lake (groundwater inflows and proximity); Imniagut, Ogama, and P.O. lakes (groundwater inflows); and Doris and Little Roberts lakes (direct and indirect water use and water loss to groundwater inflows). These lakes will be monitored during Madrid North construction and operations.

During Madrid South construction and operations, Project activities have the greatest potential to affect Wolverine and Patch lakes (groundwater inflows and proximity); Imniagut, Ogama, and P.O. lakes (groundwater inflows); Doris and Little Roberts lakes (direct and indirect water use and water loss to groundwater inflows); and Windy and Glenn lakes (direct and indirect potable water use). These lakes will be monitored during Madrid South construction and operations.

During Boston construction and operations, Stickleback Lake and Aimaokatalok Lake (Aim-Deep sampling area; Figure 3.1-1b) will be sampled for non-point source effects over the deepest section of the lakes. Following treated discharge to Aimaokatalok Lake, sampling will also be conducted at a near-field discharge exposure area (Aim-EEM; selected based on the hydrodynamic mixing model results (TMAC 2017; Appendix V5-4E)) and mid-field discharge exposure area (Aim-West).

The Doris Mine has been operating since late 2016 and has the potential to affect Doris Lake through its proximity to Project activities and future groundwater inflows to the mine. Doris Lake has been monitored annually under the Doris AEMP (formally the Doris North AEMP) since 2010.

The monitoring schedule and sampling frequency for each of the Plan's environmental monitoring components are outlined in Table 3.1-2.

Table 3.1-2. Monitoring Schedule and Sampling Frequency

Monitoring Parameter	Schedule and Frequency
AEMP Program	
Water Level and Stream Flow	Continuous recording during open-water season or year round
Ice Thickness	Annually (April)
Temperature and Dissolved Oxygen Profile	2× per year (April, August)
Water Quality	2× per year (April, August)
Sediment Quality	once every 3 years (August)
Phytoplankton Biomass (as chlorophyll *a*)	Annually (August)
Benthic Invertebrates	once every 3 years (August)
MDMER EEM Program	
Temperature and Dissolved Oxygen Profile	4× per year (April, July, August, September)
Water Quality	4× per year (April, July, August, September)
Sediment Quality	once every 3 years, if benthic invertebrate monitoring is triggered by MDMER (August)
Benthic Invertebrates	once every 3 years, if triggered by MDMER (August)
Fish	once every 3 years, if triggered by MDMER (August)

Monitoring frequency outlined in this table applies to periods during which monitoring is triggered as outlined in Table 3.1-1.

For the AEMP, water levels at the monitored lake stations will be recorded year-round or during the open-water season (depending on the hydrometric station), and stream flows at select lake outflows will be monitored during the open-water season. Ice thickness will be measured at each AEMP lake station in April. Water quality and physical profiles of temperature and dissolved oxygen will be collected in April (under ice) and August (open water). Phytoplankton biomass (as chlorophyll *a*) sampling will be conducted annually in August and benthic invertebrate and sediment quality sampling will be conducted every three years during August. Sampling will be conducted on a similar schedule in Reference Lake B for all environmental components, except water level, which will not be monitored in the lake.

MDMER EEM monitoring will be conducted in Aimaokatalok Lake and Reference Lake B. MDMER-related water quality sampling and physical profiling will occur four times per year (in April, July, August, and

September), while MDMER-related sediment quality and benthic invertebrates will be sampled every three years if benthic invertebrate sampling is triggered by MDMER requirements. Fish sampling will also be conducted every three years if triggered by MDMER requirements.

This Plan has been developed with a focus on construction and operations phases. The Plan will be re-evaluated prior to closure to determine the appropriate closure monitoring, and monitoring under temporary closure (care and maintenance) will be re-evaluated with interested parties if TMAC enters this phase. EEM monitoring will continue in Aimaokatalok Lake and Reference Lake B as required by MDMER.

3.2. MONITORING COMPONENTS AND EFFECTS ANALYSIS

The sampling program will include the collection of water level, stream flow, ice thickness, physical limnology, water quality, sediment quality, phytoplankton biomass (as chlorophyll *a*), and benthic invertebrate data. Fish and benthic invertebrates in Aimaokatalok Lake and Reference Lake B will be also be monitored as per MDMER requirements (Schedule 5, section 9). A summary of the AEMP and MDMER EEM sampling is presented in Table 3.2-1.

3.2.1. Water Level, Stream Flow, and Ice Thickness

The objectives of the lake level, stream flow, and ice thickness monitoring are to confirm the water loss predictions from the Madrid-Boston FEIS and to inform potential fisheries offsetting under applicable Fisheries Authorizations. Lake level and stream flow monitoring stations could be de-activated in the future if the modelling predictions are validated and fisheries offsetting measures are carried forth.

Methods

Lake water levels will be measured continuously year-round in Doris Lake and during the open-water season (approximately June to October) at Windy, Glenn, Patch, Imniagut, Ogama, P.O., Little Roberts, and Wolverine lakes (Figure 3.1-1a, Table 3.2-1). A pressure transducer paired with a data logger will be installed in each lake, and data will be recorded in 15-minute intervals and downloaded either monthly (Doris Lake) or a minimum of semi-annually (remaining stations). The water surface will be surveyed and tied to the monitoring station datum (either local or geodetic, as applicable).

Stream flow data will be collected at the outflows of Doris, Little Roberts, Windy, Patch, Ogama, and P.O. lakes. Manual flow measurements will be made throughout the open-water season and will be correlated with lake level measurements to develop station-specific rating curves at all flow monitoring stations. Rating curves allow the continuous lake level data to be converted to continuous stream flow data at the lake outflows. Rating curve equations will be developed using standard methods outlined by the International Organization for Standardization (ISO 2010). Once developed, a minimum of three sets of manual stream flow measurements will be made annually, spread across the open water season, to cover high and low flow periods.

Table 3.2-1. AEMP and MDMER EEM Sampling Details, Hope Bay Project

Monitoring Parameter	Lakes Sampled	# of Sampling Areas/Lake	# of Replicate Stations/Area	Depths Sampled	# of Field Subsamples/Replicate Station	Sampling Device
AEMP Program						
Water Level and Stream Flow (* lake level only)	Doris Glenn* Imniagut* Little Roberts Ogama Patch P.O. Windy Wolverine*	1	N/A	N/A	N/A	Transducer, data logger, current meter
Ice Thickness	Aimaokatalok (Deep and West sampling areas) Doris Glenn Imniagut Little Roberts Ogama Patch P.O. Windy Wolverine Stickleback Reference Lake B	2 in Aimaokatalok, 1 in other lakes	1	N/A	1	Manual measurement with metred rod
Temperature and Dissolved Oxygen Profile, Secchi depth	Aimaokatalok (Deep and West sampling areas) Doris Patch Stickleback Windy Wolverine Reference B	2 in Aimaokatalok, 1 in other lakes	1	Entire water column	1	Temp-DO meter; Secchi disk

Monitoring Parameter	Lakes Sampled	# of Sampling Areas/Lake	# of Replicate Stations/Area	Depths Sampled	# of Field Subsamples/Replicate Station	Sampling Device
Water Quality	Aimaokatalok (Deep and West sampling areas) Doris Patch Stickleback Windy Wolverine Reference B	2 in Aimaokatalok, 1 in other lakes	1	1 m below surface at all sites; additional sample at 2 m above water-sediment interface in deeper sites (> 6 m depth)	n=2 at 1 m below the surface at the shallow lakes (Stickleback and Wolverine); n=1 to 2 at each depth in deeper (> 6 m depth) lakes (target of 10% replication), discrete samples	GO-FLO or Niskin sampling bottle
Sediment Quality	Aimaokatalok (Deep and West sampling areas) Doris Patch Stickleback Wolverine Reference B	2 in Aimaokatalok, 1 in other lakes	3	Lake bottom	1	Ekman grab
Phytoplankton biomass (chlorophyll *a*)	Aimaokatalok (Deep and West sampling areas) Doris Patch Stickleback Wolverine Reference B	2 in Aimaokatalok, 1 in other lakes	1	1 m below the surface	3 discrete samples	GO-FLO or Niskin sampling bottle
Benthic Invertebrate Density and Taxonomy	Aimaokatalok (Deep and West sampling areas) Doris Patch Stickleback Wolverine Reference B	2 in Aimaokatalok, 1 in other lakes	5	Lake bottom	3 samples pooled in the field	Ekman grab; 500 µm sieve

Monitoring Parameter	Lakes Sampled	# of Sampling Areas/Lake	# of Replicate Stations/Area	Depths Sampled	# of Field Subsamples/Replicate Station	Sampling Device
MDMER EEM Program						
Temperature and Dissolved Oxygen Profile, Secchi depth	Aimaokatalok (EEM) Reference B	1	5 in Aimaokatalok, 1 in Reference B	Entire water column	1	Temp-DO meter; Secchi disk
Water Quality	Aimaokatalok (EEM) Reference B	1	3 in Aimaokatalok, 1 in Reference B	1 m below the surface and 2 m above water-sediment interface	1 to 2 at each depth (target of 10% replication), discrete samples	GO-FLO sampling bottle
Sediment Quality (if benthic invertebrate sampling is required under MDMER)	Aimaokatalok (EEM) Reference B	1	5	Lake bottom	1	Ekman grab
Benthic Invertebrate Density and Taxonomy (if required under MDMER)	Aimaokatalok (EEM) Reference B	1	5	Lake bottom	3 subsamples pooled in the field	Ekman grab; 500 µm sieve
Fish Population and Tissue (if required under MDMER)	Aimaokatalok Reference B	N/A	N/A	N/A	Ninespine Stickleback n=60 fish/lake (20 male/20 female/20 immature); including 8 fish/site same sex/size for tissue metals sex/size† Lake Trout: 100 fish/lake†	Sinking and Floating Gill Nets, Beach Seine, Minnow Traps

Notes:
N/A = Not applicable
† Samples sizes indicated are from Environment Canada (2012) but these may not be attainable in Arctic lakes.

Discrete under-ice lake level measurements will also be collected in April at Patch, Imniagut, Ogama, P.O., Windy, Glenn, Little Roberts, and Wolverine lakes. The water surface will be surveyed through an augured hole and tied to the monitoring station bench marks. The survey will be performed using a Real Time Kinematic (RTK) system, total station, or rod and level depending on field conditions at each monitoring station. The lake bottom depth will also be measured using a depth sounder or a weighted, metred line.

Ice thickness measurements will be taken once each year in April concurrent with all lake level measurements and water quality sampling. The measurement will be taken through an augured hole using a metred rod.

Effects Analysis

Water level and ice thickness data will be examined to determine if water level reductions in lakes within the Doris and Windy watersheds are consistent with predictions made in the Madrid-Boston FEIS. Results will inform potential offsetting under applicable Fisheries Authorizations in consultation with DFO, the KIA, and the Inuit Environmental Advisory Committee.

Quality Assurance and Quality Control (QA/QC)

The collection and analysis of water level and stream flow data will follow procedures outlined in the 2014 Hydrology Report (ERM Rescan 2014). A number of field- and desk-based procedures will be used to assess the reliability of data collected from the hydrometric station. Field QA/QC procedures will include following accepted water level surveying procedures and using stable benchmarks (such as bedrock).

Field crews will be trained to employ consistent methods for measuring ice thickness to ensure comparability of data.

3.2.2. Water Quality

The objectives of the AEMP water quality monitoring are to assess if Project activities are affecting the local freshwater environment, confirm the water quality predictions in the Madrid-Boston FEIS, confirm the water quality predictions from the near- and far-field plume mixing modelling exercises (e.g., TMAC 2017; Appendices V5-4B and V5-4E), and comply with MDMER EEM water quality monitoring requirements (Schedule 5, sections 7 and 8). The Plan harmonizes the AEMP and MDMER EEM by sampling water quality in Aimaokatalok Lake and Reference Lake B during the same periods and at similar depths for each program and using these data to jointly assess water quality in these lakes.

Methods

Water quality sampling will be conducted in April and August of each year at the AEMP stations in Aimaokatalok (Deep and West sites), Stickleback, Doris, Patch, Windy, and Wolverine lakes as well as Reference Lake B. All sampling will be conducted annually during the construction and operational phases of the Project, except in Windy Lake where water quality samples will be collected annually during construction and the first 2 years of operations to verify predictions under the FEIS (NWB Commitment #1; Technical Comment KIA-NWB-08). If the FEIS predictions are confirmed in Windy Lake, sampling will cease until future monitoring for the closure and post-closure phases is developed.

Water quality sampling will also be conducted in April, July, August, and September at the two MDMER EEM study areas (Aimaokatalok Lake (Aim-EEM) and Reference Lake B (Figures 3.1-1a and 3.1-1b and Table 3.2-1)), and will follow the recommendations of Environment Canada (2012). Water quality samples for the AEMP and MDMER EEM programs will be collected at the surface (1 m depth; 1 m below the ice in winter) at all lake sites and near the bottom at sites deeper than 6 m (2 m from sediments) using an acid-cleaned discrete sampling device (e.g., GO-FLO or Niskin). Duplicate samples will be collected at the shallow lake stations (Stickleback and Wolverine lakes) and replicate samples will be collected at 10% of the total deep station samples.

All water samples will be collected using laboratory-approved clean sampling bottles, with personnel wearing powder-free vinyl gloves. Samples will be preserved with the appropriate chemicals and properly labelled and stored. All samples will be sent to a Canadian Association for Laboratory Accreditation (CALA)-certified analytical laboratory for analysis of the water quality variables listed in Table 3.2-2 (except temperature and dissolved oxygen which will be field-measured). Water quality samples collected from MDMER EEM sampling areas (Aim-EEM and Reference Lake B) will be analyzed for total cyanide and radium-226 as required under the MDMER (Schedule 5, subsection (7)(d)). Total and free cyanide will also be monitored at three AEMP sampling areas: Aim-Deep and Aim-West in Aimaokatalok Lake and Reference Lake B (Technical Comment KIA-NIRB-19).

Table 3.2-2. Water Quality Variables

Variable	Variable
Physical Tests	**Total Metals** *(cont'd)*
Conductivity[b]	Calcium (Ca)
Dissolved Oxygen (Field-measured) [a,b]	Cesium (Cs)
Hardness (as $CaCO_3$)[b]	Chromium (Cr)[a,b]
pH[a,b]	Cobalt (Co)[b]
Temperature (Field-measured) [a,b]	Copper (Cu)[a,b]
Total Suspended Solids[a,b]	Gallium (Ga)
Turbidity[a]	Iron (Fe)[a,b]
Water Depth	Lead (Pb)[a,b]
Anions and Nutrients	Lithium (Li)
Alkalinity, Total (as $CaCO_3$)[b]	Magnesium (Mg)
Ammonia, Total (as N) [a,b]	Manganese (Mn)[b]
Bromide (Br)	Mercury (Hg)[a,b,d]
Chloride (Cl) [a,b]	Molybdenum (Mo)[a,b]
Fluoride (F) [a]	Nickel (Ni)[a,b]
Nitrate (as N) [a,b]	Phosphorus (P)
Nitrite (as N) [a]	Potassium (K)
Total Phosphorus[a,b]	Rhenium (Re)
Sulphate (SO_4)[b]	Rubidium (Rb)

Variable	Variable
Organic Carbon	Selenium (Se)[a,b]
Dissolved Organic Carbon	Silicon (Si)
Total Organic Carbon	Silver (Ag)[a]
Cyanides	Sodium (Na)
Free Cyanide[a,f]	Strontium (Sr)
Total Cyanide[b,e,f]	Tellurium (Te)
Radiological	Thallium (Tl)[a,b]
Radium-226[b,c,e]	Thorium (Th)
Total Metals	Tin (Sn)
Aluminum (Al)[a,b]	Titanium (Ti)
Antimony (Sb)	Tungsten (W)
Arsenic (As)[a,b]	Uranium (U)[a,b]
Barium (Ba)	Vanadium (V)
Beryllium (Be)	Yttrium (Y)
Bismuth (Bi)	Zinc (Zn)[b]
Boron (B)[a]	Zirconium (Zr)
Cadmium (Cd)[a,b]	**Dissolved Metals**
	Zinc (Zn)[a]

Notes:
Unless otherwise indicated, variables will be analyzed in a CALA-accredited laboratory using standard methods.
a Variables for which there are CCME water quality guidelines for the protection of aquatic life (CCME 2018b).
b Variables subject to EEM Water Quality Monitoring Study (MDMER, Schedule 5, subsection 7(1)(b) to (d)).
c Radium-226 monitoring in receiving waters will be discontinued if effluent monitoring test results show that end-of-pipe concentrations are less than 0.37 Bq/L for 10 consecutive weeks (MDMER, subsection 13(2)).
d Mercury monitoring in receiving waters may be discontinued if effluent monitoring test results show that end-of-pipe concentrations are less than 0.10 µg/L in 12 consecutive samples (MDMER, Schedule 5, subsection 4(4)).
e Total cyanide and radium-226 will be monitored at the MDMER EEM sampling areas (Aim-EEM and Reference Lake B).
f Total and free cyanide will be monitored at three AEMP sampling areas: Aim-Deep, Aim-West, and Reference Lake B.

Temperature and dissolved oxygen profiling will be conducted using a calibrated temperature-dissolved oxygen meter. Each open-water profile will extend from the surface to approximately 1 m above the sediment surface, with values recorded every 1 m. Under-ice profiling will begin just below the base of the ice layer (approximately 2 m) and will extend to 1 m above the sediments. All data will be recorded onto field sheets with the applicable meta-data such as date, time, personnel, weather, calibration data, and ice thickness measurements.

Analysis of Effects

For AEMP program sites, water quality variables with CCME guidelines will be evaluated for potential effects using qualitative (graphical) and quantitative (statistical) analysis methods. Profile data (temperature and dissolved oxygen) will be evaluated qualitatively. Non-CCME variables will be reported in the appendices of the annual AEMP report and could be evaluated for Project effects if warranted.

The statistical analysis of CCME water quality variables will employ either a before-after-control-impact (BACI) design or a trend analysis to assess potential Project-related effects based on the robustness of the temporal dataset for each lake. For a BACI design, 'before' data would include data collected before the start of construction and operations, while 'after' data would include data collected after the start of construction and operations. Reference Lake B would be the 'control' component and other monitoring sites would be the 'impact' components. The interaction between the 'before-after' and 'control-impact' terms is the BACI effect of interest. If sufficient years of data are available for a particular AEMP lake (based on examination of dataset by the program statistician), a trend analysis using LOESS (locally weighted smoothing) regression will be used as an alternative to the BACI design. In this instance, the trend in a water quality variable over time at an exposure lake will be compared to both a slope of zero and the trend at Reference Lake B to determine if there is evidence of a change over time and whether the change is also evident at the reference site. Potential effects will be assessed at a significance level of 0.05.

Results of the AEMP analysis of effects will be interpreted and adaptively managed within the context of a Response Framework (see Section 4) to detect and pre-empt adverse changes in water quality.

For the MMER EEM monitoring sites (Reference Lake B and discharge area in Aimaokatalok Lake), the water quality data will be reported in the appendices of the AEMP and will aid in the interpretation of the broader water quality and biology in Aimaokatalok Lake.

Quality Assurance and Quality Control (QA/QC)

Quality assurance measures will include the training of environmental staff who will carry out the sampling as well as QA/QC procedures such as using certified laboratories for water quality analyses and using lab-approved clean bottles and high quality preservatives. On-site quality control measures will include the use of chain-of-custody (CoCs) forms to track shipped samples and collecting travel blanks, field blanks, and replicate samples to assess potential sources of contamination and variability in the sampling program. The travel and field blanks are designed to identify sources of contamination during the collection and transportation of water samples, while replicate samples identify potential *in situ* variability within the sampling environment.

Rigorous QA/QC measures will be followed at the analytical laboratory and will include identifying holding time exceedances and using split samples and spiked samples (using certified standards) to track laboratory precision and ensure that data quality objectives are met.

3.2.3. Sediment Quality

The objectives of the AEMP sediment quality monitoring are to evaluate Project effects in nearby lake sediments, confirm the sediment quality predictions in the Madrid-Boston FEIS, assess the performance of sediment and erosion control measures near Project lakes, support the interpretation of water quality and biological monitoring results, and comply with MDMER EEM sediment quality monitoring requirements (Schedule 5, subsection 12(1)(e)). Sediment sampling under MDMER EEM is intended to support benthic invertebrate studies; therefore, sediments will only be sampled at the EEM sampling areas if a study of the benthic invertebrate community is triggered under Schedule 5, subsection 9(1)(b) of the MDMER. The Plan harmonizes the AEMP and MDMER EEM by sampling sediment quality in Aimaokatalok Lake and Reference Lake B in August every 3 years using similar methods and using these data to jointly assess sediment quality in these lakes.

Methods

Surficial sediment quality samples will be collected using an Ekman grab sampler and will be collected concurrently with benthic invertebrate sampling. Three replicate samples will be collected from each AEMP sampling area (Aimaokatalok [Aim-Deep and Aim-West], Doris, Patch, Stickleback, and Wolverine lakes; Figures 3.1-1a and 3.1-1b and Table 3.2-1) as has been done historically, and five replicates will be collected from each MDMER EEM sampling area (Aim-EEM and Reference Lake B; Figures 3.1-1a and 3.1-1b and Table 3.2-1). Each sediment sample will be carefully transferred onto a plastic tray, and the top 2 to 3 cm of sediment will be removed and homogenized in a plastic bowl using a plastic spoon and placed into two containers: one for particle size and one for sediment chemistry. All samples will be kept cool and sent to an accredited analytical laboratory within the appropriate holding times.

Samples will be analyzed for the sediment quality variables outlined in Table 3.2-3.

Table 3.2-3. Sediment Quality Variables

Variable	Variable
Physical and Nutrients	**Total Metals** *(cont'd)*
% Moisture	Lithium (Li)
pH	Magnesium (Mg)
Particle Size[b]	Manganese (Mn)
Total Nitrogen	Mercury (Hg)[a]
Total Organic Carbon[b]	Molybdenum (Mo)
Total Metals	Nickel (Ni)
Aluminum (Al)	Phosphorus (P)
Antimony (Sb)	Potassium (K)
Arsenic (As) [a]	Selenium (Se)
Barium (Ba)	Silver (Ag)
Beryllium (Be)	Sodium (Na)
Bismuth (Bi)	Strontium (Sr)
Boron (B)	Sulphur (S)
Cadmium (Cd) [a]	Thallium (Tl)
Calcium (Ca)	Tin (Sn)
Chromium (Cr) [a]	Titanium (Ti)
Cobalt (Co)	Uranium (U)
Copper (Cu) [a]	Vanadium (V)
Iron (Fe)	Zinc (Zn) [a]
Lead (Pb) [a]	

[a] *Variables for which there are CCME sediment quality guidelines for the protection of aquatic life (CCME 2018a).*
[b] *required for EEM benthic invertebrate survey*

Analysis of Effects

For the AEMP monitoring stations, sediment quality variables that have CCME guidelines will be evaluated for potential Project-related effects using graphical analysis as well as a BACI or trend analysis as described for water quality. Results of the AEMP analysis of effects will be interpreted and adaptively managed within the context of a Response Framework (see Section 4) to detect and pre-empt potential adverse changes in sediment quality. Non-CCME variables will be reported in the appendices of the annual AEMP report and could be evaluated for Project effects if warranted.

For the MDMER EEM monitoring stations (the exposure and control areas in Aimaokatalok Lake), the sediment quality data will be reported in the appendices of the AEMP and will aid in the interpretation of the broader water quality and biology in Aimaokatalok Lake.

Quality Assurance and Quality Control

The QA/QC program for sediment quality sampling will include the collection of replicates to account for within-site variability and the use of CoC forms to track samples. Rigorous QA/QC will be followed at the analytical laboratory to ensure that data quality objectives are met.

3.2.4. Phytoplankton Biomass (as chlorophyll *a*)

The objective of the AEMP phytoplankton biomass monitoring is to assess the trophic status of the Project lakes that could be affected by nutrient inputs from point-source discharge and non-point source runoff.

Methods

Triplicate samples will be collected for phytoplankton biomass (as chlorophyll *a*) at the AEMP stations (Figures 3.1-1a and 3.1-1b; Table 3.2-1) from 1-m depth using a discrete sampling device. Each replicate sample will be collected in a foil-wrapped bottle and filtered onto a 0.45 µm filter. The volume of water filtered will be recorded, the filter frozen, and samples sent to a laboratory for analysis of chlorophyll *a*.

Analysis of Effects

Potential changes in phytoplankton biomass will be evaluated using qualitative (graphical) analysis and a BACI or trend analysis similar to that described for water quality, with chlorophyll *a* as the response variable. Results of the analysis of effects will be interpreted and adaptively managed within the context of a Response Framework (see Section 4).

Quality Assurance and Quality Control

The QA/QC program for chlorophyll *a* sampling will include collecting the water in a opaque bottle (to prevent further photosynthesis), keeping the filtered sample frozen at all times prior to analysis, collecting replicate samples, and using CoC forms to track sample shipment.

3.2.5. Benthic Invertebrates

The objectives of the AEMP benthic invertebrate monitoring are to determine if Project activities are affecting benthic invertebrate communities in nearby lakes, confirm the assessments in the Madrid-Boston FEIS, and comply with MDMER EEM benthic invertebrate monitoring requirements. Under

MDMER, a benthic invertebrate community study related to treated discharge will be required in Aimaokatalok Lake if the concentration of the discharge in the exposure area is greater than 1% at 100 m from the final discharge point (Schedule 5, subsection 9(1)(b)). The Plan harmonizes the AEMP and MDMER EEM by sampling benthic invertebrates in Aimaokatalok Lake and Reference Lake B in August every 3 years using similar methods for each program and using these data to jointly assess the abundance and diversity of benthic invertebrates in these lakes due to Project activities.

Monitoring of the benthic invertebrate community will follow the sampling recommendations in the *Metal Mining Technical Guidance for Environmental Effects Monitoring* (Environment Canada 2012), and the evaluation of effects will be based on the effects endpoints recommended in the MDMER (Schedule 5, subsection 12(1)).

Methods

Benthic invertebrates will be collected using an Ekman grab sampler. Five replicate samples will be collected from each AEMP sampling area (Aimaokatalok (Aim-Deep and Aim-West), Doris, Patch, Stickleback, and Wolverine lakes; Figure 3.1-1a and 3.1-1b and Table 3.2-1) and from each MDMER EEM sampling area (Aim-EEM and Reference Lake B; Figure 3.1-1b and Table 3.2-1). Each benthos replicate sample will consist of a composite of three pooled field subsamples. Each pooled sample will be sieved to 500 µm, preserved with formalin, and sent to a taxonomist for identification and enumeration. Benthos samples will be collected concurrently with the sediment quality samples.

Analysis of Effects

The benthos endpoints or indicators that will be evaluated include: total density, Simpson's evenness index, taxa richness, and Bray-Curtis similarity index. For the AEMP monitoring stations, potential changes in benthos indicators will be evaluated using graphical analysis as well as a BACI or trend analysis as described for water quality. Results of the AEMP analysis of effects will be interpreted and adaptively managed within the context of a Response Framework (see Section 4).

For the MDMER EEM sampling areas in Aimaokatalok Lake and Reference Lake B, potential changes in benthos indicators will be evaluated using graphical analysis as well as a BACI or trend analysis as described for water quality. The critical effects sizes given in the MDMER (Schedule 5, subsection 1(2)) and Environment Canada (2012) will be used to evaluate the magnitude of effects for benthos indicators. To confirm a discharge-related effect on benthos, there would need to be a similar type of effect (same direction from zero) found for the same benthos indicator in studies from two consecutive three-year phases of EEM biological monitoring (Environment Canada 2012).

Quality Assurance and Quality Control

The QA/QC program for benthos sampling will include the collection of subsamples and replicates to account for within-site variability and the use of CoC forms to track samples.

A re-sorting of randomly selected sample residues will be conducted by the taxonomist on a minimum of 10% of the benthos samples to determine the level of sorting efficiency. The criterion for an acceptable sorting will be that more than 90% of the total number of organisms will be recovered from the initial sort. The number of organisms initially recovered from the sample will be expressed as a percentage of the total number after the re-sort (total of initial and re-sort count). Any sample not meeting the 90% removal criterion will be re-sorted a third time.

3.2.6. Fish

The objective of the EEM fish population monitoring is to comply with MDMER fish monitoring requirements if such a study is triggered (fish population and/or fish tissue). Under MDMER, a fish population study related to treated discharge will be required in Aimaokatalok Lake if the concentration of the discharge in the exposure area is greater than 1% at 250 m from the final discharge point (Schedule 5, subsection 9(1)(a)). Further, MDMER requires fish tissue monitoring if the annual mean end-of-pipe total mercury (Hg) or total selenium (Se) concentrations in the treated discharge exceed 0.1 µg/L or 5 µg/L, respectively, or if a single concentration of total selenium exceeds 10 µg/L (Schedule 5, subsections 9(1)(c) and (d)).

If triggered, fish population surveys will be undertaken in Aimaokatalok Lake and Reference Lake B (reference area; Figures 3.1-1a and 3.1-1b) to determine if the treated discharge has affected fish abundance or biological status. A fish tissue survey will also be initiated in exposure and reference areas if triggered by mercury and/or selenium concentrations in the treated discharge at end-of-pipe. The objective of a fish tissue study would be to determine if fish in the exposure area are safe for human consumption.

<u>Methods</u>

Fish Population Survey

If triggered, fish monitoring will follow EEM guidance (Environment Canada 2012). Fish population and health sampling will be conducted on two target species, Lake Trout (*Salvelinus namaycush*) and Ninespine Stickleback (*Pungitius pungitius*), once every three years according to the schedule outlined in Table 3.1-2. Sampling will focus on Aimaokatalok Lake where point-source, treated discharge effects are most likely to be detected, and Reference Lake B where effects will not be present (Figure 3.1-1a and 3.1-1b).

Lake Trout are a large-bodied, long-lived species and thus highly susceptible to long-term population level effects from lethal sampling. To avoid any negative effects on population size and structure, non-lethal biological sampling will be employed for Lake Trout. Non-lethal sample sizes of up to 100 adults are recommended for each site (Environment Canada 2012); however, it is recognized that this may not always be attainable for Lake Trout in northern waterbodies. Lethal sampling will be employed on the small-bodied, short-lived, Ninespine Stickleback. The objective will be to collect data from 20 mature male, 20 mature female, and 20 juvenile Ninespine Stickleback from each lake. EEM guidance suggests that greater numbers of juvenile small-bodied fish be captured for a robust analysis of age; however, a minimum of 60 lethal samples of Ninespine Stickleback may also be unattainable in some Arctic lakes. The EEM guidance document recognizes that this number samples is unlikely to be caught in many waterbodies (Environment Canada 2012).

Fish population and health surveys will take place every three years in August using gillnets for Lake Trout, and beach seines and minnow trapping for Ninespine Stickleback. Sampling locations will be determined randomly and conducted throughout each lake to collect fish of all species and determine an unbiased catch-per-unit-effort (CPUE) within lakes. To meet power requirements with the low sample sizes, individual fish selected for tissue metal sampling should be of the same sex and approximate size (Environment Canada 2012). Therefore, if random sampling does not result in sufficient sample size to meet these requirements, additional sampling may be conducted using targeted methods. For example, sampling for Ninespine Stickleback may be conducted at a specific area of the lake, or a single gillnet mesh size may be used to capture Lake Trout of a certain size. CPUE for these methods will be recorded separately so as not to bias the results of the random sampling.

Survival, growth, reproductive, and condition parameters will be collected from the fish and compared between sites and over time to properly assess changes in fish populations and health over the life of the mine. Lethal sampling of Ninespine Stickleback will measure and assess all the biological variables and effects endpoints listed in Table 3.2-4, while only a subset of variables will be assessed from non-lethal sampling of Lake Trout.

Table 3.2-4. Fish Biological Variables and Effects Endpoints

Effects Endpoints	Biological variables	Lake Trout	Ninespine Stickleback
Survival	Age frequency	X	X
	Length frequency	X	X
Growth	Length at age	X	X
	Weight at age	X	X
Condition	Body weight at length	X	X
	Liver weight at body weight		X
	DELT	X	X
Reproduction	Gonad weight at body weight		X
	Gonad weight at length		X
	Egg Size		X

The estimates of survival, growth, condition and reproduction will be based upon measurements conducted on individual fish. Live sampled fish will be identified to species, given a unique sample number, measured for fork length to the nearest 1 mm and weighed to the nearest 0.1 g using a calibrated electronic balance. Information on the external deformities, erosion, lesions, and tumours (DELTs) and pectoral fin rays and scale samples will be collected and placed in labeled envelopes. For lethally sampled fish (Ninespine Stickleback), each individual will be identified to species, given a unique sample number, measured for total length to the nearest 1 mm and weighed to the nearest 0.01 g using a calibrated electronic balance. Once dissected, livers will be weighed to the nearest 0.001 g. Because Ninespine Stickleback will be used for the reproductive endpoint, it is unlikely that the minimum of 100 eggs will be met to measure egg weight (Environment Canada 2012). As such, gonad weight (ripe ovary weight) and egg size will be used as variables for the reproductive endpoint (Table 3.2-4). Information on the internal and external DELTs, and pectoral fin rays and scale samples will be collected and placed in labeled envelopes. Ageing structures will be non-lethally sampled from Lake Trout by taking the first four pectoral fin rays. Otoliths will be removed from Ninespine Stickleback for ageing analysis.

Fish Tissue Survey

If triggered, fish tissue data will be incorporated into the fish health sampling program. Tissue samples from Lake Trout and Ninespine Stickleback will be collected and analyzed for metals and moisture content. For each species, a minimum of eight samples of the same sex and approximate body size will be collected from Aimaokatalok Lake and Reference Lake B (Environment Canada 2012) every three years in August. To avoid negative effects on population size and structure, non-lethal sampling using tissue plugs will be undertaken for Lake Trout. Tissue plugs will be collected from Lake Trout for analysis using methods developed by Baker et al. (2004), whereas Ninespine Stickleback will be sacrificed for whole-body tissue metal analysis.

Analysis of Effects

Descriptive summary statistics will be reported for all collected biological parameters. Potential effects to fish size (length and weight) and age will be determined using analysis of variance (ANOVA). All ANOVA assumptions will be met prior to analysis, including normally distributed populations, equal variances between populations, and sample independence. If populations or variances are unequal, the appropriate transformation will be applied before the ANOVA.

The remaining effects endpoints, except DELT, will be analyzed for statistical differences and interactions between the exposure and reference sites using analysis of covariance (ANCOVA). Assumptions of normality and constant variance will be met before an ANCOVA is applied. The assumption of equal regression slopes will also need to be met for relative fecundity to control for variability in weight. However, for most of the endpoints (excluding relative fecundity), the slope of the natural log of the dependent variable and covariate is the endpoint of interest (e.g., the slope of ln (weight) and ln(length) is condition). Thus, it is the differences in slope that indicates significant effect, and the assumption of equal regression slopes will not apply.

Potential differences in DELT characteristics between exposure and reference sites will be compared using the chi-squared (X^2) test.

For fish population and health endpoints, the critical effects sizes summarized in the MDMER (Schedule 5, subsection 1(2)) and Environment Canada (2012) will be used to evaluate the magnitude of effects. For fish tissue mercury concentration, an effect on fish usability is defined as a measurement of total mercury that exceeds 0.5 mg/kg wet weight of fish tissue taken from an exposure area and that is statistically different from and higher than the mercury concentration in fish tissue measured in a reference area (MDMER, Schedule 5, section 1). For fish tissue selenium concentration, there is no threshold concentration given in the MDMER; therefore, an effect on fish usability is defined as a concentration of selenium in fish tissue taken from an exposure area that is statistically different from and higher than the fish tissue selenium concentration measured in a reference area.

To confirm a discharge-related effect on fish population and health or fish tissue, there would need to be a similar type of effect (same direction from zero) found for the same endpoint in studies from two consecutive three-year phases of EEM biological monitoring (Environment Canada 2012).

Quality Assurance and Quality Control

QA/QC measures will be followed throughout the data, field, and laboratory phases. Data quality will be screened for entry errors and will be checked for outliers using the appropriate boxplot, residual plot or quantile-quantile plot. In the field, all personnel will have suitable expertise to conduct surveys and perform dissections. All standard operating procedures will be followed. Proper sampling gear (e.g., dissecting equipment) and methods (e.g., electrofishing) will be employed by personnel while in the field. All sampling information will be appropriately documented, preserved (as necessary), stored, and shipped. CoC forms will used to track all sample shipments.

Fish samples will be analyzed by accredited laboratories with trained staff. If sub-sampling is required (e.g., fecundity, egg size), efficiency and accuracy results of the technique must be documented and the information used to calculate appropriate correction or scaling factors to minimize potential differences in methods and efficiency. All records of lesions, parasites, and other deformities will be noted.

4. RESPONSE FRAMEWORK

4.1. BACKGROUND

Potential Project-related effects to the freshwater receiving environment will be adaptively managed through the implementation of a Response Framework, which links the results of the AEMP to management actions so that significant adverse effects can be avoided. The Response Framework is largely based on the concepts presented in the *Guidelines for Adaptive Management — a Response Framework for Aquatic Effects Monitoring* (WLWB 2010). The Response Framework is founded on the concept of comparing monitoring results to an 'action level', which is "*a magnitude of environmental change which […] triggers a management action"* (WLWB 2010). The Response Framework is the "*systematic approach to responding when the results of an aquatic effects monitoring program indicate that an action level has been reached" (WLWB 2010)*.

This framework was adapted from the Doris AEMP (TMAC 2016) that was reviewed and approved by the NWB, the Kitikmeot Inuit Association (KIA), the NIRB, Environment and Climate Change Canada (ECCC), Indigenous and Northern Affairs Canada (INAC), and Fisheries and Oceans Canada (DFO) during the Doris Project Type A Water Licence amendment process.

4.2. OBJECTIVES AND APPROACH

The overarching objective of the Response Framework is to protect the freshwater receiving environment in the Hope Bay Project area. The Response Framework acts as an early-warning system with defined action levels that trigger monitoring and/or management actions within an adequate timeframe so that significant adverse effects do not occur. The Response Framework consists of the following components:

- appropriate benchmarks and action levels such that Project-related environmental effects are investigated, and if necessary, mitigated, prior to any significant environmental effect occurring;
- a procedure by which Project-related environmental effects are assessed against defined action levels;

- a procedure for reporting exceedances of action levels;
- a procedure for developing Response Plans and proposing mitigation actions that may be implemented if action levels are exceeded; and
- a procedure for submitting Response Plans, and defining the process for reviewing and amending the Response Plans.

The Response Framework defines the process by which the results of the AEMP are compared to the benchmarks or triggers associated with pre-defined action levels, and the potential management responses initiated in response to reaching an action level. Figure 4.2-1 presents an overview of how the AEMP feeds into the Response Framework. The action levels used to screen the results of the AEMP are assigned the magnitudes 'low', 'medium', and 'high', which correspond to increasing magnitudes of effects to the aquatic environment, culminating in the exceedance of a 'significance threshold'. A significance threshold is defined as "*the magnitude of environmental change which, if reached, would result in significant adverse effects*" (WLWB 2010). Setting low, medium, and high action levels below the significance threshold requires that mitigative action (if necessary) is taken well before a significant threshold is reached, so that any potentially adverse trends are stopped or reversed by the implementation of management actions in response to exceedances of action levels.

4.3. SIGNIFICANCE THRESHOLDS

A significance threshold is a level of change in any monitored variable that would be unacceptable to reach because it would result in a significant adverse effect to the aquatic environment (WLWB 2010). The significance thresholds are specific to each component of the AEMP.

For water quality and/or sediment quality and/or phytoplankton biomass, the significance threshold is defined as:

- The water and/or sediments and/or phytoplankton biomass of the monitored lakes have changed in such a way that a healthy aquatic ecosystem can no longer be supported.

For benthic invertebrates, the significance threshold is defined as:

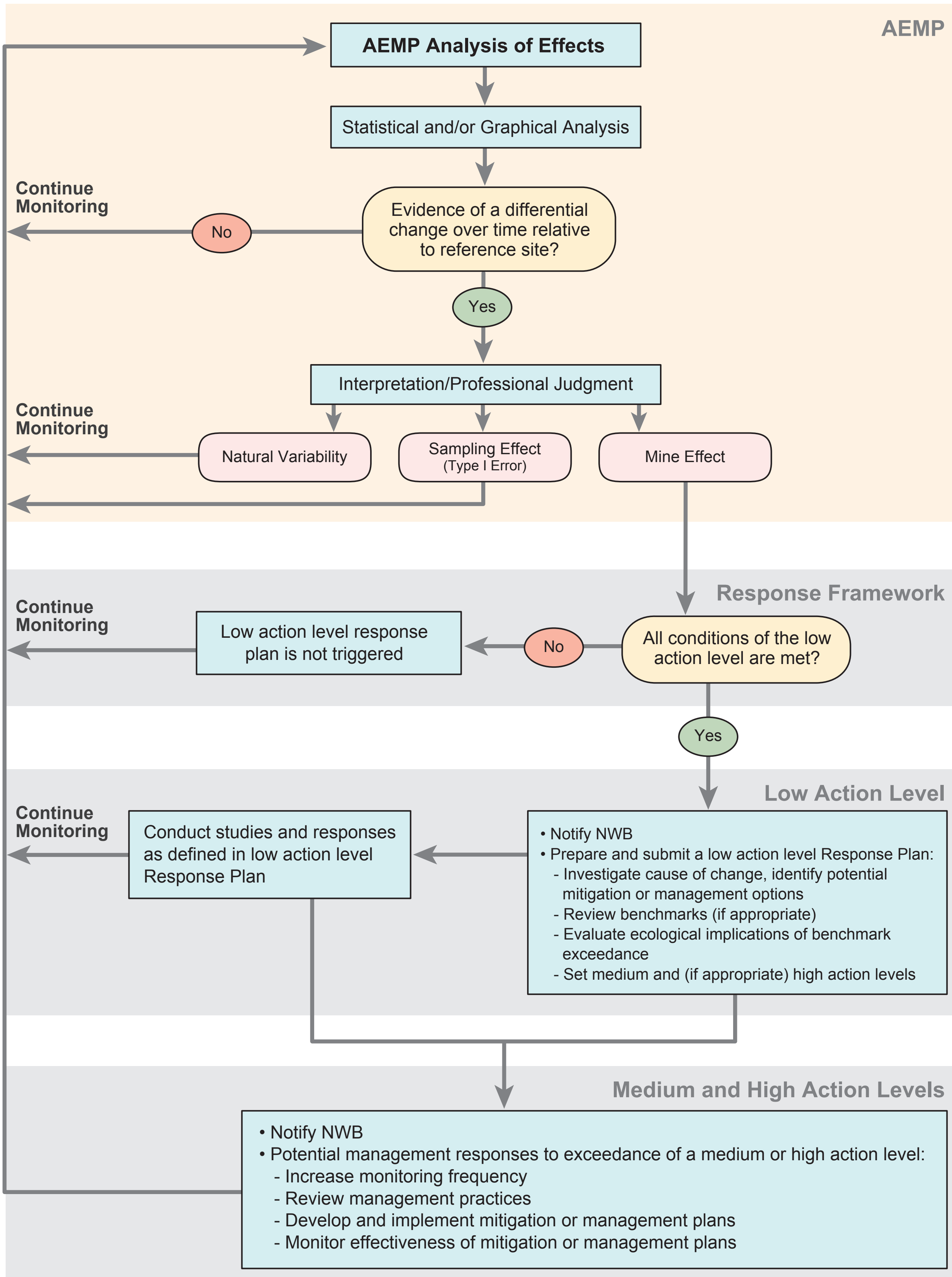
- The benthic invertebrates in the monitored lakes have changed in such a way that sufficient food for fish is no longer available.

4.4. ACTION LEVELS

The Response Framework includes three tiers of action levels: low, medium, and high. Low action levels are defined below for each monitored component. Medium and, if appropriate, high action levels will only be defined within the low action level Response Plan once the low action level is reached for any monitoring component (WLWB 2010). In some cases, the definition of the high action level may be deferred if specific and appropriate rationale is provided (e.g., additional research is required). The low action level for each monitored component is based on baseline data, and/or water or sediment quality guidelines, and/or recommended critical effects sizes for that component. Variation in monitored components within the normal baseline range, as defined by the data collected to date, will be considered negligible and will not trigger the low action level.

Figure 4.2-1

AEMP Analysis of Effects and Response Framework



4.4.1. Water Quality

The benchmarks used for water quality variables are the CCME water quality guidelines for the protection of aquatic life (CCME 2018b), presented in Table 4.4-1. Note that if the CCME guideline for a particular variable is updated after the submission of this Plan, the most up-to-date guideline will be used as a benchmark.

Table 4.4-1. Freshwater Water Quality Benchmarks

Indicator	Variable	Benchmark[a]
pH	pH	6.5 – 9.0 pH units
TSS	TSS	Maximum average increase of 5 mg/L from background (for clear-flow waters; long-term exposure)
Turbidity	Turbidity	Maximum average increase of 2 NTUs from background (for clear-flow waters; long-term exposure)
Dissolved Oxygen	Dissolved Oxygen	9.5 mg/L (cold-water biota: early life stages); 6.5 mg/L (cold-water biota: other life stages)
Anions	Chloride	120 mg/L (long term)
	Fluoride	0.12 mg/L
Nutrients	Total Ammonia as N	pH- and temperature-dependent[b]
	Nitrate as N	3 mg/L (long term)
	Nitrite as N	0.06 mg/L
Total Metals	Aluminum	0.005 mg/L (if pH < 6.5); 0.1 mg/L (if pH ≥ 6.5)
	Arsenic	0.005 mg/L
	Boron	1.5 mg/L
	Cadmium	0.00004 mg/L for hardness (as $CaCO_3$) of < 17 mg/L; $10^{(0.83[\log(\text{hardness})]-2.46)}$/1000 mg/L for hardness of ≥ 17 to ≤ 280 mg/L; 0.00037 mg/L for hardness of > 280 mg/L (long term)
Total Metals *(cont'd)*	Chromium	0.001 mg/L (hexavalent); 0.0089 mg/L (trivalent)
	Copper	0.002 mg/L for hardness (as $CaCO_3$) of <82 mg/L; $0.2 * e^{(0.8545[\ln(\text{hardness})]-1.465)}$/1000 mg/L for hardness of ≥ 82 to ≤ 180 mg/L; 0.004 mg/L for hardness of > 180 mg/L
	Iron	0.3 mg/L
	Lead	0.001 mg/L for hardness (as $CaCO_3$) of ≤60 mg/L; $e^{(1.273[\ln(\text{hardness})]-4.705)}$/1000 mg/L for hardness of > 60 to ≤ 180 mg/L; 0.007 mg/L for hardness of > 180 mg/L
	Mercury	0.000026 mg/L
	Molybdenum	0.073 mg/L
	Nickel	0.025 mg/L for hardness (as $CaCO_3$) of ≤60 mg/L; $e^{(0.76[\ln(\text{hardness})]+1.06)}$/1000 mg/L for hardness of > 60 to ≤ 180 mg/L; 0.15 mg/L for hardness of > 180 mg/L

Indicator	Variable	Benchmark[a]
	Selenium	0.001 mg/L
	Silver	0.00025 mg/L
	Thallium	0.0008 mg/L
	Uranium	0.015 mg/L
Dissolved Metals	Zinc	$e^{(0.947[\ln(hardness)]-0.815[pH]+0.398[\ln(DOC)]+4.625)}$/1000 mg/L for hardness of 23.4 to 399 mg/L, pH of 6.5 to 8.13, and DOC of 0.3 to 22.9 mg/L; 0.007 mg/L for hardness (as $CaCO_3$) of 50 mg/L, pH of 7.5, DOC of 0.5 mg/L
Cyanide	Free Cyanide	0.005 mg/L (as free cyanide)

Notes:
[a] Source: The Canadian Water Quality Guidelines for the Protection of Aquatic Life, Summary Table (CCME 2018b). Note that when multiple guidelines are given (e.g., short and long term), the most conservative (i.e., lowest) guideline is included in the table.
[b] The CCME guideline for total ammonia depends on pH and temperature. For circumneutral freshwater (pH 6.5 - 7.5) at conservative temperatures (15°C), the guideline for total ammonia as N is 1.83 to 18.1 mg/L.

For each assessed water quality variable, the following conditions must be met for an exceedance of the low action level:

1. identification of a statistically significant and potentially adverse change[1] from baseline conditions when assessing the results of the AEMP for that water quality variable; and
2. the concentration of the water quality variable is outside of the normal range based on baseline concentrations; and
3. the concentration of the water quality variable exceeds 75% percent of a water quality benchmark; and
4. the absence of a similar change at the reference location.

4.4.2. Sediment Quality

The benchmarks used for sediment quality variables are the CCME sediment quality guidelines for the protection of aquatic life (CCME 2018a), presented in Table 4.4-2. Note that if the CCME guideline for a particular variable is updated after the submission of this Plan, the most up-to-date guideline will be used as a benchmark. For each assessed sediment quality variable, the following conditions must be met for an exceedance of the low action level:

1. identification of a statistically significant increase in concentration from baseline conditions when assessing the results of the AEMP for that sediment quality variable; and
2. the concentration of the sediment quality variable is outside of the normal range based on baseline concentrations; and

[1] For most water quality constituents, only an increase would be considered a potentially adverse change; however, for dissolved oxygen concentration, only a decrease would be considered potentially adverse, and for pH, a change in either direction would be considered potentially adverse.

3. the concentration of the sediment quality variable exceeds 75% percent of a sediment quality benchmark; and
4. the absence of a similar change at the reference location.

Table 4.4-2. Freshwater Sediment Quality Benchmarks

Sediment Quality Variable	Benchmark[a] (mg/kg)	
	ISQG	PEL
Arsenic	5.90	17.0
Cadmium	0.60	3.50
Chromium	37.3	90.0
Copper	35.7	197
Lead	35.0	91.3
Mercury	0.170	0.486
Zinc	123	315

Notes:
ISQG = Interim Sediment Quality Guideline; PEL = Probable Effects Level
[a] Source: The Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Summary Table (CCME 2018a).

4.4.3. Phytoplankton Biomass (as Chlorophyll *a*)

All of the following conditions must be met for an exceedance of the low action level for chlorophyll *a* concentration:

1. identification of a statistically significant change from baseline conditions when assessing the results of the AEMP for chlorophyll *a*; and
2. the concentration of chlorophyll *a* is outside of the normal range based on baseline concentrations; and
3. the absence of a similar change at the reference location.

4.4.4. Benthic Invertebrates

All of the following conditions must be met for an exceedance of the low action level for benthos community indicators (i.e., total density, Simpson's evenness index, taxa richness, and Bray-Curtis similarity index):

1. identification of a statistically significant decrease from baseline conditions when assessing the results of the AEMP for benthic community indicators; and
2. the benthos indicator is less than the normal range based on baseline levels;
3. the absence of a similar decrease at the reference location; and
4. the magnitude of the decrease exceeds the critical effects size of ± 2 within-reference-area standard deviations (SD), as recommended by Environment Canada (2012).

4.5. RESPONSE PLANS

If a low action level is exceeded, a Response Plan will be developed that contains the following components:

- general description of the monitoring component or variable;
- determination or confirmation of the action level exceedance;
- likely cause(s) of the exceedance;
- ecological consequences of the exceedance;
- proposed monitoring and management responses;
- definition of medium and, if appropriate, high action levels; and
- a proposed schedule for responses and any additional reporting.

These Response Plans will be specific to the environmental variable for which a low action level response has been triggered.

4.5.1. Low Action Levels

For low action levels, the Response Plan will include the setting of medium and potentially high action levels. In some cases, the definition of the high action level may be deferred if specific and appropriate rationale is provided (e.g., additional research is required). Monitoring and management response actions for a low action level Response Plan will be largely investigative, and may include the following:

- an investigation to verify the source(s) of observed change;
- a comparison to predictions made in the evaluation of effects (TMAC 2015, 2017);
- the evaluation or confirmation of ecological relevance;
- increased monitoring frequency;
- the planning or initiation of an issue-specific information collection program or study to define the magnitude, spatial extent, and reversibility of the effect;
- a review of the water or sediment quality benchmark or development of a site-specific objective; or
- the identification of possible mitigation options.

If a likely cause can be identified, management responses for a low action level may include updates to best management practices or standard operating procedures to improve the mitigation or avoidance of the Project-related effect.

4.5.2. Medium and High Action Levels

The management response actions in medium or high action level Response Plans will usually involve greater intervention to reflect the increased risk of exceedance of significance thresholds. These plans will incorporate options identified during investigations when the low action level is exceeded.

Additional monitoring and management responses in medium and high action level Response Plans may include the following:

- an investigation to verify the causes(s) of observed change;
- investigation of mitigation options;
- increased monitoring frequency;
- monitoring additional aquatic components;
- further review of the water or sediment quality benchmarks or development of site-specific objectives;
- review and revision of facility water use and groundwater management practices to reduce water loss from Project lakes;
- selecting, planning for, and implementing a mitigation option such as modification of management plans, and/or modification of water and air quality management practices; or
- an assessment of the effectiveness of implemented mitigation options as part of the Response Plans for the variable in question.

4.6. CYCLICAL MONITORING AND REPORTING PROCESS

The environmental monitoring data collected through the AEMP will be fed into the Response Framework for assessment against action levels. The assessment will be conducted annually as part of the AEMP. If an action level exceedance is observed, a Response Plan will be prepared and submitted to the NWB along with the annual AEMP report or at a later date if approved by the NWB. Response Plans will also be reviewed and amended or updated as required.

5. REPORTING

5.1. ANNUAL AEMP REPORT

Following each AEMP monitoring year, an annual report will be prepared and submitted to the NWB by March 31 of the following year for distribution at their discretion. The annual report will include the following:

- All raw monitoring data obtained during that year of monitoring, including that collected under the MDMER EEM program in Aimaokatalok Lake;
- A summary of annual Project activities;
- Description of the methods used for data collection;
- Description of QA/QC measures and results;
- A detailed evaluation of effects on the monitored components and variables;
- Results from the evaluation of effects, in text and figures;
- Conclusions from the evaluation of effects; and

- Response plans as triggered through the Response Framework.

5.2. MDMER REPORTS

5.2.1. First Study Design Report

MDMER requires that a first study design be submitted to an authorization officer within 12 months of the mine becoming subject to MDMER (Schedule 5, section 10) and six months before biological monitoring is initiated (Schedule 5, subsection 11(1)). Once triggered, this report will contain:

- a site characterization;
- a description of how the study respecting the fish population will be conducted;
- a description of how the study respecting the fish tissue will be conducted;
- a description of how the study respecting the benthic invertebrate community will be conducted;
- a sampling schedule for the biological monitoring; and
- a description of the QA/QC measures that will be implemented to ensure the validity of the data collected.

5.2.2. Cycle 1 Interpretative EEM Report

Pursuant to Schedule 5, subsection 12(1) of the MDMER, the first interpretative report will be submitted within 36 months after the mine becomes subject to MDMER. Once triggered, this report will contain the following information:

- documentation of latitude and longitude of sampling areas and a sufficient description of sampling areas to allow proper identification;
- schedule of sample collection;
- sample sizes;
- the results of data assessment with appropriate statistical analyses and all supporting raw data;
- the identification of any biological effects;
- the conclusions of biological monitoring and water quality studies, taking into account any other potential factors not related to the treated discharge (anthropogenic or natural), and a description of QA/QC measures that were implemented;
- a description of how future study design for monitoring will be affected by the results; and
- the date when next biological EEM cycle will commence.

REFERENCES

1985. *Fisheries Act*, RSC, 1985, c F-14.

1988a. *Environmental Protection Act*, RSNWT (Nu) 1988, c E-7.

1988b. *Environmental Rights Act*, RSNWT (Nu) 1988, c 83 (Supp).

1993. *Nunavut Land Claims Agreement Act*, SC 1993, c 29.

Metal and Diamond Mining Effluent Regulations, SOR/2002-222.

Nunavut Waters Regulations, SOR/2013-69.

Baker, R. F., P. J. Blanchfield, M. J. Paterson, R. J. Flett, and L. Wesson. 2004. Evaluation of nonlethal methods for the analysis of mercury in fish tissue. *T Am Fish Soc*, 33: 568–76.

CCME. 2018a. Canadian Council of Ministers of the Environment. st-ts.ccme.ca/ (Canadian sediment quality guidelines for the protection of aquatic life: Summary table accessed January 2018).

CCME. 2018b. Canadian Council of Ministers of the Environment. st-ts.ccme.ca/ (Canadian water quality guidelines for the protection of aquatic life: Summary table accessed September 2018).

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. https://www.ec.gc.ca/esee-eem/default.asp?lang=En&n=AEC7C481-1 (accessed April 2018).

ERM Rescan. 2014. *Doris North Project: 2013 Hydrology Compliance Monitoring Report*. Prepared for TMAC Resources Inc. by ERM Rescan: Yellowknife, NT.

INAC. 2009. *Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories: Overview Report*. Indigenous and Northern Affairs Canada: Yellowknife, NT.

ISO. 2010. *Hydrometry - Measurement of liquid flow in open channels. Part 2: Determination of the stage discharge relationship, ISO 1100-2*. Third edition. International Organization for Standardization.

Rescan. 2010. *Doris North Gold Mine Project: Aquatic Effects Monitoring Plan*. Prepared for Hope Bay Mining Ltd. by Rescan Environmental Services Ltd. Feburary 2010: Vancouver, BC.

TMAC. 2015. *Revisions to TMAC Resources Inc. Amendment Application No. 1 of Project Certificate No. 003 and Water Licence 2AM-DOH1323. Available from the NIRB website at http://ftp.nirb.ca/03-MONITORING/05MN047-DORIS%20NORTH%20GOLD%20MINE/01-PROJECT%20CERTIFICATE/03-AMENDMENTS/AMENDMENT%20No.1/1-APPLICATION*.

TMAC. 2016. *Hope Bay Project: Doris Aquatic Effects Monitoring Plan*. Prepared by TMAC Resources Inc.: Toronto, ON.

TMAC. 2017. *Madrid-Boston Project Final Environmental Impact Statement*. TMAC Resources Inc.: Toronto, ON.

WLWB. 2010. *Guidelines for Adaptive Management - a Response Framework for Aquatic Effects Monitoring* Wek'èezhìi Land and Water Board: October 17, 2010.

Wright, D. G. and G. E. Hopky. 1998. *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters*. Catalogue number Fs97-6/2107. Department of Fisheries and Oceans: Winnipeg: MN.