TMAC Resources Inc.

HOPE BAY PROJECT

Proponent's Response to Technical Comments on the 2AM-BOS and 2AM-DOS1323 Water Licence Applications

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Proponent's Response to Technical Comments on the 2AM-BOS and 2AM-DOS1323 Water Licence Applications

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1.3 SUMMARY

During the review of the DEIS and FEIS, details on the Conceptual Fisheries Offsetting Plans have been requested to adequately assess whether habitat losses that will be incurred as a result of water withdrawal/use and infrastructure will be adequately compensated during offsetting to reach the conclusion of no residual effects to fish and fish habitat. To date, Conceptual Offsetting Plans lack potential habitat gain details (calculations) to determine whether offsetting will adequately compensate habitat losses due to water withdrawal/ use and infrastructure.

1.3.1 Importance of issue

It is important to understand whether the Fisheries Offsetting plan is sufficient to counterbalance the effects of habitat loss prior to water withdrawal/use and project infrastructure development. Thus, details on preliminary gain calculations for each potential offset option should be provided at this stage to understand the potential to offset habitat losses, especially due to water withdrawal/use prior to the issuance of a Type A Water Licence.

1.3.2 Detailed Review Comment

During the review of the DEIS and FEIS, technical comments were made requesting additional detail be provided in the Conceptual Offsetting Plans to sufficiently assess whether habitat losses as a result of water withdrawal/use and infrastructure would be adequately compensated by habitat gains through potential offset options. Both the Freshwater and Marine Conceptual Offsetting Plans only identify a procedural framework and potential offset options "should its development be deemed necessary by DFO". In response to the technical review comments made during the DEIS. TMAC committed to working as required with DFO and KIA to develop a freshwater and marine fisheries offsetting plan." Timeline – FEIS

During the review of the FEIS, details of the Fisheries Offsetting plans were not sufficient to assess whether offsetting would counterbalance the habitat losses outlined in the FEIS to conclude drawn regarding fish habitat loss in the FEIS. The conclusions of the FEIS stated:

- As a result of mitigation, balancing potential fisheries losses with fisheries offsetting, and monitoring plans there are no residual effects anticipated on the VEC freshwater fish habitat due to interaction with the Madrid-Boston Project infrastructure footprint; and
- "As a result of mitigation, balancing fisheries losses with fisheries offsetting, and monitoring plans there are no residual effects anticipated on the VEC freshwater fish habitat due to Madrid-Boston Project water withdrawal and use."

These technical issues would typically be addressed during the FEIS stage. However, to date, details on preliminary gain calculations for potential offset options have not been provided in the Conceptual Fisheries Offsetting Plans. The proponents have initiated discussion with DFO and the KIA (V5-6AB), but details on potential habitat gains are still lacking.

1.4 Recommendation/Request

TMAC should provide preliminary gain calculations for potential offsetting options, in communication with DFO and KIA, prior to issuance of a Type A Water Licence during the NWB Licensing phase to assess whether offsetting options have the potential to counterbalance habitat losses predicted during the EIS. A detailed Freshwater and Marine Fisheries Offsetting Plan could then be submitted during the permitting phase prior to DFO authorization (should it be deemed necessary by DFO).

1.5 TMAC Response to KIA-NWB-01

TMAC will work with DFO, the KIA and Inuit Environmental Advisory Committee to identify candidate offsetting options with a preference for developing a community-based offsetting program located near Cambridge Bay. Studies are planned for spring/summer 2018.

As described in Appendix V5-6AA, TMAC will work with DFO, the KIA and the IEAC to develop an offsetting plan that includes offsets commensurate with anticipated fisheries losses as part of regulatory processes. As indicated during the November 2017 meeting with DFO (refer to Appendix V5-6AB), TMAC is keen to investigate off-site community-based options for offsetting potential Project-related effects. Off-site, community-based offsetting can provide a broader range of benefits than just improvements to fisheries. TMAC is planning to identify potential offsetting options near Cambridge Bay during spring/summer 2018 which will provide the basis for calculating preliminary fisheries gains. TMAC's preference at this stage is to consider a Cambridge Bay-based project contributing to the overall objectives of the commercial Arctic Char fishery through the Arctic Char IFMP and/or to a subsistence fishery. TMAC will also consider the implementation of complementary measures (i.e., monetary contributions to existing research programs).

Estimated Fish Habitat Losses:

In advance of the selection of suitable offsetting options, fish habitat losses were calculated based on anticipated project activities, as summarized in Section 6.5 of the FEIS. Estimated fish habitat losses are reproduced in Table 1 below, based on the original Table 6.5-15 of the FEIS (Estimated PAD of Stream Fish Habitat from Water Withdrawal and Use for the Madrid-Boston Project). One correction from the FEIS was made and presented as a shaded cell in Table 1-1 reducing the total habitat losses of P.O. Outflow by 2,046 m^2 (only 16.7 m^2 of glide habitat is estimated to be lost, and not 2,063 m^2 as incorrectly reported in Table 6.5-15 of the FEIS where all cells (including year) had been summed).

Based on this correction, a total freshwater fish habitat area of 151,778 m^2 or 15.18 ha is predicted to be lost from the Madrid-Boston Project. Potential freshwater fish habitat loss in streams comprises 267 m^2 of in-water crossing footprints (culvert) and 2,131 m^2 (0.21 ha) resulting from anticipated water withdrawal/use and resultant drawdown. Streams predicted to be affected by culverts, are generally of low habitat value with only Ninespine Stickleback (fish that support CRA species) present. Only one crossing location, (representing 132 m^2) had moderate habitat value with Slimy Sculpin and Arctic Grayling present in addition to Ninespine Stickleback. For streams predicted to be affected by drawdown, habitat losses were conservatively predicted based on the maximum modelled drawdown over the life of the project despite drawdown generally only being temporary in most streams (14 of 22 project years) and maximum drawdowns only occurring over one to two years. Additionally, fish densities in these streams are low, ranging from <0.01 fish/m^2 to 2.3 fish/m^2 for Ninespine Stickleback and <0.01fish/m^2 to 0.10 fish/m^2 for Arctic Char (Doris Creek and Little Roberts Outflow only). Other large-bodied salmonids including Lake Trout, Lake Whitefish, and Cisco were occasionally captured but capture rates were too low to estimate density.

Potential freshwater fish habitat loss in lakes comprises 2,837 m^2 of in-water footprints (intakes/discharge infrastructure) and 146,543 m^2 resulting from anticipated water withdrawal/use and resultant drawdown in Imniagut Lake which contains only Ninespine Stickleback (fish that support CRA species); no large-bodied fish inhabit the lake likely due to its poor connectivity to Patch Lake, even during high flows.

In the Madrid-Boston Project FIES, a total marine fish habitat area of 9,675 m^2 or 0.97 ha is predicted to be lost resulting from the construction of the Roberts Bay Cargo Dock. Conversion of this fish habitat area loss to habitat equivalent units (HEU) using the habitat evaluation procedure (HEP) results in 4,766 HEU, although dock design and sizing remains to be finalized.

Table 1-1. Total Estimated PAD of Stream Habitat from Water Withdrawal and Use for the Madrid-Boston Project

Watershed	Stream	Total Stream Length (m)	Total Stream Area (m²)	Max. Reduction in Hope Bay Project-affected September Streamflow*			PAD (m²)					PAD (% of Total Stream Area)
				Streamflow (m³/s)	% Reduction from Baseline	Year	Glide	Pool	Riffle	Cascade	Total	
Doris	Imniagut Outflow◊	30	120	N/A	N/A	N/A	120.0	-	-	-	120.0	100
Doris	Patch Outflow	155	1,810	0.084	18.4	2031	19.6	52.0	-	-	71.6	4.0
Doris	P.O. Outflow§	39	402	0.105	15.6	2031	16.7	-	-	-	**16.7**	4.2
Doris	Ogama Inflow	998	7,636	0.306	6.0	2031	258.3	47.7	33.6	1.4	341.0	4.5
Doris	Ogama Outflow	1,276	13,551	0.273	6.9	2031	97.1	59.2	38.9	-	195.2	1.4
Doris	Doris Outflow	4,469	25,521	0.283	18.4	2031	786.8	93.8	20.6	144.1	1,045.2	4.1
Doris	Little Roberts Outflow	1,310	19,132	1.053	20.3	2031	218.2	93.4	18.6	-	330.2	1.7
Aimaokatalok	Stickleback Outflowᵻ	262	262	0.001	25.0	2031	61.1	4.3	-	-	65.4	25.0

PAD = Potential alteration to, or destruction of, fish habitat; calculated as reduction in channel top width estimated from hydraulic modeling multiplied by channel length

** maximum reduction of simulated September Hope Bay Project-affected streamflow compared to simulated September baseline streamflow during the life of the Madrid-Boston Project (i.e., Years 1 to 22)*

◊ No hydraulic model; PAD is equal to total habitat area

§ No hydraulic model; PAD estimated based on relationship between streamflow reduction from baseline and glide habitat loss in Patch Outflow (nearest upstream channel)

ᵻ No hydraulic model; PAD estimated as 25% of total habitat area)

The total combined freshwater and marine fish habitat loss area for the Madrid-Boston Project is therefore predicted to be 161,453 m^2 or 16.15 ha.

Fisheries Offsetting Precedence at the Hope Bay Project and in Nunavut:

To assess the potential feasibility for offsetting anticipated fisheries losses associated with the Madrid-Boston Project, consideration of the magnitude of predicted fish habitat losses from previously approved projects in Nunavut is warranted. Through the assessment, permitting, and development of the Doris North Project (part of the Hope Bay Project), losses of 76.657 ha of freshwater fish habitat and 0.176 ha of marine fish habitat were predicted and authorized (DFO Fisheries Authorizations NU-02-0117 and NU-02-0117.3), with compensation programs subsequently developed and undertaken (Golder 2007, ERM 2014, ERM 2016). Other projects in Nunavut, approved by the NIRB (i.e., Meadowbank, Meliadine, Mary River, and Back River), predicted freshwater and/or marine fish habitat losses during project-approval phases ranging from approximately 25 ha to over 300 ha (AEM 2012, AEM 2015, AEM 2016, Golder 2014, Baffinland 2012, Sabina 2015).

The predicted habitat area loss for the Madrid-Boston Project is equivalent to only 21% of the authorized loss of the Doris North Project, and between less than 5% and 65% of the habitat area losses predicted in the other approved projects across Nunavut provided as examples above. Therefore, predicted habitat losses from the Madrid-Boston Project are within an order of magnitude of (and up to 95% less than) those predicted for previously approved projects where offsetting commensurate with anticipated losses was considered technically feasible. In these cases there was limited concern that offsetting options would be unavailable or insufficient to counterbalance predicted habitat losses and projects were approved to proceed. There is thus precedence that a suitable offsetting plan may be developed to offset the predicted habitat losses associated with the Madrid-Boston Project, and within the framework of an EIS, offsetting is considered a suitable mitigation measure to prevent significant residual effects.

Preliminary gain calculations:

Multiple preliminary offsetting options were outlined in the Conceptual Fisheries Offsetting Plans submitted with the Madrid-Boston Project FEIS (Appendix V5-6AA and Appendix V5-10G). Given that TMAC's preference at this stage is to consider a Cambridge Bay-based project which seeks to enhance fish passage, preliminary habitat gain estimates and support that habitat gains associated with this option have the potential to counterbalance habitat losses predicted in the FEIS are described below.

Barrier Removal on Freshwater Creek, Kitiga Falls, or Other Rivers Identified

A proposed offsetting option identified in the FEIS includes enhancing fisheries productivity through removal of barriers (e.g., natural or anthropogenic) that prevent Arctic Char from reaching overwintering/spawning habitats in upstream lakes. A preliminary option proposed in the FEIS (refer to Appendix V5-6AA) included Freshwater Creek where a poorly-constructed culvert (UTM coordinates, Zone 13 N 503818E 7672034N) along the road from Cambridge Bay to Ovayok Territorial Park was identified as a potential barrier to fish passage; other permanently or temporarily (i.e., during low flows) compromised natural areas may also exist. Another potential option identified was along the Kitiga River where Kitiga Falls may pose a partial barrier to migration during low flows.

During spring/summer of 2018, TMAC will engage with the IEAC, KIA, and HTOs through meetings in Cambridge Bay to confirm preliminary offsetting site options and/or to identify other offsetting options. TMAC will undertake field surveys in summer 2018 to ground-truth offsetting options, and refine objectives, constraints, and opportunities associated with each site. These activities will contribute to preliminary gain calculations in support of the development of a Fisheries Offsetting Plan.

An offsetting program involving barrier removal was applied for the Doris North Project through the enhancement of migratory channels through a low flow barrier (i.e., boulder garden) in Roberts Outflow to allow Arctic Char and Lake Trout that were previously getting stranded in the boulder garden to reach spawning and overwintering habitat in upstream Roberts Lake. Offsetting accounting for this project involved quantifying the total HU for Arctic Char in Roberts Lake as habitat gains, based on the successful passage of Arctic Char to use those habitats. The success of barrier removal has been demonstrated at the Roberts Outflow over three post-enhancement monitoring years. Survival of Arctic Char passing through the migratory channel in Roberts Outflow (i.e., avoiding stranding) has been demonstrated to be approximately 50% to 55% greater than in pre-enhancement years at comparable stream discharge (ERM 2016). It is assumed that this increase in access to upstream habitats will be translated into increased fisheries productivity over time, and therefore will more than offset anticipated losses associated with the Doris North Project.

The total lake area of Roberts Lake is 383 ha. Grenier Lake, located upstream of Freshwater Creek has a total area of > 3,500 ha and Kitiga Lake located upstream of Kitiga Falls has a total area of > 10,000 ha. Given the size of the upstream lakes in the two stream systems proposed as offsetting options for the Madrid-Boston Project, it is conceivable that HU gains and increased fisheries productivity resulting from an increase in access by Arctic Char (or other migratory salmonids) to upstream lake habitats after the removal of fish passage barriers would offset the relatively small amount of habitat area predicted to be lost from proposed Madrid-Boston activities.

References:

AEM. 2012. Agnico Eagle Mines Meadowbank Division - No Net Loss Plan. October 15, 2012.

AEM. 2015. Agnico Eagle Mines Meadowbank Division - Fish Habitat Offsetting Plan: Phaser Lake. July, 2015.

AEM. 2016. Agnico Eagle Mines Meadowbank Division – Conceptual Fish Habitat Offsetting Plan: Whale Tail Pit. June 2016.

Baffinland. 2012. Mary River Project Environmental Impact Statement - Volume 10, Appendix 10D7: Fish Habitat Compensation Plan.

ERM. 2014. Doris North Project: 2014 Windy Lake Shoal Compliance Monitoring Program. Prepared for TMAC Resources Inc. by ERM Consultants Canada Ltd. Yellowknife, NT.

ERM. 2016. Doris North Project: 2015 Roberts Lake Fish Enhancement Monitoring Program. Prepared for TMAC Resources Inc. by ERM Consultants Canada Ltd.: Yellowknife, NT.

Golder. 2007. Doris North Project No Net Loss Plan. Prepared for Miramar Hope Bay Ltd. by Golder Associates Ltd. Edmonton, AB.

Golder. 2014. Conceptual Fisheries Protection and Offsetting Plan – Meliadine Gold Project, Nunavut. Prepared for Agnico Eagle Mines Ltd. by Golder Associates Ltd.

Sabina. 2015. Back River Project Conceptual Fish Offsetting Plan. November 2015.

2. KIA-NWB-02

2.1 Subject/Topic

Aquatic Effects Monitoring Plan (AEMP)

2.2 References

P4-18 Section 2.1, last paragraph

V5-S6S, 6.5.3.3

2.3 Summary

Include lake surface elevation monitoring in Imniagut, Glenn, Ogama and PO Lake in the Aquatic Effects Monitoring Plan (AEMP).

2.3.1 Importance of issue

As stated at the beginning of Section 2.1, P4-18, "The Madrid-Boston Project has the potential to affect surface water quantities by direct water withdrawal for site and processing (domestic and industrial) activities and through groundwater inflow into the underground mines." Monitoring lake water levels in all the lakes that may be affected by water withdrawal and underground mining is therefore important to estimate fish habitat losses that may develop during the project, and to inform adaptive water management and fish offsetting plans.

2.3.2 Detailed Review Comment

In Section 2.1, it is stated "To monitor potential effects of water withdrawal and groundwater removal on the surface water, lake water level monitoring will occur in Wolverine, Patch, Doris, Windy, and Aimaokatalok lakes." The list of mentioned lakes does not include Imniagut, Glenn, Ogama and PO Lake. These lakes are, however, included in the list of the lakes that may be affected directly by the Project through water withdrawal and use, or indirectly by changes in inflows from upstream lakes. As such, lake water level monitoring in these lakes should be added in the AEMP.

2.4 Recommendation/Request

Include lake surface elevation monitoring in Imniagut, Glenn, Ogama and PO Lake in the Aquatic Effects Monitoring Plan (AEMP).

2.5 TMAC RESPONSE TO KIA-NWB-02

In order to monitor potential effects of water withdrawal and groundwater removal on the surface water, TMAC will monitor water levels in fish bearing lakes that are predicted to be potentially impacted by the Project during mining. These include Wolverine, Imniagut, Patch, P.O., Ogama, Doris, Little Roberts, Glenn, Windy, and Aimaokatalok. Hydrometric monitoring will be carried out by standard methods appropriate for assessing changes in lake level (e.g., suitable combination of pressure sensors, staff gauges, and/or manual flow measurements in lakes and/or streams).

Monitoring requirements will be developed and submitted as part of a fisheries offsetting monitoring plan submitted with a Fisheries Authorization application. Similar to AEMP plans, TMAC intends to develop a framework that will include water level and flow thresholds that if reached, they will trigger low action levels resulting in the application of additional mitigation measures as deemed necessary. In this way, monitoring requirements relevant to fish and fish habitat will form part of conditions committed to during the regulatory phase following Project approval.

3. KIA-NWB-03

3.1 SUBJECT/TOPIC

Water Withdrawal PAD calculations

3.2 REFERENCES

P5-4 Hope Bay Water Load Balance Report

P4-18 Aquatic Effects Monitoring Plan;

V5-S6 Freshwater Fish Section 6.5.4.2

3.3 SUMMARY

Potential fish habitat losses (PAD) are calculated based on base case and not high groundwater sensitivity case scenarios. Adaptive mitigation, including additional offsetting should be indicated to compensate for the high groundwater sensitivity case should monitoring and subsequent habitat loss calculation indicate that the high sensitivity case is likely to be realized.

3.3.1 Importance of issue

It is important to compensate for the losses of fish habitat. If the FEIS is based on the base case groundwater scenario, the resulting areas of habitat loss (residual effects) will not take into account a high groundwater sensitivity case. Thus, it should be explicitly stated that adaptive management and additional offsetting would be applied in the case where a high groundwater sensitivity case is deemed likely through monitoring.

3.3.2 Detailed Review Comment

TMAC has indicated that potential habitat losses (PAD) in streams resulting from water withdrawal and use were calculated only for the base case scenario and not the high groundwater sensitivity case as this case is not anticipated until 2030. TMAC further indicates that the potential effects to fish habitat loss will be monitored on an ongoing basis and if data from these monitoring programs indicate that high groundwater sensitivity case is likely, appropriate measures to evaluate and quantify fish habitat losses under this case will be applied. However, it is also important that if these habitat loss numbers are greater than those reported in the FEIS are, additional offsetting will be implemented to compensate for these losses.

3.4 RECOMMENDATION/REQUEST

Please indicate whether additional mitigation through offsetting will be applied in, the case where high groundwater sensitivity is likely and habitat losses are greater than those reported in the FEIS are.

3.5 TMAC RESPONSE TO KIA-NWB-03

TMAC will apply adaptive management processes during monitoring. Should a high groundwater sensitivity case result in habitat losses that exceed those predicted for the base case, TMAC would apply an offsetting plan (as required by DFO) that is commensurate with these losses.

4. KIA-NWB-04

4.1 Subject/Topic

Arsenic Site-Specific Water Quality Objective

4.2 References

V5-S4. Table 4.5-2, Section 4.5.1.2.

Golder. 2017. Back River Project - Development of a Site-Specific Water Quality Objective for Arsenic.

Technical Memorandum Prepared for Sabina Gold & Silver Corporation by Golder Associates.

February 2017.

Hutchinson Environmental Sciences Ltd. 2018. Boston-Madrid Final Environmental Impact Statement and Water Licence Arsenic Site-Specific Water Quality Objective. Prepared for the Kitikmeot Inuit Association

4.3 Summary

The proponent has chosen long-term freshwater site-specific water quality objective for arsenic was incorrectly derived and is not sufficiently conservative for application to the Hope Bay belt-receiving environment.

4.3.1 Importance of issue

A more conservative SSWQO than that proposed in the Boston-Madrid FEIS highlights a diminished difference between the modeled changes resulting from the project and a change that would constitute a significant impact to the aquatic environment. This more limited operational flexibility underscores the need for robust environmental monitoring through the Aquatic Effects Monitoring Program (AEMP) and Surveillance Network Program (SNP) to ensure any changes to the aquatic environment are in line with those presented in the FEIS and any divergences are effectively adaptively managed in a timely manner.

4.3.2 Detailed Review Comment

The proponent has included non-resident species and chosen a less conservative statistical model to derive a long-term freshwater site-specific water quality objective (SSWQO) for arsenic for the Hope Bay belt. The proponent's approach has resulted in a proposed SSWQO of 0.028 mg/L for arsenic.

HESL has recalculated the arsenic SSWQO accounting for the concerns outlined in the accompanying technical memorandum. We have removed the amphibian species *Lithobates pipiens*, the Leopard Frog, from the derivation dataset and selected the resulting SSWQO from the model outputs based on a statistical determination of best fit and conservatism. HESL derived an arsenic SSWQO of 0.019 mg/L.

While HESL's SSWQO does not alter the conclusions as presented in the Boston-Madrid FEIS, it highlights a diminished difference between the modeled changes resulting from the project and a change that would constitute a significant impact to the aquatic environment. All modeled arsenic concentrations are below HESL's updated SSWQO. This more limited operational flexibility underscores the need for robust environmental monitoring through the Aquatic Effects Monitoring Program (AEMP) and Surveillance Network Program (SNP) to ensure any changes to the aquatic environment are in line with those presented in the FEIS and any divergences are effectively adaptively managed in a timely manner.

Please see "Hutchinson Environmental Sciences Ltd. 2018. Boston-Madrid Final Environmental Impact Statement and Water Licence Arsenic Site-Specific Water Quality Objective. Prepared for the Kitikmeot Inuit Association" for more details.

4.3.3 Recommendation/Request

HESL recommends that TMAC adopt a long-term total arsenic SSWQO of 0.019 mg/L for application throughout the freshwater environment of the Hope Bay belt. This objective was derived following accepted CCME protocols; considers newly generated, high quality, applicable toxicity data; and is sufficiently protective of the aquatic life in the Project area.

Please see "Hutchinson Environmental Sciences Ltd. 2018. Boston-Madrid Final Environmental Impact Statement and Water Licence Arsenic Site-Specific Water Quality Objective. Prepared for the Kitikmeot Inuit Association" for more details.

4.4 TMAC RESPONSE FOR KIA-NWB-04

TMAC has re-considered applying an SSWQO for arsenic at this early juncture of the Madrid-Boston Project. Instead, it will monitor potential changes to arsenic in the Project lakes through the AEMP. If arsenic levels increase significantly over time in a Project lake relative to the reference condition, or increase to 75% of the CCME water guideline, the development of an SSWQO could be considered as a medium or high action level response through the Aquatic Response Framework within the AEMP (including using the 0.0019 mg/L put forth by the KIA). TMAC re-considered this position because increases in arsenic above the CCME guideline are only predicted for Doris Creek for approximately one month per year during post closure and the maximum predicted concentrations for the rest of the Project lakes are less than 50% the CCME guideline (0.005 mg/L) during all

Project phases and are therefore safe for aquatic life. It is also likely the maximum arsenic concentrations in Doris Creek during post closure are overestimates because in the water quality modelling exercise (Annex V1-7, Package P5-4) conservatively routed TIA overflow directly to Doris Creek instead of northern Doris Lake (which is actual pathway) where arsenic would be diluted before flowing into Doris Creek. Nonetheless, from a water quality effects standpoint, the maximum arsenic concentration modelled in Doris Creek during post-closure (0.00999 mg/L), is far below the 0.019 mg/L arsenic SSWQO recommended by the KIA and using the assessment criteria outlined in Table 4.5-12 of the FEIS water quality assessment (Volume 5, Chapter 4) this would be considered an infrequent, low to moderate magnitude residual effect that will not result in significant effects in Doris Creek, and more broadly, through the Madrid-Boston Project area.

TMAC appreciates the KIA's information regarding the updated arsenic SSWQO of 0.0019 mg/L and will consider this value if an SSWQO is developed as part of the Aquatic Response Framework within the Madrid-Boston AEMP. This AEMP is currently being revised and will be provided to interested parties on April 27, 2018.

5. KIA-NWB-05

5.1.1 Subject/Topic

AEMP Water Quality Sampling Frequency

5.1.2 References

P4-18 Section 3.2.2

V5-S4 Section 4.5.4.2; Table 4.5-6

5.1.3 Summary

AEMP sampling frequency is not sufficient to assess predicted changes to water quality associated with effluent discharges into Aimaokatalok Lake as presented in the FEIS.

5.1.4 Importance of issue

Failure to collect samples during freshet will preclude confirmation of seasonally specific modeled changes to the aquatic environment as presented in the FEIS.

5.1.5 Detailed Review Comment

TMAC has indicated that the AEMP *"design, indicators, methodologies, and sampling frequency have been selected based on anticipated or potential effects related to Madrid-Boston development"*. The AEMP is therefore intended to confirm whether the predicted changes to the aquatic environment resulting from project activities are accurate and allow for timely adaptive management of any diverging effects.

TMAC has proposed a monitoring frequency in the AEMP that is incongruous to the predicted effects as presented in the FEIS. The predicted effects to Aimaokatalok Lake as presented in Table 4.5-6 of V5-S4 of the FEIS indicates differing scenarios under ice (both in high and low current scenarios), during freshet and in open water conditions. However, Table 3.1-2 of P4-18, the AEMP, indicates water quality sampling will only occur twice per year – once in April under ice and once in August in open water conditions.

This sampling frequency is not sufficient to assess project impacts and evaluate the accuracy of water quality predictions as outlined in the FEIS.

5.2 RECOMMENDATION/REQUEST

Water quality sampling should be conducted during freshet as well as under ice and in the open water season through the AEMP to align the field program with the predicted effects as presented in the FEIS.

The occurrence of freshet in the arctic is relatively brief (approximately two weeks); the timing of the freshet field event should rely on indicative meteorological data and local flow measurements.

5.3 TMAC RESPONSE FOR KIA-NWB-05

Water quality sampling for the Madrid-Boston AEMP will be conducted once during the under-ice season (April) and three times during the open-water season (July, August, September) at MMER-specific sampling sites and twice annually (April and August) at non-MMER sampling sites. This approach is consistent with other Nunavut AEMPs (e.g., Back River, Meliadine). Within Aimaokatalok Lake, sampling will be conducted four times per year along the MMER discharge pathway to assess potential effects related to the treated water discharge.

Sampling the Project lakes during freshet is not proposed as this has not been done during the historical baseline programs, as part of the former Doris North AEMP, nor the current Doris AEMP. Additionally, ice off varies from lake to lake during freshet affecting the timing of sampling (Plate 1) and there are inherent safety risks associated with sampling lakes during the freshet when the lakes are partially ice covered with exposed perimeters. Water quality sampling will be conducted in July in Aimaokatalok Lake and Reference Lake B, however, shortly after ice off and the freshet period.

The Madrid-Boston AEMP is currently being revised and will be available to the interested parties prior to the Final Hearing on April 27, 2018.

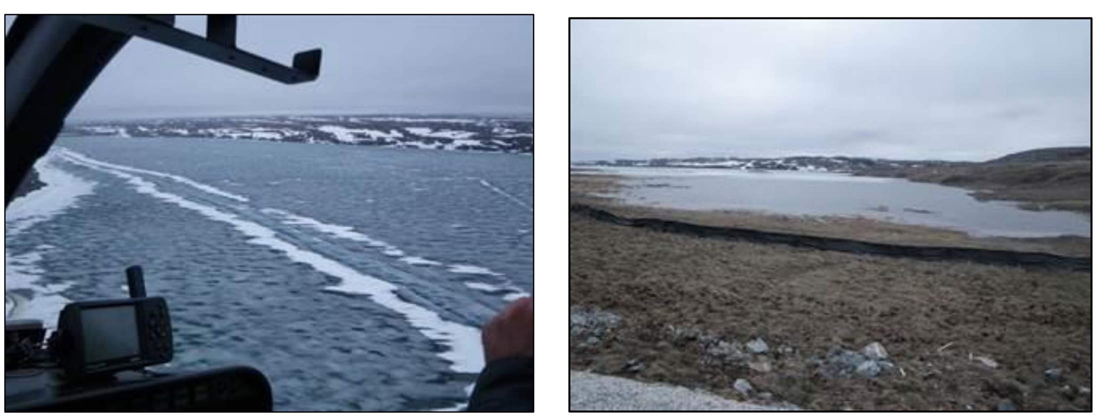

Plate 1. Hope Bay lakes during freshet period. A) Patch Lake on June 21, 2011 looking south (ice covered); b) Doris Lake on June 21, 2011 looking south (partially ice covered).

6. KIA-NWB-06

6.1 Subject/Topic

AEMP Parameter Suite

6.2 References

V1 Section 3.3.1.6

P4-18 Section 3.2.2; Table 3.2-1

6.3 Summary

The AEMP does not include any form of cyanide in the monitoring parameter suite. Cyanide is a contaminant of concern associated with the cyanide leach process that will be used as part of gold extraction at the Boston site.

6.3.1 Importance of issue

Neglecting to assess cyanide in the freshwater receiving environment will preclude a determination as to whether the cyanide destruction circuit and other management practices have mitigated the risks associated with that parameter to the aquatic environment.

6.3.2 Detailed Review Comment

TMAC notes *"Processing of ore at Boston will consist of sorting, crushing, milling, gravity concentration, floatation, cyanide leach, and gold recovery. The Boston process plant is expected to be similar to that of the Doris process plant. The Boston process plant will produce two types of tailings, flotation circuit tailings and detoxified tailings."* Cyanide is therefore a contaminant of potential concern in the freshwater receiving environment (Aimaokatalok Lake) associated with mining and milling at the Boston site.

We are concerned that cyanide (weak acid dissociable nor total) has not been included in the AEMP parameter suite TMAC will use to assess the freshwater aquatic environment. Neglecting to assess cyanide in the freshwater receiving environment will preclude a determination as to whether the cyanide destruction circuit and other management practices have mitigated the risks associated with that parameter to the environment.

6.4 Recommendation/Request

The AEMP parameter suite should be updated to include:

- weak acid dissociable cyanide, the form of the compound for which a CCME water quality objective exists, and
- total cyanide, the form of the compound that will be regulated under the forth coming Metal and Diamond Mines Effluent Regulations (MDMER)

For more details on the MDMER, see "Government of Canada. 2017. Regulations Amending the Metal Mining Effluent Regulations. Vol. 151, No. 19 — May 13, 2017."

6.5 TMAC RESPONSE FOR KIA-NWB-06

TMAC agrees to add free cyanide which has a CCME water quality guideline of 0.005 mg/L and total cyanide to the AEMP parameter suite for Aimaokatalok Lake and Reference Lake B.

7. KIA-NWB-07

7.1 SUBJECT/TOPIC

Preparation for Metal and Diamond Mine Effluent Regulations

7.2 REFERENCES

P4-7 Section 5.4; Table 5-3

P4-8 Section 4.2; Table 4-1

7.3 SUMMARY

TMAC has not applied the updated MDMER discharge criteria to all contact water that will be discharged from the site.

7.3.1 Importance of issue

MDMER is expected to come into force in 2018 and may pose operational challenges for the discharge of contact water with elevated

7.3.2 Detailed Review Comment

Mining at Boston and Madrid will require continued (from mining the Doris North ore body) discharges to the marine environment and will require discharges to the freshwater environment. These discharges will be regulated under the existing Metal Mines Effluent Regulations (MMER); TMAC has used those regulations for discharges to Roberts Bay (P4-7), the tundra (P4-8) and Aimaokatalok Lake (P4-8).

These proposed criteria are as follows:

Table 5-3 Effluent limits during periods of discharge to Roberts Bay

Parameter	Units	*MMER*
pH		6 to 9.5
Total Suspended Solids	mg/L	15
Total Cyanide	mg/L	1
Arsenic	mg/L	0.5
Copper	mg/L	0.3
Lead	mg/L	0.2
Nickel	mg/L	0.5
Zinc	mg/L	0.5
Radium	Bg/L	0.37

We acknowledge that these discharge criteria are in line with the current MMER, but note that discharges associated with Madrid North, Madrid South and Boston will all be subject to the updated Metal and Diamond Mines Effluent Regulations (MDMER) which is expected to come into force in 2018 (Government of Canada, 2017).

Under MDMER, discharges throughout the Hope Bay Belt will be subject to the more stringent discharge criteria presented in the updated Schedule 4, Table 2:

Item	Column 1	Column 2	Column 3	Column 4
	Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a: Composite Sample	Grab Sample
1	Arsenic	0.30 mg/L	0.45 mg/L	0.60 mg/L
2	Copper	0.30 mg/L	0.45 mg/L	0.60 mg/L
3	Cyanide	0.50 mg/L	0.75 mg/L	1.00 mg/L
4	Lead	0.10 mg/L	0.15 mg/L	0.20 mg/L
5	Nickel	0.50 mg/L	0.75 mg/L	1.00 mg/L
6	Zinc	0.50 mg/L	0.75 mg/L	1.00 mg/L
7	Suspended Solids	15.00 mg/L	22.50 mg/L	30.00 mg/L
8	Radium 226	0.37 Bq/L	0.74 Bq/L	1.11 Bq/L
9	Un-ionized ammonia	0.5 mg/L expressed as nitrogen (N)	Not applicable	1.00 mg/L expressed as nitrogen (N)

More stringent discharge criteria will not alter the conclusions presented in the FEIS but may present operational challenges to comply with the new regulations when discharging from contact ponds with elevated concentrations.

We note that while most MDMER discharge criteria has been incorporated into the water and load balance model, cyanide has not.

For more details on the MDMER, see "Government of Canada. 2017. Regulations Amending the Metal Mining Effluent Regulations. Vol. 151, No. 19 — May 13, 2017."

7.4 RECOMMENDATION/REQUEST

We recommend TMAC update the Water Licence and FEIS applications to reflect the discharge criteria that will come into force under the updated MDMER.

TMAC should also include a discussion as to the feasibility of meeting MDMER criteria in both ongoing and intermittent discharges to the marine and freshwater environments and any operational changes that will be required to comply ensure compliance.

7.5 TMAC RESPONSE FOR KIA-NWB-07

The Madrid-Boston (Phase 2) Project Water and Load Balance, Hope Bay Project (Annex V1-7, Package P5-4) indicates that with the proposed mitigation measures, TMAC will be able to meet the current MMER and proposed MDMER regulations for all mine effluents.

The report compares key parameters for mine effluents to the current MMER and the proposed MDMER in the main body text, see Table7-1 below for reference locations. The key parameters were selected based on the project effects relative to baseline and do not include all MMER or MDMER parameters, such as cyanide. However, all model parameters for each mine effluent are presented in Appendix C-2 of P5-4 and were compared to the current MMER and proposed MDMER. It was found that all mine effluents meet the current MMER and proposed MDMER regulations throughout all stages of the mine life.

The Doris-Madrid and Boston Water Management Plans (Annex V1-7, Packages P4-7 and P4-8) reference the current MMER regulations, however do not present the proposed MDMER regulations as part of the current monitoring plans. TMAC will update these documents to include the proposed MDMER regulations prior to the proposed regulations coming into effect.

Table 7-1: Comparison of Key Model Parameters to the current MMER and proposed MDMER regulations

Mine Effluent	Summary WQ Results
Doris TIA Closure Runoff	Table 7-1 of P5-4
Marine Mix Box Discharge	Table 7-2 of P5-4
Combined Boston Effluent	Table 7-3 of P5-4
Boston TMA Closure Runoff	Table 7-4 of P5-4

8. KIA-NSB-08

8.1 Subject/Topic

Confirmation of Model Predictions – Water Quality Monitoring

8.2 References

KIA-DEIS-46

P5-4 Section 3.7.10, Section 7.4.2

V5-S4 Table 4.2-2

P4-18 Figure 3.1-1a and 3.1-1b

8.3 Summary

The water balance and load model does not use water quality source terms from individual modeled lakes in the Boston, Madrid and Doris areas. The AEMP should be adjusted to ensure water quality monitoring is sufficient to confirm all modelling results.

8.3.1 Importance of issue

Monitoring to confirm modeling results is required to ensure adaptive management can occur in a timely manner should predicted changes to water quality be more significant than expected.

8.3.2 Detailed Review Comment

We note that TMAC has complied with KIA-DEIS-46 and have collected water quality in 2017 from Doris, Patch, Windy, Wolverine, Aimaokatalok and Stickleback lakes. However, we express concern that lake specific data has not been used as background water quality inputs within the water and load balance model. *"Doris Lake water quality from 2012 to 2017 was selected as representative of background conditions and was applied to the remaining lakes and to all undisturbed surface runoff in the Doris or Windy watersheds upon model activation. The only exception to this was Tail Lake, which is used to store water collected in the Doris sedimentation pond… For the Boston background source term, Aimaokatalok Lake water quality collected between 2012 and 2017 was selected as representative of background conditions and was applied to all lakes and all undisturbed runoff in the Boston watershed except Stickleback Lake. A separate source term was developed for Stickleback Lake and was applied as the starting concentration for this lake upon model activation."*

This approach introduces additional uncertainty into the model outputs for lakes other than the Doris, Aimaokatalok and Stickleback lakes.

This concern is exemplified in instances where these lakes will experience direct inputs of contaminants from local sources. For example, no lake specific source term was applied in the load balance model for Windy Lake. However, *"During operations, Windy Lake will receive a small amount of runoff from the Madrid North Mine surface infrastructure. However, the model results show that water quality in the lake is unaffected. Once Madrid North enters post-closure, additional loads from disturbed runoff that was previously captured in the Madrid North CWP and groundwater flow from the Madrid North Mine are predicted to enter the lake."* The model indicates that concentrations of key parameters such as arsenic and copper will be elevated because of these project interactions.

We acknowledge however, that the sensitivity analysis will likely address uncertainties in the modeled outputs and smaller divergences can be adaptively managed if they are detected through a robust monitoring program.

8.4 RECOMMENDATION/REQUEST

We request TMAC include ongoing water quality monitoring through the AEMP in all modeled lakes in which impacts from project activities are predicted. Specifically, the AEMP should be amended to include water quality monitoring in Windy Lake. Water quality monitoring is already proposed for Aimaokatalok, Stickleback, Patch, Doris and Wolverine lakes as part of the AEMP.

8.5 TMAC RESPONSE FOR KIA-NSB-08

The AEMP includes lakes in which effects from project activities are predicted during construction or operations phases of the Project. Windy Lake was excluded from the AEMP, as nearly every assessed water quality parameter was within predicted baseline concentrations as a result of the Project until the post closure period. The exception was mercury, which was predicted to change by a maximum of 25% over the operations phase (0.000001121 mg/L), yet remain 25 times lower than the CCME guideline for inorganic mercury (0.000026 mg/L). The greatest changes to water quality in Windy Lake are predicted more than 20 years into the Project during post-closure. Windy Lake can be added to the AEMP prior to this period, when potential changes due to the Project are expected, or if the potential for the Project to affect the lake changes due to updated Project design (e.g., alterations to operational water management plans resulting in Project activities near Windy Lake).

9. ID #INAC-TC-1

9.1 SUBJECT/TOPIC

Doris Tailings Impoundment Area

9.2 REFERENCES

P4-21: Hope Bay Project – Doris-Madrid Interim Closure and Reclamation Plan
P5-4: Hope Bay Project – Water and Load Balance
P5-9: Hope Bay Project – Geochemical Source Term Predictions
P5-16: Hope Bay Project – Doris Tailings Management System

9.3 SUMMARY

The current closure concept for the Doris TIA involves placement of a simple isolation barrier constructed from quarry rock. Based on the properties of tailings that will be contained in the TIA, the proposed cover concept is generally appropriate. However, clarification is required regarding the water quality criteria that will be used to assess the performance of the cover during the post-closure phase. Additional studies are also needed to refine aspects of the cover design to ensure it is able to achieve its intended environmental outcomes.

9.4 DISCUSSION

Importance of Issue to the Impact Assessment Process

Flotation tailings are the only material that will be stored on surface during the post-closure phase. To minimize the potential for long-term environmental impacts, the design of the Doris TIA must be optimized.

Detailed Review Comment

The flotation tailings that will be deposited in the Doris Tailings Impoundment Area (TIA) contain excess acid neutralization capacity which makes them non-potentially acid generating (non-PAG) and therefore there are no requirements to prevent their oxidation. While acid generation is not a concern, long-term humidity cell tests indicate that neutral pH metal leaching may develop, with arsenic being of particular concern. Nonetheless, TMAC has stated that, based on the TIA water and load balance, neutral metal leaching does not pose a limitation in ensuring the post closure water quality discharging from the TIA. We note, however, that post-closure water quality criteria have not been established for the project.

Based on the above, TMAC determined that an infiltration reduction cover is not required. However, the tailings surface will be susceptible to wind and water erosion which could result in tailings releases to the environment (i.e., as dust and/or suspended solids). To prevent these potential impacts, TMAC's proposed closure concept for the Doris TIA is to place a granular cover over the tailings surface to prevent wind and water erosion. This cover will also function as a separation barrier to prevent tailings contact with humans and wildlife. At post-closure, runoff from the TIA is anticipated to enter the north end of Doris Lake where some localized mixing and dilution with lake water could occur.

Potential considerations and concerns related to the Doris TIA are as follows:

Post-Closure Water Quality Criteria

A key closure objective for the Doris TIA (as well as other project components) is to ensure a walk away closure scenario, which implies no requirements for long-term water management. While geochemical source term predictions indicate that post-closure tailings seepage will have an upper case arsenic concentration of 0.21 mg/L (document P5-9, Table 4-2), discharges from the facility as a whole will have an average upper case concentration of 0.079 mg/L (document 5-4, Table 7-1). Based on these concentrations, TMAC concluded that post-closure discharges from the Doris TIA will comply with the applicable criteria which they have assumed to be the Metal Mining Effluent Regulations (MMER). Specifically, in the case of arsenic, average post-closure discharges from the TIA are predicted to remain below the proposed revised MMER criterion of 0.1 mg/L. However, we note that the technology-based MMER are intended for operating mines and therefore question the appropriateness of their use during the post-closure phase.

Instead, during post-closure, compliance criteria should be derived from the appropriate environmental quality criteria (EQC). For example, in the case of arsenic, the criterion would be set based on the CCME Freshwater Aquatic Life criterion of 0.005 mg/L or the site-specific water quality objective (SSWQO) of 0.028 mg/L. In either case, discharges from the TIA to Doris Lake would be noncompliant until sufficient mixing has occurred within the receiver.

Based on the above, TMAC's conclusion that drainage from the TIA will meet applicable criteria is premature; that determination can only be made once the post-closure criteria have been set. While this issue has been raised in relation to the Doris TIA, it also applies to other site components. Specifically, as noted throughout Section 7 of document P5-4, there are multiple water bodies that will consistently exceed the applicable CCME criteria for arsenic and copper during the post-closure phase.

Doris TIA Cover Design

TMAC's proposed closure concept for the Doris TIA involves placing a 0.3 m thick layer run of quarry (ROQ) rock[1]. The 0.3 m thickness is stated as being the minimum thickness of cover that can practically be placed over the tailings surface. The cover will be placed during winter to facilitate equipment traffic on the saturated tailings. Potential issues associated with the proposed cover concept include:

1. **Separation Layer** – The placement of coarse rock covers over saturated tailings can, depending on a variety of factors, result in gradual cover settlement into the tailings and/or vertical "piping" of tailings through the cover to the surface (e.g., tailings boils at the Beaverlodge and Discovery Mines). One potential mitigation is the placement of a separation layer such as a geofabric between the tailings and coarse rock cover. No such layer has been included in the proposed Doris TIA cover design.

2. **Design Thickness** - ROQ typically includes rock sizes of up to 0.3 m. Taking into consideration the proposed cover thickness is only 0.3 m, there is a potential that some tailings will be exposed through void spaces that extend from the tailings surface to the top of the cover. Environmental consequences of this possibility do not appear to have been considered when developing the design (e.g., vegetation growing through the cover voids). This potential would be reduced if the cover is constructed of crushed rock instead of ROQ.

3. **Differential Settling** - TMAC acknowledges that ice lenses, compression consolidation and other factors are likely to result in differential settling of the TIA surface. During the period immediately following closure, this issue will be addressed by filling any depressions that are formed with additional cover or fill material. However, over the long-term, differential settling will continue to occur and may result in ponding that has elevated concentrations of some parameters. While this is not necessarily a concern for the aquatic environment, it does represent a potential exposure pathway for terrestrial receptors.

4. **Predicted Freezeback of Tailings** – The post-closure environmental performance of the Doris TIA will depend, in part, on the extent to which the tailings freeze and remain frozen. TMAC's modelling of the tailings freezeback was based on phase change of porewater at 0˚C which, based on the salinity of the materials involved, may not be appropriate.

5. **Compatibility with Wildlife** - Post-closure, the covered TIA surface could be an attractant to some species. However, the angular ROQ surface may present a hazard to some animals such as caribou.

In summary, there are multiple uncertainties related to the design of the Doris TIA cover and its ability to achieve its intended environmental outcomes. TMAC currently has no plans to perform reclamation research to resolve such uncertainties.

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[1] Application documents also include statements indicating the cover will be constructed from waste rock (e.g., document P5-16 page 2). Nonetheless, this review is based on the understanding that the cover will be constructed of ROQ rock.

9.5 RECOMMENDATION/REQUEST

RECOMMENDATION #1

TMAC should explicitly demonstrate that any proposed post-closure water quality criteria are protective of the receiving environment. Any areas where the criteria will not be met (e.g., within mixing zones) should be clearly defined and potential adverse impacts within those areas should be quantified. While this recommendation is associated with the Doris TIA, it should be applied to all aspects of the Phase II Hope Bay Project.

9.6 TMAC RESPONSE TO RECOMMENDATION #1

While MMER does not apply during the Post-closure phase of Project, TMAC considers it appropriate to use MMER water quality criterion for post-closure water quality in the Doris TIA as the goal of MMER is to be protective of fish and their habitat in the ambient receiving environment, and these criterion will be used through the operations to be protective of fish and their habitat. It is unnecessarily conservative to set TIA water quality objectives to CCME water quality criteria, and indirectly turn the TIA into an ambient system as the TIA has already been compensated for under the *Fisheries Act*. TMAC's responsibility during post-closure is to ensure water quality in the receiving environment is safe for aquatic life, and therefore it is appropriate to apply CCME guidelines where they are intended, in the ambient receiving environment.

The water quality in the post-closure freshwater environment (and its protectiveness to aquatic life therein) was quantitatively predicted using the Water and Load Balance model (Package P5-4), with the results assessed in Volume 5, Chapter 4 of the FEIS. The assessment considered the water quality to be protective of freshwater aquatic life, if predicted base case water quality concentrations were:

- were within 10% of predicted baseline concentrations;
- below CCME water quality guidelines for the protection of aquatic life or an adopted SSWQO (arsenic and copper);
- below observed baseline (95th percentile) concentrations.

Nearly all base case water quality predictions for the Post-closure phase were within 10% of the predicted baseline concentrations or were below CCME guideline or SSWQO thresholds. There were two parameters, aluminum in Doris Creek and fluoride in Stickleback Lake, that were greater than 10% of predicted baseline and their CCME guidelines; however, the predicted concentrations of these parameters were well within natural observed baseline conditions and were therefore considered to be safe for aquatic life since these conditions have occurred naturally during extensive baseline sampling. Also, the base case concentrations were predicted to be infrequent and short-lived, with maximum predicted concentrations barely above guideline concentrations, and median predicted concentrations (0.93 mg F/L in Stickleback Lake) of less than 78% of the guideline (0.12 mg/L). Given these predictions, the water quality in the Project waterbodies were assessed to be protective of aquatic life.

In addition to the above, SSWQOs for copper and arsenic were used to assess water quality in the Project Lakes. In the absence of a SSWQO, copper is predicted to be greater than the minimum CCME guideline (0.002 mg/L) in Wolverine and Stickleback lakes during post-closure, with predicted base case concentrations being nearly 25% and 85% greater than predicted baseline concentrations, respectively, and a predicted maximum of 0.00771 mg/L in Stickleback Lake. These results are likely overestimated since the observed baseline concentrations were about 50 to 100% less than predicted baseline concentrations at model start-up, and the cyroconcentration factors used in the model were nearly twice the actual cyroconcentration factors observed naturally for copper in each of the lakes (Package P5-4). This would have led to lower predicted base case concentrations that would be closer to the copper CCME guideline. Nonetheless, TMAC assessed the effects of copper in Wolverine and Stickleback lakes during the DEIS technical comment period at a maximum predicted concentration of 0.01 mg/L, which was nearly 30% greater than that predicted in the FEIS. This assessment is available in technical comment INAC-TRC4 which has been attached. The conclusions of this assessment were the water quality at 0.01 mg Cu/L would be protective of aquatic life in Wolverine and Stickleback lakes. This was supported by the development of the copper SSWQO of 0.009 mg/L in the FEIS (Appendix V5-4C).

RECOMMENDATION #2

TMAC should conduct a comprehensive reclamation research plan (RRP) to assist with the design of the Doris TIA cover. The RRP should include field trials to confirm that any proposed cover concepts perform as intended. In addition to evaluating the performance of the proposed cover

9.7 TMAC RESPONSE TO RECOMMENDATION #2

TMAC does not agree that a comprehensive reclamation research plan (RRP) is warranted at this time to support design of the Doris Tailings Impoundment Area (TIA) cover. The rationale for the cover has been clearly documented based on the outcome of a rigorous and conservative water and load balance model (Annex V1-7, Package P5-4), which in turn is informed by rigorously developed and conservative geochemical source terms (Annex V1-7, Package P5-9). Based on this information the function of the cover has been defined as preventing dust and eliminating direct contact by terrestrial life (Supporting Document Package P5-16 Doris Tailings Management System Phase 2 Design, Hope Bay Project). The reviewer has pointed out five potential issues with the proposed 0.3 m (minimum) thick rock cover. All of these potential issues, as well as many others were considered and are described in Appendix L (Preliminary TIA Cover Design memo) of P5-16 as part of a Cover Failure Modes and Affects Analysis (FMEA). However, to specifically address the reviewers comments regarding the five potential issues:

1. The potential for "frost boils" was explicitly considered in the FMEA, and in Section 4.5 of Appendix L (of Supporting Document Package P5-16), where TMAC provides a more detailed description of the physical processes involved and why it is not deemed a concern;

All cover material needs to be produced on site using quarry rock, and associated crushing and screening. Therefore it is in the best interest of TMAC to strike a balance between rock size and volume needed to construct the quarry. To that end, TMAC has been using quarry rock to construct the mine infrastructure continuously between 2007 and 2018, and has a very good understanding of what can be effectively and cost efficiently produced on site. Therefore, TMAC is satisfied, that based on over a decade of actual on site experience, using the specific material that will be required for construction of the TIA cover, that they understand how the proposed rock cover can be constructed to the design thickness proposed.

TMAC would also like to point out that revegetation was excluded as a function of the cover. Given the climatic regime, natural revegetation is unlikely, but should that occur, that is not of any concern.

Differential settlement was again expressly considered in the FMEA, and in a comprehensive analysis of the likely magnitude of this was presented in Section 4.23 of Appendix J - Hope Bay Project: Phase 2 Tailings Impoundment Area, South Dam and West Dam Settlement, and Tailings Frost Heave Evaluation (Annex V1-7, Package P5-16), demonstrating that this is not an issue of concern.

Tailings pore water salinity was carefully evaluated on the basis of predicted water quality during operations, closure and post-closure (Supporting Document P5-4 Madrid-Boston Project Water and Load Balance, Hope Bay Project). This includes both tailings chemistry discharged to the Doris TIA (i.e., process plant chemistry), and water in the Tailings Reclaim Pond. Based on maximum total concentration of Cl-, Ca2+, K+, Na+ and Mg+, it was confirmed that the freezing point depression of the tailings would, at most, be between 0.15 and 0.25°C. The average chemistry of these sources however suggest a freezing point depression of 0.05°C, which is why 0°C was adopted in the analysis. Using a 0.25°C value would not change the conclusions reached.

The rock material that will be used to construct the proposed cover is the same rock that is currently being (and has since 2007) used to construct all surface infrastructure. Wildlife monitoring is currently in place, and will be continuous throughout the mine life. Wildlife monitoring will amongst other things determine any wildlife interactions with surface infrastructure.

10. ID #INAC-TC-2

10.1 Subject/Topic

Boston Tailings Management Area Seepage

10.2 References

P4-10: Hope Bay Project – Boston Tailings Management Area – Operation,

Maintenance and Surveillance Manual

P5-4: Hope Bay Project – Water and Load Balance

P5-25: Hope Bay Project – Geochemical Characterization of Waste Rock and Ore

from the Boston Deposit

P5-26: Hope Bay Project – Boston Tailings Management Area Preliminary Design

P5-27: Hope Bay Project – Boston Tailings Disposal Alternatives Assessment

10.3 Summary

The environmental performance of the Boston project depends on the extent to which neutral drainage from the TMA is controlled. Towards this end, TMAC's proposed cover concept of a dry stack tailings facility that will be covered by a geomembrane liner is an appropriate closure strategy. However, given the importance of the liner to the environmental performance of the site, the potential water quality impacts associated with partial failure of the liner over the long-term should be evaluated.

10.4 Discussion

Importance of Issue to the Impact Assessment Process

Higher than anticipated arsenic loadings from the Boston TMA could result in unacceptable impacts to the surface water environment. Potential TMA failure modes should be addressed through proactive maintenance.

Detailed Review Comment

Flotation tailings from the Boston Mine are not predicted to be acid generating. However, the tailings are potentially metal leaching under neutral conditions and are predicted to generate seepage with elevated metal concentrations (arsenic in particular with concentrations of 3.8 mg/L). TMAC's proposed flotation tailings management strategy at the Boston Mine involves the construction of a “dry stack” of filtered tailings. The technology has been used in the Canadian arctic and is currently considered to be the best practice in tailings management. TMAC predicts that seepage from the TMA will be negligible due to the high placed density and the fact that tailings will freeze back and remain frozen for the foreseeable future (other than the active layer). Nonetheless, to reduce seepage volumes to the greatest extent possible, TMAC has elected to construct a low infiltration cover over the tailings. The cover will be constructed of a geomembrane laid directly on the tailings surface, followed by a protective nonwoven geotextile, 0.3 m of crushed gravel and 0.7 m run of quarry for erosion protection.

The combination of a dry stack facility covered by a low infiltration cover is an appropriate solution for the Boston Mine. However, TMAC correctly notes that the ongoing performance of the facility is strongly correlated to the extent of leakage through the geomembrane. TMAC therefore evaluated what they consider to be a “worst case scenario” representing an upper bound of seepage through the geomembrane (Document P5-26, Appendix E). The analysis determined that the maximum leakage rate would be only 0.64 m3/day for the entire facility. This rate was calculated based on the assumption there would be only one 2 mm hole for every acre of geomembrane. While this imperfection rate may be appropriate for a new membrane installed under ideal conditions, we question its use when assessing the long-term performance of a cover as it ages and leakage rates increase. Furthermore, it is not necessarily representative of a cover installed in a remote arctic location.

It is significant to note that TMAC predicts that discharges from the Boston TMA will have an upper case arsenic concentration of 0.079 mg/L (document 5-4, Table 7-1) which is 79% of the proposed MMER arsenic criterion of 0.1 mg/L. It is our understanding that the predicted arsenic concentration is based on the leakage assumptions noted above (i.e., very low imperfection rates in the geomembrane soon after placement). On that basis, arsenic concentrations in the TMA discharges would presumably approach and eventually exceed the MMER criterion if initial leakage rates are higher than predicted and/or as it ages with time and leakage rates increase. In addition, as indicated in Comment #1, we question the appropriateness of using the MMER during the post-closure phase.

With regard to cover performance over time, researchers estimate that the halflife (i.e., 50% degradation) of geomembranes is likely several hundred years under “typical” conditions[2]. While liners are expected to continue functioning beyond their half life, leakage rates are anticipated to increase with time until the liner is no longer capable of meeting its design intent. With regard to the Hope Bay Project, there is currently insufficient information to determine if this will occur in decades, centuries or longer. In

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[2] Geosynthetic Institute. 2011. Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions.

addition, no information is available regarding the environmental consequences of a partial liner failure.

TMAC has demonstrated that the potential for elevated arsenic loadings from the Boston TMA justify the significant expense of constructing a low-permeability cover over the facility. However, based on our review, they have not conducted a sufficiently conservative analysis of the long-term performance of the cover under sub-optimal conditions.

10.5 Recommendation/Request

RECOMMENDATION #3

TMAC should conduct a detailed analysis of long-term failure modes of the Boston TMA (geomembrane degradation/exposure, geotechnical failures, erosion, differential settling, etc.). The analysis should evaluate arsenic loadings for a scenario in which 1% of the geomembrane has "failed" and should also ascertain the likelihood of the scenario occurring over extended periods (e.g., at 50 and 100 years post-closure).

10.6 TMAC Response to Recommendation #3

TMAC has conducted a detailed analysis of potential long-term cover failure modes, which are documented in Appendix B – Hope Bay Project: Boston TMA Detailed Cover Design of Package P5-26 (Boston Tailings Management Area Preliminary Design, Hope Bay Project) as part of a Cover Failure Modes and Affects Analysis (FMEA). Furthermore, the Boston TMA and associated closure cover has been designed taking climate change into consideration. The climate change analysis and associated designs are up to the year 2100 which as described in P5-1 (Climate Change Analysis Approach Report, Hope Bay Project) is the current best practice when considering climate change analysis.

TMAC disagrees with the reviewers recommendation that an arbitrary 1% failure of the geomembrane should be analyzed. There is no engineering basis for such a statement. TMAC has assumed two 2-mm diameter holes per acre as the basis for the leakage rate, which is considered appropriate for a good installation (Schroeder et al. 1994, per Appendix E – Hope Bay Project: Boston TMA Geomembrane Leakage Assessment, P5 26). This translates to about 0.0000002% of the total liner surface area. Even assumed the worst installation, with a defect frequency of 20 holes per acre (Schroeder et al. 1994), this would translate to about 0.0000016% of the total liner surface area. The reviewers recommendation of 1% surface area of defects (2,030 m2) would translate to 12.7 million, 2 mm diameter holes for which there is no basis. Even when considering major tears in the liner, to reach the level of imperfections suggested by the reviewer, it would mean 113 complete tears from the top to the bottom of the slope of the TMA, 0.3 m wide. This is simply not possible.

The Boston TMA is a dry-stack tailings facility, which means it is comprised of a fine grained material placed and compacted in lifts over the life of the project. The material has a low water content and freezes back over time. Therefore, the surface created, upon which the cover needs to be constructed are as near to ideal as you would find in the mining industry, which is why the target liner imperfection category of 2 holes per acre, as suggested by Schroeder et al. (1994) was chosen.

Post installation, cover damage can only occur as a result of the cover being exposed, or the TMA deforming leading to liner rupture. Cover exposure due to cover slippage was assessed (Section 3.2.3 of Appendix C – Hope Bay Project: Boston Tailings Management Area Stability Analysis, Package P5-26), and overall TMA deformation as a result of long term creep was assessed (Appendix F – Dry Stack Deformation Analysis, P5-26). Both these analysis confirmed that liner damage in the long-term, which would result in a need to increase the calculated seepage rate is not warranted.

RECOMMENDATION #4

TMAC should specify the anticipated design life of the Boston TMA components, with reference to comparable case studies. Descriptions of maintenance activities that would extend the design life of the facility should also be provided, with a focus on the prevention/mitigation of the potential failure modes described in the response to Recommendation #3.

10.7 TMAC RESPONSE TO RECOMMENDATION #4

The Boston Tailing Management Area (TMA) closure is perpetual. However, engineering designs cannot be perpetual, and therefore engineering designs are considered to have a 100 year design life. This means that the engineered structures, such as the Boston TMA cover is expected to perform its intended function for at least 100 years. The engineering analysis presented in Supporting Document Package P5-26 Boston Tailings Management Area Preliminary Design, Hope Bay Project, and further described in the response to Recommendation #3 (in this document) confirm this to be valid.

As described in the response to Recommendation #3, the failure mechanisms that would impact performance of the cover is stability of the protective cover overlying the membrane, and deformation of the TMA due to creep. Both these aspects will be monitored by means of geotechnical inspections as outlined in the Boston Conceptual Closure and Reclamation Pan (P4-19 Hope Bat Project Boston Conceptual Closure and Reclamation Plan).

TMAC disagrees with the reviewers conclusions regarding the Koerner et al. (2011) reference. This reference, which TMAC agrees is one of the more pragmatic, research-based information sources regarding liner longevity, provides the following conclusions which are of relevance to the Boston TMA cover:

- High density polyethylene (HPDE) (the same as that proposed at the Boston TMA) liner degradation is mostly driven by temperature (if covered), or UV exposure (if uncovered);
- Degradation (if covered) is defined as occurring in three stages (see Table 10-1, extracted from Koerner et al (2011) below for typical times at different temperatures):
  - Stage A: depletion time of antioxidants;
  - Stage B: Induction time to onset of degradation; and
  - Stage C: time to reach service life (i.e. 50% degradation point, or liner half-life).

Table 10-1: Lifetime prediction of HDPE (non-exposed) at various field temperature (Extracted from Koerner et al, 2011)

In Service Temperature (°C)	Sage "A" (Years)			Stage "B" (Years)	Stage "C" (Years)	Total Prediction* (Years)
	Standard OIT	High Pressure OIT	Average OIT			
20	200	215	2018	30	208	446
25	135	144	140	25	100	265
30	95	98	97	20	49	166
35	65	67	66	15	25	106
40	45	47	46	10	13	69

*Total = Stage A (average) + Stage B + Stage C

Equivalent research at temperatures lower than those listed in Table 10-1 of Koerner *et al*. (2011) has not been carried out, but the available information suggest that performance at colder temperatures can be expected to be greater than those shown, which suggest that for the designated design life there good justification that the cover would continue to perform its intended function.

Reference:

Koerner, R.M., Hsuan, Y.G., Koerner, G.R. (2011). Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions. Geosynthetic Research Institute White Paper #6, February 8.

RECOMMENDATION #5

TMAC should describe any post-closure mitigative actions that could be taken if seepage from the Boston TMA exceeds the applicable MMER criteria.

10.8 TMAC Response to Recommendation #5

Current predictions of post-closure water quality has been based on a rigorous and conservative water and load balance model (P5-4 Madrid-Boston Project: Water and Load Balance, Hope Bay Project), which in turn is informed by rigorously developed and conservative geochemical source terms (P5-9 Source Term Predictions for the Proposed Madrid North, Madrid South and Boston Mines, Hope Bay Project). Based on this information, and considering the stage of the project TMAC believes that there is sufficient evidence to suggest post-closure seepage water quality will not be of concern.

However, as stated in the Boston Conceptual Closure and Reclamation Plan (Package P4-19), contingency measures for water quality exceedances include extending the monitoring period to allow characterization of the source of the exceedances. Once the source of exceedances are understood, water treatment or cover upgrades can be considered.

RECOMMENDATION #6

TMAC should conduct a comprehensive reclamation research plan to assist with the design of the Boston TMA cover. The RRP should include field trials to confirm that any proposed cover concepts perform as intended. The RRP and field trials should be initiated within one year of licence issuance to ensure that research findings can be incorporated into revised cover designs.

10.9 TMAC RESPONSE TO RECOMMENDATION #6

TMAC does not agree that a comprehensive reclamation research plan (RRP) is warranted at this time to support design of the Boston TMA cover. The rational for the cover been clearly documented based on the outcome of a rigorous and conservative water and load balance model (Package P5-4), which in turn is informed by rigorously developed and conservative geochemical source terms (Package P5-9). Based on this information the function of the cover has been defined described in Package P5-26, with the most pertinent function being minimizing infiltration. Subsequently TMAC has selected a geomembrane cover as the preferred technology as there are no suitable low permeability natural soils available at the project site. A detailed rationale for the choice a geosynthetic is provided in Appendix B – Hope Bay Project: Boston TMA Detailed Cover Design in P5-26. The performance of these geomembranes are well understood and cover trial to demonstrate such performance is not required. Similarly, construction methods for these covers are well understood and does not require trail testing. The failure mechanisms that would impact cover performance as described in Recommendation #3, although not expected as demonstrated through engineering analysis, will only manifest over a very long period, and only if the cover is installed on the TMA. Therefore early trials constructed on an incomplete TMA will serve no purpose in understanding these phenomena.

11. ID #INAC-TC-3

11.1 Subject/Topic

Closure Planning and Requirements

11.2 References

P4-14: Hope Bay Project – Hydrocarbon Contaminated Material Mgmt. Plan
P4-19: Hope Bay Project – Boston Conceptual Closure and Reclamation Plan
P4-20: Hope Bay Project – Boston Conceptual Closure and Reclamation Plan Detailed Cost Estimate
P4-21: Hope Bay Project – Doris-Madrid Interim Closure and Reclamation Plan
P4-22: Hope Bay Project – Doris-Madrid Interim Closure and Reclamation Plan Detailed Cost Estimate

11.3 Summary

From a technical perspective, the closure and reclamation approaches proposed by TMAC appear to be appropriate for the current level of project definition. While there will be opportunities to refine the closure and reclamation plans as the project progresses through its life cycle, uncertainty could be reduced significantly by conducting a more thorough and methodical planning process.

11.4 Discussion

Importance of Issue to the Impact Assessment Process

Better definition of closure and post-closure requirements will: a) result in more accurate closure cost estimates; and b) provide greater certainty regarding closure expectations.

Detailed Review Comment

In many respects, potential impacts associated with the operational phase of the Hope Bay Project are well understood, are of limited duration and/or are readily mitigated through active interventions. In contrast, uncertainties regarding the post-closure performance of the sites could result in unintended and difficult to mitigate impacts. To minimize these uncertainties, the closure and reclamation planning process is intended to provide a clearly defined, well documented, transparent and rational path towards successful relinquishment. It is therefore in the best interest of TMAC and other parties to ensure that the process is thorough and conforms to all applicable requirements.

Potential considerations and concerns related to the closure planning process are as follows:

Compliance With Applicable Guidance

TMAC indicated that the Hope Bay Project CRPs conform with the following document: *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB and AANDC 2013).* Although the NWT guideline does not apply specifically to Nunavut, TMAC stated that the guide was used because it represents current best practice in northern closure planning. Our review therefore assessed the performance of the CRPs against the requirements that are specified in the MVLWB/AANDC guidance. A focus was placed on the current status of the Boston CCRP (document P4-19), as summarized in Table 1.

Table 1 – Assessment of the Boston CCRP Against MVLWB/AANDC Closure Planning Guidance

CCRP REQUIREMENT	PROVIDED?
Project Environment	Yes
Project Description	Yes
Objectives	Prelim.
Criteria	No
Options Analysis	No
Evidence of Preferred Option Performance	No
Predicted Residual Effects	No
Progressive Reclamation	Prelim.
Temporary Closure	Yes
Uncertainties	No
Reclamation Research	No
Contingencies	Prelim.
Post Closure Monitoring/Maintenance Plan	Prelim.
Engagement / Consultation	No
Financial Security	Yes

As indicated in Table 1, the CRPs do not meet the requirements of the guidance in multiple areas. Notable deficiencies include:

- **Objectives and Criteria** – Proposed objectives are identified for some but not all components. These objectives form the basis of the CRPs and should be explicitly identified. Criteria are generally not defined at all. This is acceptable for preliminary closure plans but should be addressed in all subsequent iterations.
- **Options Analysis** – TMAC does not identify or analyze potential closure options. Instead, the preferred approach is presented, with very limited information regarding the rationale for its selection.
- **Evidence of Preferred Option Performance** – With the exception of statements indicating the preferred options have been used at other sites, limited information is presented describing their performance under comparable conditions.

- **Uncertainties and Reclamation Research** – Important gaps/uncertainties are not identified and there are no proposed reclamation research initiatives.
- **Engagement / Consultation** – No evidence is presented indicating that interested parties have been engaged or consulted on the proposed plans.

Despite these deficiencies, the proposed closure strategies presented in the CRPs generally appear to be appropriate from a technical/engineering perspective. Specifically, there are no significant technical flaws in the plans. Nonetheless, the deficiencies should be addressed to ensure there is greater clarity regarding the expectations, rationale and thresholds that will need to be met for site relinquishment.

Definition of Post-Closure Maintenance and Surveillance Requirements

A key determinant in the setting and relinquishment of reclamation securities is the extent to which maintenance and surveillance (monitoring) are required during the post-closure phase. These potentially costly requirements are often overlooked until a mine is approaching the end of its operational life, thereby creating uncertainty for proponents, regulators and interested parties. To reduce this uncertainty, post-closure maintenance and surveillance requirements should be conceptually defined as early as possible during the mining life-cycle, ideally prior to the issuance of authorizations. Post-closure requirements should be assessed within the context of an appropriate post-closure timeframe (e.g., 100 years). All post-closure assets (e.g., tailings covers, dams) should be assessed qualitatively to determine their anticipated performance throughout this timeframe by evaluating potential failure modes/consequences and any maintenance and/or surveillance actions that may be necessary to mitigate the risks or consequences. When determining the extent of maintenance that might be required, precedent suggests that conservatism is justified. For example, after experiencing multiple unplanned maintenance requirements in its portfolio of northern mine sites, INAC's Northern Contaminated Sites Program has found that the following general guidance is appropriate when determining post-closure maintenance requirements and costs:

1. **Year 10 Post-Closure Repair Event:** 10% of the original closure cost of relevant components *(e.g., tailings covers, dams and water conveyance channels)*;2
2. **Year 35 Post-Closure Risk Event:** An additional 20% of the original closure cost of relevant components;
3. **Mobilization / Demobilization / Camp:** 80% of the original mob/de-mob and camp costs, applied to each of the Year 10 and Year 35 events.

These anticipated maintenance requirements are being built into the Department's long-term plans and budgets.

Based on our review, the current versions of TMAC's CRPs provide limited information on the post-closure maintenance and surveillance requirements. While statements indicating potential requirements are made, a systematic evaluation of potential requirements is not presented. Failure to define postclosure maintenance and surveillance expectations has the potential to undermine project certainty and could affect relinquishment.

Clarity Regarding Post-Closure Land Use

Closure and reclamation plans should be based on clearly defined and consistent post closure land uses. With regard to precedent, the majority of northern mine sites have selected "parkland" (or equivalent) land use designations when designing their CRPs. However, in the case of the Hope Bay Project, there is a lack of clarity regarding post-closure land use. For example, the following documents indicate that "industrial" land use remediation guidelines will be used:

- Hydrocarbon Contaminated Material Management Plan (P4-14)
- Doris-Madrid Interim Closure and Reclamation Plan (P4-21)

Clarity is required regarding the proposed post-closure land use of the Hope Bay sites. This issue should be resolved as early as possible in the closure planning process.

11.5 Recommendation/Request

RECOMMENDATION #7

TMAC should comply with all requirements of the applicable closure planning guidance, both in content and structure, when submitting all subsequent revisions of the Hope Bay Project CRPs.

11.6 TMAC Response to Recommendation #7

TMAC disagrees with the reviewers conclusion and statement that the Closure and Reclamation Plans (Packages P4-19 and P4-21) do not comply to the applicable closure planning guidance as stated. While TMAC did not follow the guideline Table of Contents to the letter, all of the relevant and important information pertaining to a Conceptual and Interim Closure Plan are provided, considering the relevant stage of closure planning in each case. In this regard TMAC would like to point out that in accordance with the guidelines, the concept of "Preliminary Closure Plans" as the reviewer is calling TMAC's plans don't exist, there are only Conceptual and Interim Closure Plans during the pre-development stages. The Boston Conceptual Closure and Reclamation Plan and the Doris-Madrid Interim Closure and Reclamation Plan are developed at these levels respectively.

Furthermore, while TMAC will ensure, as it always has, that all future closure plans will continue to comply with applicable closure planning guidance in terms of informational content, TMAC will not blindly follow template Tables of Content proposed in the guidance. Each Closure Plan is unique and should be written as such. Doing so ensures that the document remain functional, practical and fit for the intended purpose. Furthermore, TMAC will ensure that Closure Plans remain concise and will reference rather than repeat information that are formally documented elsewhere.

RECOMMENDATION #8

TMAC should fund and establish a stakeholder working group (or equivalent mechanism) to promote effective engagement/consultation related to closure planning. The working group should be actively involved when determining foundational aspects of the CRPs (closure principles, objectives, criteria, etc.)

11.7 TMAC RESPONSE TO RECOMMENDATION #8

At present, TMAC has prepared pre development closure plans as per process requirements and there will continue to be engagement and updates to the closure plan in years to come if the project is approved. No unconventional closure technology is being proposed and there is no requirement to have a specific stakeholder working group. INAC may be familiar with working groups in the context of properties that are nearing closure where a specific working group may be required to address specific or unconventional closure items. This is not the case for TMAC's Project.

RECOMMENDATION #9

TMAC should clearly define the long-term post-closure maintenance and monitoring requirements of the Hope Bay Project. The requirements should be directly linked to a systematic review of all site components to determine potential failure modes and necessary mitigations.

11.8 TMAC RESPONSE TO RECOMMENDATION #9

Post-closure monitoring and maintenance is described in Section 4.7 of Package P4-21 and Section 9 of Package P4-19. These monitoring and maintenance activities have been selected taking into consideration the elements that drive the closure activity, and the associated performance criteria of those activities. Given the early project, and therefore closure plan, stage, the level of detail associated is considered appropriate.

The reviewer points towards specific anticipated maintenance requirements being built into INAC's long-term plans and budgets, which would prescribe maintenance and monitoring activities. This prescriptive approach seems contradictory when compared with the reviewers statement that a systematic evaluation of potential post-closure monitoring and maintenance requirements taking the project life cycle into account should be considered.

RECOMMENDATION #10

Working with interested parties, TMAC should specify the post-closure land uses for the Hope Bay properties.

11.9 TMAC RESPONSE TO RECOMMENDATION #10

TMAC has a land lease with the KIA and this will be an ongoing discussion. To date the KIA is in agreement with our closure plan.

12. ID #INAC-TC-4

12.1 Subject/Topic

Water Treatment Plant Effluent Quality

12.2 References

P5-4: Hope Bay Project – Water and Load Balance

12.3 Summary

The effluent quality of the proposed water treatment plants is highly optimistic. Additional information is required to confirm that predicted effluent quality concentrations are achievable.

12.4 Discussion

Importance of Issue to the Impact Assessment Process

Loadings from the water treatment plants are a key variable when assessing potential water quality impacts from the project.

Detailed Review Comment

Contact water quality modelling for the Boston project predicts that elevated concentrations of arsenic and cadmium are a concern. A two-stage contact water treatment process has therefore been proposed. The process will target arsenic removal with ferric co-precipitation, followed by lime neutralization to reduce cadmium concentrations to discharge limits. The Boston Process Plant will also use ferric co-precipitation and lime neutralization but with the addition of a biological process to address ammonia.

With regard to the Doris and Madrid sites, once the Madrid project comes online, arsenic concentrations in the mine water and Doris TIA are predicted to exceed the proposed MMER regulations for arsenic (0.1 mg/L). A Doris contact water treatment plant will therefore be required to remove arsenic. The process will use the first stage of the Boston contact water treatment plant (i.e., arsenic removal via ferric co-precipitation).

TMAC's analysis of potential environmental impacts from the Hope Bay Project is based on assumptions regarding the treatment efficiency and effluent quality from the various water treatment plants. Of particular importance, document P5-4 (Table 3-19) indicates the Boston Contact Water Treatment Plant will achieve an arsenic concentration of 0.01

mg/L in its treated effluent[3]. The other treatment plants at Boston and Doris will reportedly achieve the same effluent quality. We consider this to be highly optimistic for a field application of ferric co-precipitation and question the ability of the treatment plants to achieve such low concentrations. None of the reviewed documentation describes the treatment processes in detail, nor is any evidence provided to substantiate the reported effluent quality

12.5 RECOMMENDATION/REQUEST

RECOMMENDATION #11

TMAC should provide a conceptual design of its proposed water treatment processes. The study should clearly indicate the anticipated effluent quality of the systems and provide evidence of comparable results being achieved in full-scale mining operations.

12.6 TMAC RESPONSE TO RECOMMENDATION #11

Ferric-coprecipitation is an industry wide accepted and proven treatment technology for arsenic. This technology is recognized as a best available technology economically achievable (BETEA) for arsenic removal by Mine Environment Neutral Drainage (MEND) and numerous plants in operation throughout Canada are able to meet the proposed MDMER regulation of 0.1 mg/L arsenic (MEND 2014).

In this proposed process, ferric iron is added to the feed under low pH conditions (4 to 6) to co-precipitation arsenate as ferric arsenate.

$$Fe_2(SO_4)_6 + 2H_6AsO_4 + 2H_2O \leftrightarrow 2FeAsO_4 \cdot H_2O_{(s)} + 3H_2SO_4$$

Arsenate removal is a function of the ferric dosage, with higher removal rates the higher the molar ratio between Fe^{3+} and As^{5+}. The MEND report (2014), indicates that within the precious metal sector, 10 sites have a treatment technology classified as "self-identified as targeting" meaning that employ a technology that specifically treats for arsenic. In Table 6.29 (MEND 2014) average and minimum effluent arsenic concentrations were 0.085 and 0.00025 mg/L, respectively, for plants targeting for a MMER effluent arsenic concentration of 0.5 mg/L.

Arsenic treatment tests were conducted on historic flotation and cyanidation samples from Hope Bay in 2008 and 2009 (Pocock 2009). For the Naartok West and East flotation decant (most reflective of influent arsenic concentrations), arsenic concentrations were lowered from 0.59 and 0.49 mg/L to <0.005 mg/L with a ferric dosage of 23 mg/L (Pocock 2009). Based on data collected by MEND and previous water treatment test work by Pocock the treatment target of 0.01 mg/L for arsenic is achievable.

[3] Appendix C-1 of the same document indicates the Boston Contact Water Treatment Plant will have average dissolved arsenic concentrations of 0.00074 mg/L and the Process Water Treatment Plant will achieve effluent concentrations of 0.0035 mg/L

References:

[MEND] Mine Environment Neutral Drainage. 2014. Study to Identify BATEA for the Management and Control of Effluent Quality from Mines. MEND Report 3.50.1. Prepared by Hatch. September 2014.

Pocock Industrial, Inc. 2009. Initial Arsenic Treatment Scoping Test Summary on Decan Solutions from Flotation Tailings, and Flotation Concentrate (CIL) before and after Cyanide Destruction. Report prepared for Newmont Mining Corporation. December 2008 – February 2009

13. ID #INAC-TC-5

13.1 Subject/Topic

Backfill Material

13.2 References

P4-11: Hope Bay Project – Waste Rock, Ore and Mine Backfill Mgmt. Plan
P4-19: Hope Bay Project – Boston Conceptual Closure and Reclamation Plan
P4-21: Hope Bay Project – Doris-Madrid Interim Closure and Reclamation Plan

13.3 Summary

There is a lack of clarity regarding TMAC's rationale for sourcing additional backfill from quarried rock instead of readily available filtered tailings at the Boston site.

13.4 Discussion

Importance of Issue to the Impact Assessment Process

Development of quarries to source incremental backfill presents potential environmental impacts and additional closure requirements.

Detailed Review Comment

The closure plans for the Hope Bay Project involve backfilling the underground with the entire inventory of filtered detoxified cyanide leach tailings and waste rock. TMAC predicts that the volume of detoxified tailings and waste rock will be insufficient to meet the backfill requirements and proposes to source the additional backfill from rock quarries. Based on current estimates, approximately 1.8 million tonnes of additional backfill will be required at the Doris-Madrid properties and an additional 0.9 million tonnes will be needed at the Boston site. The total backfill deficit is therefore approximately 2.7 million tonnes.

With regard to other potential sources of backfill, we note that the project will produce 18 million tonnes of low solids slurried flotation tailings that will be deposited in the Doris TIA and 5.1 million tonnes of filtered flotation tailings that will be placed in the Boston "dry stack" TMA. While we assume that TMAC assessed whether these waste streams could be used as backfill instead of quarried rock, we have not identified any descriptions of these assessments in the project documentation. For example, potential advantages of using the Boston filtered tailings as a source of mine backfill include: 1) the capacity of the Boston TMA could be reduced by approximately 50%; and 2) the need for an incremental 2.7 million tonnes of quarried backfill could be eliminated.

13.5 RECOMMENDATION/REQUEST

RECOMMENDATION #12

TMAC should describe their rationale for using quarried rock instead of filtered flotation tailings to address backfill volume deficits at the Hope Bay sites.

13.6 TMAC RESPONSE TO RECOMMENDATION #12

TMAC's mining methods require structural backfill. The floatation tailings does not offer the necessary strength characteristics without addition of a binder such as cement. The amount of cement necessary to provide the required strength of backfill is cost prohibitive, but more importantly, the time required for the cement to cure and provide the necessary strength would not be practical.

14. ID #INAC-TC-6

14.1 Subject/Topic

Long-Term Climate Change Effects

14.2 References

P5-1: Hope Bay Project – Climate Change Analysis Approach Report

14.3 Summary

Flotation tailings will remain on surface in perpetuity. Natural freezing is one of the mechanisms that will be used to isolate these wastes, thereby reducing their metal leaching potential. Climate modelling predicts that temperatures will increase more than 5°C by the year 2100 and will result in increased active zone depths. Despite the inherent challenges of long-term climate modelling, additional efforts are needed to characterize climate change impacts beyond this point. This information will help to ensure closure plans are sufficiently conservative.

14.4 Discussion

Importance of Issue to the Impact Assessment Process

Thawing of frozen tailings could result in elevated metal leach rates and impacts to surface water receivers. This situation would not become apparent until decades after closure of the mines. Conservatism is therefore justified when predicting potential impacts and closure strategies.

Detailed Review Comment

There is agreement within the engineering community that climate change is occurring, and that it should be integrated into engineering designs. Towards this end, TMAC prepared a climate change analysis report for the Hope Bay Project which provides the climate change projections for key climatic and hydrologic design parameters for use in engineering designs (document P5-1). The report concluded that the mean annual air temperature (MAAT) at Doris, which includes Madrid, is expected to increase by 6.8°C by 2100. In the case of the Boston site, the MAAT is predicted to increase by 5.5°C over the same period. These and other predictions compare well with estimates from independent studies, including the International Panel on Climate Change (IPCC). It is important to note that TMAC's climate modelling extended only to the year 2100 which is generally accepted to be the maximum reasonable timeframe for climate change predictions. Beyond that point there is a high degree of uncertainty regarding climate change modelling.

In terms of potential climate change impacts, the depth of the active layer at the Hope Bay Project will play an important role in the post-closure chemical and physical stability of the sites. For example, the potential flux of contaminants from the Doris TIA and Boston TMA will be influenced by the depth of the active layer. TMAC predicts that climate change up to 2100 will result in a 0.93 m increase in the thickness of the active layer (in clay overburden) and we assume this has accounted for in the geochemical load balance.

While we acknowledge the uncertainties associated with climate modelling past 2100 and accept TMAC's approach, consideration should also be given to potential climate change impacts that might credibly extend beyond that point. This could be addressed by performing sensitivity analyses that project further into the future using the predicted climate data for 2100. For example, if the climate were to remain constant from 2100 onward, would the thickness of the active zone increase further? At what depth would the active zone become stable? Would this affect the overall environmental performance of the site (e.g., would there be increased seepage/leaching)? Answers to these questions would help to provide perspective on potential climate change impacts and could be used to determine the required level of conservatism that should be factored into the designs. This is particularly important given the metal leaching potential of the flotation tailings that will be stored on surface in perpetuity (i.e., long after 2100).

14.5 Recommendation/Request

RECOMMENDATION #13

TMAC should confirm that the geochemical source terms used to assess project impacts have accounted for anticipated climate changes up to 2100.

14.6 TMAC Response to Recommendation #13

TMAC confirms that climate change has been considered when evaluating source terms for the Doris TIA and Boston TMA covers. Specifically, the Doris TIA oxidation layer thickness calculation is presented in Appendix C of Package P5-9 (Source Term predictions for the proposed Madrid North, Madrid South, and Boston Deposits, Hope Bay Project)and the Boston TMA active layer thickness is based on the year 2100 active layer thickness for the TMA as presented in Appendix D of Package P5-26 (Boston Tailings Management area Preliminary Design, Hope Bay Project).

RECOMMENDATION #14

TMAC should perform sensitivity analyses that projects climate change effects to 200 years post closure using the predicted climate data for 2100. The sensitivity analyses should assess any incremental environmental impacts that might occur (e.g., additional seepage from tailings). The findings of the sensitivity analyses should be considered when developing the next revisions of the Closure and Reclamation Plans.

14.7 TMAC Response to Recommendation #14

TMAC disagrees that additional climate change sensitivity analysis is required. TMAC's approach to climate change is clearly documented in Package P5-1 – Climate Change Analysis Approach Report, Hope Bay Project. This approach is explicit, transparent and intentionally does not make predictions based on opinions or personal preferences with regard to approach, methodology, period or choice of climatic models. Suggesting sensitivity analysis beyond the year 2100, goes against current acceptable practice insofar as use of climate change models, as recognized and supported by Environment and Climate Change Canada (ECCC).

Furthermore, while climate change does play a role in predicted post-closure water quality predictions, the most significant driver is the actual tailings source terms which have been rigorously and conservatively calculated as defined in Package P5-9 (Source Terms Predictions for the Proposed Madrid North, Madrid South, and Boston Deposits, Hope Bay Project). As more information of these source terms becomes available through project development, water quality predictions will be updated and that would provide much greater certainty regarding future conditions than academically speculating about climate change.

15. ID #INAC-TC-7

15.1 Subject/Topic

Release of Saline Minewater to the Tundra

15.2 References

P4-3: Hope Bay Project - Spill Contingency Plan
P4-7: Hope Bay Project – Doris-Madrid Water Management Pan
P4-19: Hope Bay Project – Madrid Water Management Design
P4-18: Hope Bay Project – Aquatic Effects Monitoring Plan
P5-4: Hope Bay Project – Water and Load Balance
FEIS Volume 7 – Accidents and Malfunctions

15.3 Summary

Overburden materials in the vicinity of the mining developments are ice rich. Permafrost degradation in such soils has the potential to compromise their structural integrity and to cause environmental impacts (e.g., erosion). Degradation is a particular concern when ice rich soils are exposed to high salinity fluids. Large volumes of saline mine water will be handled throughout the construction and operational phases of the project. It is therefore important that consideration be given to potential impacts from accidental releases of saline mine water to the tundra.

15.4 Discussion

Importance of Issue to the Impact Assessment Process

Permafrost degradation in ice rich soils could result in structural failures, erosion, sedimentation and impacts to surface water receivers/receptors.

Detailed Review Comment

Madrid North and Madrid South will be developed within a portion of the taliks of 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 pumped to surface, transported via pipelines and discharged to a marine outfall diffuser in Roberts Bay. The salinity of the minewater is anticipated to reach peak chloride concentrations of 18,000 mg/L. This is similar to seawater which has a freezing point of approximately −2 °C.

Overburden materials throughout the development areas are dominated by marine silts and clays containing ground ice at concentrations of up to 50% (some drill holes at Boston have also reported ice up to 70% in overburden). The elevated ice content of these soils makes them susceptible to permafrost degradation which, in turn, can compromise the physical properties of the soils, causing structural failures (e.g., subsidence), erosion, sedimentation and other environmental impacts to surface water receivers/receptors.

Based on the above, there is a potential that inadvertent discharges of saline mine water to the tundra would have adverse effects on the environment. This issue is addressed partially in Volume 7 of the FEIS which concluded that a pipeline rupture or significant leak is considered "possible" and that the associated environmental consequences would be "moderate". However, that analysis did not explicitly consider the impact of releasing large volumes of high salinity mine water in areas with ice rich soils. This represents a gap in the analysis of potential project impacts and required mitigations.

15.5 RECOMMENDATION/REQUEST

RECOMMENDATION #15

TMAC should explicitly evaluate the failure modes and consequences of high salinity water (including mine water) being discharged to the tundra, with an emphasis on potential impacts to ice rich soils. The analysis should include case studies of similar events. Subject to the findings of this evaluation, modifications should be made to the project's management plans to further prevent such events and/or mitigate their impacts.

15.6 TMAC RESPONSE TO RECOMMENDATION #15

The Roberts Bay Marine Discharge (RBMD) Pipeline, approved under the existing Doris Water License is a 5.7 km overland pipeline that transports saline mine water (similar to what will be encountered at Madrid) from the Doris mine to Roberts Bay. This pipeline which is currently under construction was subject to a rigorous Hazard and Operability (HAZOP) study as part of its detailed design. This study is expressly intended to review all potential hazards associated with the pipeline, and if necessary provide for additional engineering or management controls to mitigate those hazards. This is normal best practice in pipeline design, and TMAC will continue to follow that process.

16. ID #INAC-TC-8

Water Licences for Hope Bay

Reference:

- NWB Renewal Licence No. 2BE-HOP1222, Hope Bay Regional Exploration Program, Nunavut Water Board, June 30, 2012
- NWB Type "A" Water Licence No. 2AM-DOH1323 Amendment No.1– Doris North Project, Nunavut Water Board, November 6, 2016
- NWB Renewal Water Licence No. 2BB-BOS1727, Nunavut Water Board, July 26, 2017
- TMAC's Water Licence No. 2BB-MAE1727 Amendment No.1 for Madrid Advanced Exploration Program, Nunavut Water Board, January 12, 2018
- P2-1 Project Description, Amendment no.2 Type A Water Licence 2AM-DOH1323 (Doris and Madrid), TMAC Resources Inc., December 2017
- P2-2 Project Description, Type A Water Licence Boston, TMAC Resources Inc., December 2017
- P4-12 Water and Ore/Waste Rock Management Plan for the Boston Site, SRK Consulting Inc., January 2017

Comment:

Presently, TMAC has four water licences regulating their activities in the Hope Bay belt:

1) **2BE-HOP1222** – Exploration licence covering the use of water and disposal of waste during camp operations and exploration drilling at the 180 person Windy Lake Camp associated with the Hope Bay Regional Exploration Program. Associated infrastructure includes fuel storage, water intake, wastewater treatment, quarries A, B & D, and Doris-Windy all weather road. Permitted water use includes 63 m^3/day for potable water, 80 m^3/day for drilling purposes, and 200 m^3/day seasonally from Windy Lake for dust suppression on the Doris-Windy road. The licence includes discharge criteria for treated sewage, contact water from the bulk fuel storage facility and contact water from the quarries. The geographical extents covered by this licence are: 67°29'11.226' to 68°12'30.017"N and 106°8'3.172" to 106°45'0.001"W.

2) **2BB-MAE1727** – Advanced exploration licence allowing for geologic and geophysics mapping, surface and underground diamond drilling (including off ice drilling), test stoping and bulk sampling of two 50 000 tonne samples at Madrid North and Madrid South. Infrastructure includes roads and culverts, surface ore and waste storage pads, fuel storage facilities, pollution control ponds and sumps, vent raises, and offices and emergency shelters. Permitted water use includes 5 m^3/day for potable water use and 290 m^3/day for industrial use. The licence includes discharge criteria for contact water from pollution control pond, contact water from the bulk fuel storage facility and contact water from quarries G, H & I. The geographical extents covered by this licence are: 68°00'07'' to 68°06'34"N and 106°29'00" to 106°40'29"W.

3) **2BB-BOS1727** – Advanced exploration licence allowing for prospecting, surface land based drilling and on-ice diamond drilling, diamond and reverse circulation drilling, on-site core splitting and logging, bulk sampling, the operation of a bulk sampling and crushing and sorting plant, a camp including domestic use of water, treatment and disposal of greywater and sewage, further underground development and underground exploration drilling, and the operation of a landfarm and bulk fuel storage facilities. Infrastructure includes a 30 person camp, sewage treatment facility, containment Pond, bulk fuel storage facility, landfarm facility, and contaminated soil temporary storage area, and portal decline. Water use permitted is 100 m^3/day for all purposes. The licence includes discharge criteria for contact water from the containment pond, portal, landfarm, bulk fuel storage area and for treated sewage. The geographical extents covered by this licence are: 67°36'13'' to 67°41'41"N and 106°19'22" to 106°26'27"W.

4) **2AM-DOH1323** – Mine undertaking licence with many components, allowing for the Doris North gold mine project. The geographical extents covered by this licence are: 68°02'55'' to 68°11'13"N and 106°31'37" to 106°39'15"W.

In their project descriptions, TMAC explain how they would like the present type B licences handled by requesting:

- *"To expand the scope of Licence 2AM-DOH1323 Amendment No. 1 by incorporating into this Licence the scope of all facilities and activities authorized under the Type B Licence 2BB-MAE1727. TMAC requests that the Madrid Type B Water Licence 2BB-MAE1727 be maintained until such time that the bulk sample is completed and the decision is made to enter into production at Madrid."*
- *"TMAC will retain Type B Licence 2BB-BOS1217 for ongoing exploration activities of the Boston deposits."*

INAC is of the opinion that licences should cover distinct undertakings with as little overlap as possible for clarity on the proponent's obligations and responsibilities for monitoring, inspections and reclamation associated with each licence. As such, the applicant's request to keep concurrent licences for the same activities is problematic.

With respect to Madrid, it is not clear if TMAC wants to hold off on amendment no.2 until they have made a decision to enter into production there. If this is the case, we can also hold off on evaluating this application until such time the applicant decides to proceed. If TMAC is in fact requesting that the infrastructure permitted under 2BB-MAE1727 also be permitted under 2AM-DOH1323 amendment no.2, INAC does not believe this request should be granted because it would not be possible to sort out obligations and responsibilities from both licences.

TMAC is also requesting to keep the advanced exploration licence at Boston. The infrastructure proposed for the 2AM-BOS---- licence includes some of what is licensed under 2BB-BOS1727 or will be built over existing licensed infrastructure. Keeping two licences in this instance leads to confusion, as is already apparent from the application, for example:

- Camp size: Table 1.2-1 of the project description (P2-2) the camp under 2BB-BOS is for 65 people and that for 2AM-BOS is for 300 people, which totals 365 people. Yet Section 5.1 of the same document states accommodations at the Boston Site will initially be 65 persons at the existing camp and will increase to 300 persons.
- Water and Ore/Waste Rock Management Plan for Boston: The plan presented is the one associated with the 2BB-BOS1727 licence and is different than the Waste Rock, Ore and Mine Backfill Management Plan that applies to all of the Hope Bay mines including Boston. It contains statements such as: "*If an opportunity to process this material (ore) arises*" and "*If further mine development is considered, this plan will be updated at that time to reflect the change.*", which do not account for the new type A application.

Since the area for exploration covered by the 2BB-BOS1727 licence is also covered by 2BE-HOP1222, authorization for exploration activities would not be lost if the 2BB-BOS1727 licence was rolled into a type A licence. The component which would be lost was the possibility of taking a bulk sample at Boston.

INFORMATION REQUEST #1

The applicant should clarify whether they want to hold off on the amendment to 2AM-DOH1323 to include the Madrid project until they have made a decision regarding entering production, or if they are requesting to hold two water licences (a type B and a type A) to cover the same infrastructure at Madrid.

16.1 TMAC Response to Information Request #1

TMAC will be providing a response to this recommendation prior to April 8th, 2018 as per the NWB's extension granted to TMAC

RECOMMENDATION #16

INAC recommends that, if granted, a 2AM-BOS licence incorporate the scope of activities and facilities authorized under 2BB-BOS1727, so that the type B licence can be cancelled.

16.2 TMAC Response to Recommendation #16

TMAC will be providing a response to this recommendation prior to April 8th, 2018 as per the NWB's extension granted to TMAC.

17. ID #INAC-TC-9

Industrial water treatment plant at Doris

Reference:

- P3-1 Application for Water Licence Amendment (2AM-DOH1323 no.2), TMAC Resources Inc., December 20, 2017
- P2-1 Project Description, Amendment no.2 Type A Water Licence 2AM-DOH1323 (Doris and Madrid), TMAC Resources Inc., December 2017
- P4-7 Doris-Madrid Water Management Plan, TMAC Resources Inc., December 2017
- P5-4 Madrid-Boston Project Water and Load Balance, SRK Consulting Inc., November 2017
- P5-19 Madrid Water Management Engineering Report, SRK Consulting Inc., November 2017

Comment:

Box 15 of the amendment application indicates "*an industrial water treatment plant will be added to Doris site. Refer to P5-4 Madrid-Boston Project Water and Load Balance for additional details*." There is no reference to this treatment plant in the Project Description (P2-1) and the only place it appears in the Water Management Plan (P4-7) is in Figure 1. The same Figure 1 with a "Doris Contact Water Treatment Plant" is part of the Madrid Water Management Engineering Report, though no mention of it is made in the text.

The description in the Water & Load Balance is: "*A Doris contact water treatment plant will be required to remove arsenic. The process will employ the first stage of the Boston contact water treatment plant, which is arsenic removal via ferric co-precipitation. In the model, the arsenic and iron concentrations from the Boston contact water plant effluent were applied to the Doris contact water plant.*"

Given the information provided, it is difficult to assess the adequacy of the proposed plant.

INFORMATION REQUEST #2

The applicant should provide information on the industrial water treatment plant including:

- Its approximate physical location;
- Whether a surge pond will be necessary, as at Boston. If so, preliminary design of the pond should be provided;
- Technology to be used and how effective it can be (related to **R 11**);

- The plant's capacity; and
- Planned construction date.

17.1 TMAC Response to Information Request #2

- The Doris treatment plant will be constructed at the Doris TIA, adjacent to the Reclaim Pond pump station.
- The Doris TIA is the Doris contact water surge pond.
- See TMAC's response to INAC Recommendation 11.
- The Doris treatment plant will have a maximum treatment flowrate of 9,750 m3/day.
- The Doris treatment plant is required to one year after Madrid North processing start. Based on the schedule presented in the FEIS, treatment is required in June 2021.

RECOMMENDATION #17

INAC recommends that TMAC integrate answers to **IR 2** into the Doris-Madrid Water Management Plan. An Operation and Management Plan for the plant should also be provided.

17.2 TMAC Response to Recommendation #17

TMAC will update the Doris-Madrid Water Management Plan to include details of water treatment, and submit the updated plan for approval 90 days prior to commissioning the water treatment plant.

18. ID #INAC-TC-10

Water & Load Balance model validation

Reference:

- P5-4 Madrid-Boston Project Water and Load Balance, SRK Consulting Inc., November 2017

Comment:
The water & load balance model was calibrated using data from 2010 to 2016. "*Five flow stations were selected as points to validate the model calibration.*" According to Figures 5-3 to 5-5 and 5-7, the years covered by validation were also 2010 to 2016.

It is not clear if the data was used for validation was also used for calibration. If it was, it would render the validation unconvincing.

INFORMATION REQUEST #3

The applicant should clarify if data from the five flow stations used for model validation were also used for calibration

18.1 TMAC Response to Information Request #3

The model water and load balance went through a calibration process to set runoff coefficients and then through a model validation exercise. The Doris Tailings Impoundment Area (TIA) was selected for the Doris and Madrid Catchments and Aimaokatalok Lake was selected for the Boston Catchment. The Doris TIA contained the strongest calibration points as flows in and out of the lake were well documented in site records and the lake elevation is continuous and georeferenced. Aimaokatalok Lake was the strongest calibration point in the Boston Watershed although not as strong as the Doris TIA, as less data had been collected at this location comparatively. During the calibration exercise, runoff coefficients were selected for each catchment.

The model produces flow and level predictions for 12 lakes and many stream flow locations. Flow and level measurements at some of these locations were sporadic during the period spanning 2010 to 2016. Data for the following locations was compared to measured data to validate the previously completed calibration:

- Doris Creek TL-2,
- Patch Lake Outflow,
- Ogama Lake Outflow,
- Windy Lake Outflow, and,

- Aimaokatalok Lake Outflow.

Limited data was available for Boston during the calibration process. Using both the Aimaokatalok Lake elevation and outflows defeats the validation of this location, however there were years where only flow was available and in the absence of other data this was used.

Overall the model calibration and subsequent validation do span the same periods. This does not render the validation unconvincing as different nodes were selected for validation that are affected by model mechanisms in different ways.

19. ID #INAC-TC-11

Aquatic Effects Monitoring Plans

Reference:

- P4-18 Madrid-Boston Aquatic Effects Monitoring Plan, TMAC Resources Inc., December 2017
- Doris Aquatic Effects Monitoring Plan, TMAC Resources Inc., June 2016
- P5-4 Madrid-Boston Project Water and Load Balance, SRK Consulting Inc., November 2017

Comments:

i. The Madrid-Boston Aquatic Effects Monitoring Plan (AEMP) is meant to supplement the existing Doris AEMP. In some areas, it is not clear how the two documents fit together. For example, the Doris AEMP includes a site for ice thickness, temperature and dissolved oxygen monitoring at the north end of Doris Lake, and the Madrid-Boston AEMP also includes a site at the north end of Doris Lake, but this one is for many more parameters including water quality, chlorophyll a, benthos and sediment quality. Another example is chloride being included as a water quality parameter in the Madrid-Boston AEMP, but not in the Doris AEMP. As well, the Doris AEMP includes a Response Framework, which is not included or mentioned in the Madrid-Boston AEMP.

ii. Water quantity monitoring is included in the Madrid-Boston AEMP: "*To monitor potential effects of water withdrawal and groundwater removal on the surface water, lake water level monitoring will occur in Wolverine, Patch, Doris, Windy, and Aimaokatalok lakes.*" Further detail is provided as to station locations: "*Hydrometric monitoring stations will be installed in each lake, preferably at accessible locations near exposed bedrock (for survey purposes) and deeper water (to allow year-round under-ice data collection).*" It is not clear if flow data from the lake outflows will be measured or estimated, as has been done for the hydrology data described in the Water and Load Balance, which includes both level and flow for the lake outflows.

   The Water and Load Balance model predicts impacts to lake elevation and lake outflow, with the greatest changes in the Doris watershed. Outflow reductions of 56%, 23% and 32% are estimated for Wolverine, Patch and Doris Lakes, respectively. It may be easier to identify changes in the stream outflows rather than lake levels so they should be included in the monitoring.

iii. The Madrid-Boston AEMP includes monitoring of Reference Lake B in an adjacent watershed outside the project's expected area of influence. Water levels are to be monitored in five lakes in the study area but not at Reference Lake B. Measuring lake levels at Reference Lake B might allow the applicant to tease out

   project effects from climate change effects, particularly since the requested licence term of 25 years could be sufficiently long to measure impacts. The AEMP states "*lake water levels … will be compared to baseline information and environmental impact statement (EIS) predictions*" and because those predictions incorporate the effects of climate change on the hydrometerological system, measuring water level changes on Reference Lake B is relevant.

iv. No monitoring is proposed for Imniagut Lake in the Madrid-Boston AEMP. Since the Water and Load model predicts a lake level decrease of more than 1.5 m, which can have an important effect in a relatively small lake, some monitoring this lake should be undertaken.

v. In the plan, the applicant proposes reducing monitoring during closure or temporary closure: "*During the Closure and Temporary Closure (i.e., care and maintenance) phases, sampling will continue as prescribed under the Metal Mining Effluent Regulations (MMER) at sites related to MMER Environmental Effects Monitoring (EEM) discharge sampling in Aimaokatalok Lake (as identified in Table 3.1-1). Water level monitoring will also continue as long as combined winter water withdrawal and groundwater inflows are greater than 10% of lake volume. Due to the reduction of site activities, other sampling addressing non- point-source inputs will be suspended during Closure and Temporary Closure unless effects have been detected in the immediately preceding years.*"

Although site activities would be reduced under closure or temporary closure, some important non-point source inputs will still be present. For example, the tailings will remain exposed to wind. The reduced site presence associated with care and maintenance, sustaining monitoring activities is critical to ensuring management measures for the ore, waste rock, fuel, quarries and infrastructure are effective at protecting water.

vi. The analysis method proposed for evaluating potential effects in water quality data is the before-after-control-impact (BACI) design. "*'Before' data will be that collected at a site prior to potential effects*", however the plan does not specify a minimum duration of 'before' data collection. Several years of water quality data may be necessary to understand natural variability.

vii. INAC **R 1** requests an explicit demonstration that post-closure water quality criteria are protective of the receiving environment. The Response Framework in the Doris AEMP states: "*For water quality, the following trigger conditions will be considered for the Low action levels:*

- *identification of a significant difference in the "before" and "after" periods in the AEMP effects analysis (section 3.2) for that water quality variable; and*
- *exceeding the 75% percentage of a Canadian Council of Ministers of the Environment (CCME) water quality benchmark.*"

One of the low action level responses from the Doris AEMP Response Framework may be "*a review of the water quality benchmark or development of a site-specific water quality objective (SSWQO).*" and we are aware that TMAC has proposed site specific water quality objectives for arsenic.

In light of the Water and Load Balance model predicting concentrations of certain elements in lakes exceeding CCME water quality guidelines for the protection of aquatic life after closure, further discussion on SSWQOs is warranted. In order to evaluate whether proposed water treatment and waste management options presented in the application are adequate, it is necessary to know and agree on water quality objectives. The AEMP might be an appropriate place to develop the response.

INFORMATION REQUEST #4

The applicant should provide more information on the hydrological measurements planned, including:

- Station locations; and
- If lake outflows will be calculated, and if so what rating curves will be used and how often will they be verified.

19.1 TMAC RESPONSE TO INFORMATION REQUEST #4

TMAC will monitor water levels and flows in fish bearing lakes and streams that are predicted to be potentially impacted by the Project during mining. Hydrometric monitoring will be carried out by standard methods appropriate for assessing changes in lake level/stream flow (e.g., suitable combination of pressure sensors, staff gauges, and/or manual flow measurements in lakes and/or streams).

Station specific rating curves will be developed at all flow monitoring stations. Rating curve equations are typically developed using standard methods outlined by the International Organization for Standardization (ISO 2010). Once developed, typically a minimum of three sets of manual stream flow measurements are made annually, spread across the open water season, to cover high and low flow periods.

Reference:

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.

INFORMATION REQUEST #5

The applicant should clarify the minimum duration of 'before' water quality data collection for the BACI analysis.

19.2 TMAC RESPONSE TO INFORMATION REQUEST #5

There are no statements within federal (e.g., Environment Canada 2012), provincial (e.g., BC MOE 2016), or territorial (INAC 2009) AEMP or aquatic monitoring guidance documents indicating the minimum baseline data required for the 'before' portion of the BACI analysis. At present, the available baseline water quality data for the proposed AEMP waterbodies to support environmental effects analyses under the AEMP, includes 8 years for Patch Lake, Wolverine Lake, and Reference Lake B, 10 years in Stickleback Lake, and more than 10 years in Aimaokatalok Lake. This data will be augmented with baseline data that has been (April 2018) or will be collected in Patch, Wolverine, Aimaokatalok, Stickleback, and Reference Lake B in 2018. This far more 'before' baseline data than typically is used within the BACI analysis at Canadian mine sites.

RECOMMENDATION #18

INAC recommends the AEMP be modified so that:

- A single plan be produced for the Hope Bay belt, as TMAC has done with many other management plans;
- Lake water levels are monitored on Reference Lake B;
- Some monitoring of conditions in Imniagut Lake be included;
- Complete monitoring during closure or temporary closure be maintained; and
- Information is presented to support setting water quality objectives higher than CCME guidelines for elements predicted to exceed the guidelines by the Water and Load Balance model: fluoride, chloride, aluminum, arsenic, copper, chromium, mercury and iron.

19.3 TMAC Response to Recommendation #18

- TMAC is in agreement that a Belt-wide AEMP be developed and will do so following the Final Hearing based on a conversation with Environment and Climate Change Canada. Comments from the revised Madrid-Boston AEMP during the Final Hearing will be used during the development and finalization of a Belt-wide AEMP.
- TMAC does not plan to monitor lake levels in Reference Lake B.
- Monitoring of Imniagut Lake is planned and will be developed and submitted to DFO as part of a fisheries offsetting monitoring plan contained within a Fisheries Authorization application.
- Similar to the Doris AEMP (Section 3.1), aquatic monitoring will be re-evaluated three months prior to closure to determine the appropriate monitoring, and monitoring under care and maintenance will be re-evaluated with interested Parties prior to the Project entering this phase.
- Water quality objectives will be considered under the annual AEMP evaluation. The revised AEMP will contain an Aquatic Response Framework with tiered action levels such that a statistically significant increase in a Project lake for a specific parameter relative to a reference lake will trigger a low action level response if the parameter concentration is greater than 75% of its benchmark concentration (i.e., CCME guideline level). A low action response will investigate the potential cause of the increase, and will set medium and potentially high level action responses that could include developing site-specific water quality objectives for those parameters that triggered the low action response.

20. ID #INAC-TC-12

Contact water pond design

Reference:

- Contact Water Berm Design, SRK Consulting Inc., November 2017
- Geotechnical Design Parameters and Overburden Summary Report, SRK Consulting Inc., November 2017
- Madrid North Surface Infrastructure Preliminary Design, SRK Consulting Inc., November 2017

Comment:

Overburden in the Hope Bay belt is largely comprised of marine clays and silts, as described in the Overburden Summary Report. The design for contact water ponds for

Boston, Madrid North and Madrid South makes use of the low permeability of this material. Specifically the Contact Water Berm Design states: "*The contact water ponds are unlined ponds that use the permafrost and naturally low permeability of the foundation materials to contain the contact water on the bottom of the pond and a geomembrane acts as the impermeable layer within the berm. The contact water pond berm design hinges on the contact between the geomembrane and permafrost soil remaining frozen.*"

The design document includes the results from a numerical model to evaluate the proposed berm's stability. Results from a thermal model are also presented "*to verify the minimum berm thickness required to maintain the liner frozen within the key-trench.*" For both models, a marine clay base is assumed. It is 20 m thick for the thermal model, and there is no vertical scale for the stability model, where the clay appears to be approximately 5 m thick.

Isopach maps of overburden thickness for Madrid North (Figure 11) and Boston (Figure 12 are presented in the Overburden Summary Report and include an overlay of underground workings. The proposed infrastructure locations are not included on the maps, so it is not possible to see the overburden thickness at proposed contact water pond locations. The Madrid North Surface Infrastructure Preliminary Design offers some information: "*Isopach maps developed from exploration and geotechnical drill holes indicate that depths of overburden under the mining infrastructure is expected to range from 0 to 10 m, with most areas having less than 3 m of overburden.*" And "*Additional geotechnical investigations will be completed prior to detailed engineering*."

It seems quite possible that additional geotechnical investigations might find the thickness of marine clays is not the 20 m used for the model, which may have an incidence on the ponds since the properties of the underlying material is an integral part of the contact water pond design.

INFORMATION REQUEST #6

INAC requests further information on the implementation of the contact water berm design including:

- Maps where the proposed pond locations can be seen in conjunction with overburden thickness;
- The minimum marine clay thickness required for the contact water ponds to perform as designed; and
- Mitigation measures considered if the ground at the proposed contact water pond locations proves to be unsuitable.

20.1 TMAC RESPONSE TO INFORMATION REQUEST #6

Overburden isopach maps with sufficient accuracy is not available for the Contact Water Berm locations. As TMAC has repeatedly committed (see responses to Technical Comments NRCan-2.1.2, NRCan-2.1.3, and NRCan 2.1.5 (TMAC 2018)), prior to detailed engineering, site specific geotechnical site characterization will be done at each of these locations to confirm foundation conditions.

Thermal modeling results of the Contact Water Ponds (Package P5-3 - Hope Bay Project: Contact Water Berm Design) will not be sensitive to marine clay thickness unless it reduces to less than 5 m. This is based on extensive experience with thermal performance on site as evidenced from analysis in P5-3 - Hope Bay Project: Contact Water Berm Design, P5-5 – Geotechnical Design Parameters and Overburden Summary Report, Hope Bay Project, P5-13 – Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South, and Madrid North Mines, Hope Bay Project, P5-16 – Doris Tailings Management System Phase 2 Design, Hope Bay Project, and P5-26 – Boston Tailings Management Area Preliminary Design, Hope Bay Project.

Should such shallow overburden conditions exist, TMAC will consider one of three potential mitigation strategies:

1. Increased thermal protection over the Contact Water Berm to ensure appropriate thermal performance;
2. Complete excavation to allow a mechanical seal of the Contact Water Berm to the bedrock; or
3. Complete bottom lining of the pond to preclude the need to relay on a cut-off seal.

All of these potential mitigation strategies are proven technologies and none of them would materially change the project footprint or the final closure strategy of the project.

Reference:

TMAC. 2018. Hope Bay Project: Proponent's Response to Technical Comments on the Madrid-Boston Final Environmental Impact Statement: Toronto, Ontario.

21. ID #INAC-TC-13

Cyanide testing

Reference:

- NWB Type "A" Water Licence No. 2AM-DOH1323 Amendment No.1– Doris North Project, Nunavut Water Board, November 6, 2016
- P4-27 Quality Assurance and Quality Control Plan, TMAC Resources Inc., December 2017

Comment:

Water licence 2AM-DOH1323 amendment no.1 requires testing of certain cyanide parameters including free cyanide, total cyanide, WAD cyanide, cyanate and thiocyanate. A new amendment to this licence or another type A for an identical gold processing plant will likely have the same requirements.

The list of analytical parameters water quality parameters to be measured presented in appendix B of the Quality Assurance and Quality Control Plan does not include cyanide. Nor could we find it in the list of parameters ALS Environmental is accredited for.

INFORMATION REQUEST #7

The applicant should state where they get there cyanide samples tested and confirm that the lab is accredited for those parameters.

21.1 TMAC Response to Information Request #7

TMAC confirms cyanide related samples are tested at laboratories accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for testing cyanide parameters. Samples requiring cyanide analysis are initially sent to an ALS Laboratory in Vancouver, BC. ALS Laboratories operates a network of labs across the country and for certain parameters (such as cyanide), samples are forwarded to other labs in their network for analysis. Specifically, in cases where testing for cyanide parameters is required, samples are forwarded from the ALS Laboratory in Vancouver to an ALS Laboratory in Waterloo, Ontario. The Waterloo ALS Lab is CALA accredited for cyanide testing including free cyanide, total cyanide, WAD cyanide, cyanate and thiocyanate. The Waterloo laboratory CALA certificate and scope can be found here: https://www.alsglobal.com/ca/locations/americas/north-america/canada/ontario/waterloo-environmental.

TMAC recognizes that the existing QA/QC Plan does not explicitly reflect this approach and will therefore revise the QA/QC Plan during the next revision to ensure clarity.

22. ID #INAC-TC-14

Maximum camp size at Doris

Reference:

- P2-1 Project Description, Amendment no.2 Type A Water Licence 2AM-DOH1323 (Doris and Madrid), TMAC Resources Inc., December 2017
- P4-4 Domestic Wastewater Treatment Management Plan, TMAC Resources Inc., December 2017
- P5-4 Madrid-Boston Project Water and Load Balance, SRK Consulting Inc., November 2017

Comment:

Table 1.2-1 of the Project Description calls for accommodations for 400 people at the Doris site, which matches the number used for Doris Camp in the Water and Load Balance. However, Section 3.2 specifies that "*An additional 100 beds may be required for the peak construction period.*"

The Wastewater Treatment Plan states: "*The Doris Camp has two modular Sanitherm® membrane biological reactor (MBR) wastewater treatment plants (WTPs) housed in multiple 40-foot long containers. Each plant has the capacity to manage the average waste volume generated by 150 people as well as the capacity to accept raw wastewater and sludge from other WTPs into its surge and conditioning tanks. A third MBR WTP is available onsite as a contingency plant in the event that one WTP malfunctions*."

Wastewater treatment capacity therefore seems to be below what is required for the camp size. If the third contingency MBR is used, it would be possible to meet the requirements of a 400 person camp, but not the 500 people predicted during construction.

INFORMATION REQUEST #8

The applicant should explain how they propose to treat wastewater generated by a camp with potentially as many as 500 people.

22.1 TMAC Response to Information Request #8

TMAC can confirm that the statement in Section 3.2 of the Project Description calling for potentially an extra 100 beds during peak construction is in error. TMAC will bring in additional membrane biological reactor (MBR) modules as necessary to ensure there is sufficient wastewater treatment capacity for the 400 person camp.

23. ID #INAC-TC-15

Requested water volumes

Reference:

- P3-1 Application for water licence amendment (2AM-DOH1323 no.2), TMAC Resources Inc., December 20, 2017
- P2-1 Project Description, Amendment no.2 Type A Water Licence 2AM-DOH1323 (Doris and Madrid), TMAC Resources Inc., December 2017

Comment:

The quantity of potable water requested in the Doris amendment no.2 application, 120 m^3/day, is equivalent to 300 L/person for the 400 person camp proposed. This quantity per person is the same as what has been requested at Boston. The project description states "*An additional 100 beds may be required for the peak construction period.*" We did not find any information on if water would be managed differently for a 500 person camp, or if more potable water would be used than what isrequested.

Industrial water is to be drawn from Doris Lake. The quantities requested in box 13 of the application are at odds. It is presented as 2 460 m^3/day and 1 930 000 m^3/year. Multiplying the first number by 365 yields 897 900 m^3/year, so it is not clear how the second value was reached.

INFORMATION REQUEST #9

The applicant should clarify:

- How they propose to manage potable water for a 500 person camp; and
- What quantity of industrial water they are requesting and more details on why the daily and yearly rates differ.

23.1 TMAC Response to Information Request #9

TMAC can confirm that the statement in Section 3.2 of the Project Description calling for potentially an extra 100 beds during peak construction is in error.

There was an error in the peak values presented in Table 3-15 of the Hope Bay Project Water and Load Balance (Annex V1-7, Package P5-4) and the correct values are presented below. Not all daily use values are applied every day in the model and applicable durations are discussed in Sections 3.5.2 and 3.5.3 of Package P5-4.

Updated Table 3-13 of P5-4: Maximum Daily and Annual Freshwater Withdrawal form the Doris and Madrid Watershed

Doris and Madrid Water Use Summary	**Peak Use (2017 to 2028)**		**Peak Use (2029 to 2032)**	
	Daily Use (m^3/day)	**Annual Use (m**^{3}/yr)	**Daily Use (m**^{3}/day)	**Annual Use (m**^{3}/yr)
Windy Lake Use				
Doris Camp	120	44,000	120	44,000
Total Windy Lake Draw	**120**	**44,000**	**120**	**44,000**
Doris Lake Use				
Doris Process Plant	880	320,000	4,000	1,100,000
Madrid Concentrator	110	40,000	1,800	460,000
Doris Industrial	760	210,000	760	210,000
Madrid Industrial	710	160,000	710	160,000
Total Doris Lake Draw	**2,460**	**730,000**	**7,270**	**1,930,000**

24. ID #INAC-TC-16

Waste rock volumes in relation to void volumes

Reference:

- P2-1 Project Description, Amendment no.2 Type A Water Licence 2AM-DOH1323 (Doris and Madrid), TMAC Resources Inc., December 2017
- P4-19 Boston Conceptual Closure and Reclamation Plan, SRK Consulting Inc., November 2017

Comment:

The same strategy for waste rock is proposed for the Doris, Madrid and Boston mines. As described in the amendment application, "*Waste rock will be used as underground backfill to the maximum extent possible. Backfilling is an integral part of the mining operation and is predicted to consume all of the Project waste rock. A predicted shortfall in available backfill will be made up from surface quarries, as required.*"

The total mass to be mined, as well as the mass of waste rock and additional quarry rock required as backfill for Boston are presented in the Boston Conceptual Closure and Reclamation Plan. We were unable to find equivalent numbers for the Madrid mines.

Sufficient space for storing all waste rock, detoxified tailings, industrial water treatment plant sludge and some hydrocarbon contaminated soils in the underground mines is critical for reclamation as planned and it is difficult to find numbers supporting statements made to the effect that there will be sufficient space.

INFORMATION REQUEST #10

The applicant should provide a table estimating the volumes of waste rock, detoxified tailings and industrial water treatment plant sludge generated by the projects, as well as an estimate of the underground mine void volume, for each Boston, Madrid North and Madrid South.

24.1 TMAC Response to Information Request #10

Figure 4 in Annex V1-7, Package P5-13 provides a time series plot of the Total Mine Void Volume and Backfill (both with and without allowance for bulking and shrinkage) for both Madrid North and Madrid South Mines. This graph should be viewed in conjunction with the tabular data of all backfill requirements presented in Table 3.5 of Package P5-4.

Table 3.5 of Package P5-4 also provides tabular data of all backfill requirements for Boston Mine. The total void space of the mine is 2,336,000 m3.

Industrial waste treatment plant sludge is not included in these estimates; however it is evident that there is more than sufficient excess mine capacity at each location to store such waste which is estimated to be about 550 m^3/year and 200 m^3/year for Doris and Boston (contact water and process water) treatment plants, respectively.

25. ID #INAC-TC-17

Detoxified tailings deposition at Madrid

Reference:

- P4-11 Waste Rock, Ore & Mine Backfill Management Plan, TMAC Resources Inc., December 2017
- P5-13 Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid North Mines, SRK Consulting Inc., November 2017

Comment:

The Boston and Doris mill produce two tailings streams; flotation tailings (comprising approximately 92-94% of the overall volume) and detoxified leach tailings (comprising about 6-8% of the overall volume). Flotation tailings will be deposited in the Doris TIA or Boston TMA. "*Detoxified leach tailings will be filtered, mixed with mine waste rock and used for underground mine backfill.*" The Waste Rock, Ore & Mine Backfill Management Plan specifies: "*These tailings will be moved underground into voids that will remain frozen within permafrost on a daily basis.*"

The plan also specifies the sequencing: "*Detoxified tailings from the Doris processing plant are transferred underground in the Doris mine on a daily basis as they are generated. Later in the mine life, detoxified tailings from the Doris processing plant will be placed as backfill in the Madrid North mine.*"

More than half the Madrid North mine is estimated to be outside permafrost and the zone within permafrost will be the first to be mined. There is no discussion of whether there will be sufficient voids in permafrost to store detoxified tailings from the Doris mill throughout the 13 years of proposed Madrid North mine life.

The project schedule has the Madrid South mine operating for a year after the Madrid North mine has stopped operating. Since the Doris mill is also proposed for processing ore from Madrid South, it is not clear where the detoxified tailings will be disposed of during the last year of mill operation.

INFORMATION REQUEST #11

The applicant should provide further information on how detoxified tailings from the Doris mill could be stored in the permafrost parts of Madrid North mine once the mining is in the talik parts of the mine, and once the mine is no longer operating.

25.1 TMAC Response to Information Request #11

Permafrost sections of all mines will remain frozen as has been demonstrated in Section 5.2.2 of Annex V1-7, Package P5-13 – Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid North Mines, Hope Bay Project. Therefore, simply because a mine transitions into the talik, does not preclude the ability to maintain frozen conditions in the permafrost zones. This is evidenced in the existing Doris Mine where mining occurs both in permafrost and talik zones, yet conditions in the permafrost remain unchanged.

Mine Planning will ensure there will be sufficient voids in the permafrost mine areas to store detoxified tailings from the Doris Mill throughout the 13 years of proposed Madrid North mine life. Madrid North will remain accessible for the last year of mine life at Doris to allow disposal of the final remaining detoxified tailings underground (21,000 m^3). This can readily be achieved after active mining ceases in Madrid North, since the necessary ventilation and pumping requirements will remain active within the zones designated for backfill which will be in close proximity to the portal.

26. ID #INAC-TC-18

Mine water at Boston

Reference:

- P5-13 Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid North Mines, SRK Consulting Inc., November 2017
- P4-6 Groundwater Management Plan, TMAC Resources Inc., December 2017
- P4-8 Boston Water Management Plan, TMAC Resources Inc., December 2017

Comment:

The Boston mine is not expected to produce any mine water because it is modelled to be entirely within permafrost. The limited permafrost data available at Boston does not fit the model used for Madrid and Doris. Specifically: "*The offshore position of the -2°C isotherm cannot be explained by the present-day lake configuration nor by lateral heat flow from the adjacent land. Therefore, it is postulated that the permafrost beneath Aimakatalok Lake has been submerged with lake expansion.*" In order to fit measured data, a site specific model for Aimaokatalok Lake is created with a reduced lake size (5 m below present levels) for 5 000 to 500 years before present and the actual size for 500 years until present. No explanation is provided as to why lake levels might rise 5 m at Aimaokatalok Lake and not at all only 50 km away at Patch Lake, which suggests there is not a full understanding of permafrost conditions onsite.

Risk zone mapping as outlined in the Groundwater Management Plan will help identify areas where the model is inaccurate and where groundwater infiltration might occur. The Groundwater Management Plan also includes a Boston Mine Inflow Management Program with specific actions to be taken at different measured mine inflows of 30, 60, and 360 m^3/day.

In contrast, the Boston Water Management Plan simply states there will be no groundwater inflow.

INFORMATION REQUEST #12

INAC would like to understand what contingency measures have been considered if groundwater should be encountered in the Boston mine, and if the proposed industrial water treatment plant could process saline mine water to remove chloride.

26.1 TMAC Response to Information Request #12

Detailed analysis has demonstrated that TMACs premise that Boston mine will be developed entirely within permafrost is well supported (Package P5-13 Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid

North Mines, Hope Bay Project). However, TMAC understands that uncertainty exists when doing such analysis, and therefore the interface where the talik is predicted to occur is not precise. As a result, TMAC has developed a Groundwater Management Plan (GWMP) for Boston that recognizes that as the mine gets developed and new areas are opened, especially near the predicted talik edge, mine water might be encountered. However, TMAC anticipates that should any such water be encountered, the point source inflow would be sealed as soon as practical and mining in that area will be reconsidered if it is confirmed that the area is in a talik zone. As a result, the GWMP for Boston has been designed as a proactive contingency to ensure safety of mine workers.

TMAC also recognized that any such point source mine water encountered will have to be managed. To that end TMAC's primary strategy is to use this water within the mining operations underground (e.g., as drilling brine)and not bring water to surface. Should the volume exceed the requirements for underground use, the contingency strategy will be to pump that water to a water truck for transport to the Doris Marine Mixing Box, or the Doris TIA if there is no active discharge to Roberts Bay taking place.

TMAC however does have about 26,000 m^3 storage capacity in their two Boston Contact Water Ponds (CWPs). Based on the Specific Performance Thresholds (SPTs) as listed in the GWMP, the total volumes of water that may have to be managed for SPT-1, SPT-2 and SPT-3 is 90, 180 and 2,520 m^3, which translates to approximately 0.3%, 0.7% and 10% of the available CWP volumes. As a result, TMAC stated that another option could be to pump contingency Boston mine water to the Contact Water Ponds, and if that water meets treatment or discharge criteria, it can be managed as part of the Boston Water Management circuit.

Additional information pertaining to this information request can be found in TMAC's response to Technical Comment NRCan-2.2.2 (TMAC 2018).

Reference:

TMAC. 2018. Hope Bay Project: Proponent's Response to Technical Comments on the Madrid-Boston Final Environmental Impact Statement: Toronto, Ontario.

27. ID #INAC-TC-19

Madrid mine water transport

Reference:

- P5-13 Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid North Mines, SRK Consulting Inc., November 2017
- P4-6 Groundwater Management Plan, TMAC Resources Inc., December 2017
- P4-7 Doris and Madrid Water Management Plan, TMAC Resources Inc., December 2017
- P5-19 Madrid Water Management Engineering Report, SRK Consulting Inc., November 2017

Comment:

Hydrogeological modeling was used to predict mine groundwater inflows during active mining. They are 1 180 m^3/day after year 7 at the Madrid North mine and 550 m^3/day after six months of development at the Madrid South mine. There is a lot of uncertainty with these estimates since the models were built with limited data. There will be important quantities of mine groundwater to be dealt with if the estimates are accurate and there could potentially be twice the original estimate.

The groundwater is saline with chloride concentrations of 19 000 mg/L for the 75th percentile. This is of the same order as sea water salinity, making it harmful if it were to be released to the freshwater environment around Madrid.

The plans presented offer very little detail on how Madrid mine water will be handled and the information is not always consistent. The Groundwater Management Plan states: "*The combined discharge from the Madrid North mine and Madrid South mine is to be at a rate of 3,000 m^3/day to Roberts Bay via the marine mix box (MMB), or if required via the TIA*." Both the Doris and Madrid Water Management Plan and the Madrid Water Management Engineering Report say: "*Mine water will be pumped or hauled to the MMB and discharged to the ocean*." The Madrid Water Management Engineering Report includes more information, namely a schematic (Figure 1) where a line for mine water is drawn between Madrid North and South mines, and the Doris contact water treatment plant, as well as two references to pipelines. The mine water pipelines are mentioned in the context of moving water from the contact water ponds: "*Dewatering of the pond will be by pumping to the concentrator for use as make-up water to reduce the freshwater draw from Windy Lake; or pumping to the Doris TIA via the tailings discharge line; or pumping to the MMB via the mine water line.*" and "*Water within the primary contact water pond will be pumped to Madrid North via the mine water pipeline or an independent contact water pipeline*".

A coherent, feasible and effective plan is necessary for managing mine water at Madrid.

INFORMATION REQUEST #13

The applicant should provide more information on Madrid mine water management including:

- A discussion of the hauling and piping options;
- If a pipeline is considered, a preliminary alignment should be presented;
- An explanation of the conditions under which mine water will be send to the marine mixing box, the TIA or the contact water treatment plant; and
- If mine water will be transported directly from the mine sumps, or whether a holding tank or pond will be necessary.

27.1 TMAC RESPONSE TO INFORMATION REQUEST #13

The description provided in Section 3.2 of P5-19 (Hope Bay Project: Madrid Water Management Design) is the proposed plan for discharging of mine water. It states "The Madrid North mine will intercept the talik below Patch, Windy, and Imniagut lakes, and mining at Madrid South mine is expected to intercept the talik below Wolverine and Patch Lakes (SRK, 2017e). This intercepted mine water is expected to be high in salinity (similar to the Doris Mine groundwater inflows). Mine water will be pumped or hauled to the Doris Mine for transfer to the marine mixing box (MMB) and discharged to the ocean, as described in the Groundwater Management Plan (TMAC, 2017a). At post-closure, drawdown through the Madrid North and Madrid South mines will cease."

Appendix B of Annex V1-7, Package P5-19 shows the proposed pipeline routes which follows the all-weather road between Madrid North and South, then the all-weather road between Madrid North and Doris.

The reference to hauling, relates to the timing of construction of the pipeline. TMAC may wish to defer construction of the pipeline until such time as larger mine water ingress is expected, and should water be encountered prior to the pipeline being in place, TMAC will use water trucks to transport water from Madrid North and South Mines to Doris.

All mine water will be pumped directly from dedicated underground mine sumps sized to accommodate the required flows, to an above ground pump station at Madrid North and Madrid South (located at the mine portals) from where it will be pumped (or trucked) to the Mill Mix Box at Doris from where it will be pumped to the Roberts Bay diffuser, or redirected to the Doris TIA in accordance with the Groundwater Management Plan (including the additional details described in the response to Technical Comment NRCan-2.2.2 (TMAC 2018)). This arrangement is consistent with the currently approved mine discharge system at Doris.

Reference:

TMAC. 2018. Hope Bay Project: Proponent's Response to Technical Comments on the Madrid-Boston Final Environmental Impact Statement: Toronto, Ontario.

RECOMMENDATION #19

INAC recommends that TMAC integrate answers to IR 13 into the Doris-Madrid Water Management Plan and the Groundwater Management Plan.

27.2 TMAC RESPONSE TO RECOMMENDATION #19

The information contained in the response to INAC Information Request #13 is already included in the Doris-Madrid Water Management Plan (Annex V1-7, Package P4-7) which refers to the Groundwater Management Plan (Annex V1-7, Package P4-6)) for management details. The Groundwater Management Plan will be updated as described in the response to Technical Comment NRCan-2.2.2 (TMAC 2018).

Reference:

TMAC. 2018. Hope Bay Project: Proponent's Response to Technical Comments on the Madrid-Boston Final Environmental Impact Statement: Toronto, Ontario.

28. ID #INAC-TC-20

Non-hazardous waste disposal

Reference:

- P4-13 Hope Bay Project Non-hazardous Waste Management Plan, TMAC Resources Inc., December 2017
- P4-21 Doris-Madrid Interim Closure and Reclamation Plan, SRK Consulting Inc., November 2017
- P4-19 Boston Conceptual Closure and Reclamation Plan, SRK Consulting Inc., November 2017
- P5-28 Boston Surface Infrastructure Preliminary Design, SRK Consulting Inc., November 2017
- September 26-27, 2015 Water Licence Inspection Form, Indigenous and Northern Affairs Canada, September 27, 2015
- November 4-5, 2016 Water Licence Inspection Form, Indigenous and Northern Affairs Canada, November 6, 2016
- October 10-11, 2017 Water Licence Inspection Form, Indigenous and Northern Affairs Canada, October 11, 2017

Comment:

As described in the Non-hazardous Waste Management Plan, non-hazardous waste will be "*collected and transported to centralized waste management facilities to be properly packaged and temporarily stored until the waste is disposed of onsite in a certified landfill or prepared for shipment to a designated waste transfer station*." There is no information provided regarding possible onsite landfills.

Limited information on the landfills is presented in the Closure and Reclamation Plans. At Doris: "*Once quarry operations are complete, a non-hazardous waste landfill will be constructed in the northeast corner of the developed quarry. The landfill will contain only inert waste and no leachate will be generated.*" The quarry referred to is Q3, which will be used as a source of rock for the tailings cover. We can therefore expect the landfill to be operational only towards the end of the closure phase.

At Boston, the timing of landfill construction is not described, but we are told: "*The Non- hazardous Waste Landfill proposed at Boston will be located in Quarry V, near the Boston Mine.*" The Boston Surface Infrastructure Preliminary Design does include landfill design and operation.

An important proportion of the material to be landfilled will be generated at closure when the mine infrastructure is dismantled. However all material generated during operations will have to be stockpiled or shipped off site at Doris, according to what has been presented. It is not clear when the landfill will be constructed at Boston or if the same stockpiling will be necessary. Presently both non-hazardous and hazardous waste generated at Doris Mine are stockpiled in the waste management area, and as indicated in the 2015, 2016 and 2017 inspection reports, there is an accumulation that has not been backhauled. This material includes historical waste and that generated by approximately one year of operations. The mine plan calsl for 14 years of operations before closure and the area allocated to waste management facility appears inadequate to deal with non-hazardous waste generated if the current plan continues to be followed.

INFORMATION REQUEST #14

The applicant should provide the expected timing of landfill construction at Boston.

28.1 TMAC RESPONSE TO INFORMATION REQUEST #14

TMAC proposes to construct the non-hazardous landfill facility in Quarry V, once Quarry V has been developed. Quarry V is one of the primary construction quarries in support of the Boston all-weather road and Boston infrastructure, and is therefore expected to be available early in the Boston mine life.

RECOMMENDATION #20

We recommend that the applicant provide further information in the Non- hazardous Waste Management Plan, describing expected volumes of waste and how they will be stored in the areas allocated for waste management. If landfill construction is to be proposed before closure, further details on design, lift covers, and water management would need to be included.

28.2 TMAC RESPONSE TO RECOMMENDATION #20

Complete design criteria and design and operational details of the Boston non-hazardous landfill are provided in Section 4.5 of Annex V1-7, Package P5-28. Engineering Drawings of this facility are also included in Attachment 2 of P5-28 which indicates the location, layout and operation of this facility. This includes lift thicknesses and water management requirements.

The facility size is only limited by the extent of the quarry, and the design presented has been sized for a minimum non-hazardous waste volume of 50,000 m^3. As can be seen by the Engineering Drawings in Attachments of P5-28 (Hope bay Project: Boston Surface Infrastructure Preliminary Design), this facility can readily be expanded to accommodate more non-hazardous waste.

29. ID #INAC-TC-21

Effect of saline water in tailings impoundment area on frozen core dam

Reference:

- P5-16 Doris Tailings Management System Phase 2 Design, SRK Consulting Inc., November 2017
- P5-4 Madrid-Boston Project Water and Load Balance, SRK Consulting Inc., November 2017

Comment:

An updated thermal model was presented to predict the behaviour of the frozen core in the North Dam. "*The calibrated model, with consideration for climate change and conservative inputs indicate the frozen core will remain below the required -2°C under normal operating conditions.*" It is not clear if the normal operating conditions include storage of saline groundwater. Temporary storage of saline groundwater in the TIA is a possibility. The Water and Load Balance evaluates the effect on the chloride concentration in the TIA water from pumping groundwater to the TIA for different durations.

Another mine in Nunavut is currently encountering difficulties with a frozen core containment structure being used to store unexpectedly large quantities of saline groundwater. This has demonstrated a potential effect of storing salt water in a structure designed for freshwater.

INFORMATION REQUEST #15

The applicant should clarify whether the operating conditions used as input in the thermal model of the North Dam included temporary storage of saline water in the TIA.

29.1 TMAC Response to Information Request #15

The maximum peak concentration of saline water are from Madrid North Mine and is about 18,000 mg/L. This is similar to seawater which has a freezing point of approximately −2 °C. However, as described in P5-13 (Hydrogeological Characterization and Modelling of the Proposed Boston, Madrid South and Madrid North Mines, Hope Bay Project) this high chloride concentration is expected to be of short duration. More importantly however, should saline mine water be directed to the Doris TIA it would be highly diluted by the volume of water in the TIA Reclaim Pond and therefore salinities of 18,000 mg/L is never expected in the TIA.

The North Dam, which is the only water retaining structure of the Doris TIA has been designed assuming a depressed freezing point of -2°C within the engineered frozen core, and -8°C within a critical section within the foundation (Annex V1-7, Package P5-16).

These design criteria are to account for naturally high porewater salinity in the foundation materials. As a result, the North Dam can readily retain the expected saline mine water inflows without risk to its performance.

30. ID #INAC-TC-22

Crown pillar recovery at Doris North

Reference:

- o P5-9 Geochemical Source Term Predictions for the Madrid-Boston Project, SRK Consulting Inc., November 2017
- o P5-12 Madrid and Boston Crown Pillar Recovery Concepts, SRK Consulting Inc., November 30, 2017

Comment:

During a site visit in October 2017, TMAC staff pointed out an area next to Doris Lake where a crown pillar recovery trench was planned. They mentioned that this would be included in the amendment application being prepared. The trench at Doris also seemed to be considered in the Geochemical Source Term Predictions for the Madrid-Boston Project because estimates of the water quality in the trench are included in Table 4-2.

However, the memo relating to the Madrid Boston Crown Pillar Recovery Concepts does not speak to a possible trench at the Doris North mine.

INFORMATION REQUEST #16

The applicant should clarify whether they plan to do a crown pillar recovery trench at Doris North. If so, they should provide information such as the location, approximate size and estimated duration of excavation.

30.1 TMAC Response to Information Request #16

This request is out of scope of the Phase 2 application.

C. RECLAMATION COST ESTIMATE

Closure and reclamations plans are required as part of the water licence applications. Following the *Mine Site Reclamation Policy for Nunavut* (INAC, 2002), the plans are used to estimate the cost of reclamation by a third party, should be applicant be unable to fulfil their reclamation obligations. Security associated with the water licences is set according to the cost estimates

INAC contracted Arcadis Canada Inc. to prepare reclamation cost estimates for both applications. The estimates were prepared based on the *Doris-Madrid Interim Closure and Reclamation Plan* (SRK Consulting Inc., November 2017) and the *Boston Conceptual Closure and Reclamation Plan* (SRK Consulting Inc., November 2017) presented in the water licence applications. If these plans are modified in the course of the technical review, modifications of the reclamation estimates may be required.

The results are summarized in the table below and reports detailing the estimate calculations are in appendix A for the Doris-Madrid amendment-renewal and in appendix B for the new Boston application.

Application	Total reclamation cost estimate	Water liability	Land liability
2AM-DOH1323 Doris-Madrid	$75,373,137	$43,724,543 (58%)	$31,648,594 (42%)
2AM-BOS----	$41,934,353	$25,006,854 (60%)	$16,927,500 (40%)

The estimate for Doris-Madrid does not include reclamation costs associated with the jetty, cargo dock or marine outfall as they are not covered by the water licence. They will be assessed separately and covered under land leases.

Currently, the total security under water licence 2AM-DOH1323 amendment no.1 is set at $30,725,650. The Kitikmeot Inuit Association holds $17,635,650 and INAC holds the balance of $13,090,000. The water-land liability division in this estimate is 48%-52% ($14,883,035 water liability - $15,842,613 land liability). The project is situated entirely on Inuit owned lands.

RECOMMENDATION #21

INAC recommends that reclamation security requirements of $75,373,137 and $41,934,353 be included in any licence issued for 2AM-DOH1323 amendment no.2 and 2AM-BOS----, respectively.

We will undertake discussions with the Kitikmeot Inuit Association and TMAC regarding the amount of security necessary and an acceptable manner of dividing the total amount between parties.

30.2 TMAC Response to Recommendation #21

Boston Closure and Reclamation Cost Estimate

Table 30-1 summarizes the differences between the TMAC and INAC closure and reclamation cost estimates. TMAC will provide a detailed, revised cost estimate which includes explicit comparisons of these differences by April 20, 2018. However, in the interim, TMAC has reviewed the key reasons for the costs differentials which are discussed here.

Table 30-1: Summary of the Differences in Costs between the TMAC and INAC Estimates

Capital Costs	TMAC FEIS Submission Cost	INAC FEIS Technical Comment	Difference
Open Pit	$ -	$ -	$ -
Underground Mine	$ 55,433	$ 63,094	$ (7,661)
Tailings Facility	$ 10,314,105	$ 15,267,745	$ (4,953,640)
Rock Pile	$ 5,394,323	$ 73,985	$ 5,320,339
Buildings and Equipment	$ 4,929,817	$ 6,144,260	$ (1,214,443)
Chemicals and Contaminated Soil Management	$ 488,231	$ 636,123	$ (147,892)
Surface and Groundwater Management	$ 47,872	$ 46,772	$ 1,100
Water Treatment	$ -	$ -	$ -
Interim Care and Maintenance	$ 2,427,027	$ 4,786,320	$ (2,359,293)
SUBTOTAL: Capital Costs	**$ 23,656,809**	**$ 27,018,298**	**$ (3,361,490)**
Mobilization/Demobilization	$ 2,142,246	$ 5,464,605	$ (3,322,359)
Post-Closure Monitoring and Maintenance	$ 4,121,425	$ 1,345,961	$ 2,775,464
Engineering	$ -	$ 1,350,915	$ (1,350,915)
Project Management	$ 833,298	$ 1,350,915	$ (517,617)
Health and Safety Plans/Monitoring & QA/QC	$ -	$ -	$ -
Bonding/Insurance	$ -	$ -	$ -
Contingency	$ 4,731,362	$ 5,403,660	$ (672,298)
Market Price Factor Adjustment	$ -	$ -	$ -
SUBTOTAL: Indirect Costs	**$ 11,828,330**	**$ 14,916,055**	**$ (3,087,725)**
TOTAL COSTS	**$ 35,485,139**	**$ 41,934,353**	**$ (6,449,214)**

With few exceptions it would appear that INAC has accepted TMAC's cost components, quantities and unit rates. INAC did however reorganize the cost categories into different components of the RECLAIM cost estimate as evidenced by the individual cost categories of Table 30-1. Focusing on the Direct Costs first, the overall difference between TMAC and INAC is about $3.36 million. The key reasons for this differential is as follows:

1. INAC agreed with, and used all TMAC's cost assumptions for the Interim Care and Maintenance period, but doubled the time from TMAC's 1.5 years to 3 years. This accounts for almost $2.4 million (70%) of the cost difference. As described in TMAC's submission, TMAC maintains that 1.5 years is appropriate, and is consistent with the agreed upon timeframe for the existing Doris Water License.

2. About $0.80 million (24%) of the cost difference is associated with additional haulage and disposal costs associated with the building and infrastructure component of the project. This difference stems primarily from INAC's erroneous application of haulage volumes equivalent to the standing volumes of buildings used to calculate demolition costs. For each individual building TMAC's cost estimate provides distinct quantities for standing volume used to calculate demolition costs as well as collapsed volumes for estimating post-demolition debris handling and haulage costs.

3. About $0.15 million (4%) of the cost differential is associated with the difference in unit rate for grading of pads. TMAC believes that this area of the cost estimate does warrant a review to confirm the appropriate rate.

4. The final approximately $0.05 million (2%) of the cost differential is associated with quantities rounding and unit rates simplifications adopted by INAC, which TMAC disagrees with as the appropriate details provided, makes this unnecessary.

Similarly, INAC appears to generally have adopted TMAC's assumptions, quantities and unit rates associated with Indirect Costs, but reorganized the categories where costs have been applied. Focusing on the total differential of about $3.09 million, these differences stem from:

1. INAC added about $0.27 million (9%) to account for travel time of employees to site. TMAC unit rates for labor and equipment are fully inclusive rates and therefore accounting for travel time separately is double counting costs.

2. About $0.28 million (9%) of the cost difference is associated with INAC's contention that post-closure monitoring should be longer than that proposed by TMAC. TMAC maintains that the period as proposed in the application is appropriate.

3. About $0.52 million (17%) of the differential is attributed to INAC's position of assigning 5% of Direct Costs as the Project Management allowance. TMAC

calculated the Project Management allowance based on actual hours and are therefore more appropriate.

4. INAC has an allowance of 5% of Direct Costs for Engineering. This amounts to $1.35 million (44%) of the cost differential. TMAC does not have an engineering allowance and will revisit this aspect in the revised submission.

5. The remaining difference of $0.67 million (22%) is associated with the contingency cost, which is simply different because INAC's Direct Cost is greater.

In conclusion, TMAC will review the grading costs, which, at most would result in an increase of TMAC's Direct Costs by 1%. Also, TMAC will consider adding an allowance for Engineering under the Indirect Cost category. Overall, based on the anticipated changes, as outlined above, TMAC does not expect the overall closure and reclamation cost estimate to increase by more than 3% to about $36.5 million.

Doris-Madrid Closure and Reclamation Cost Estimate

Table 30-2 summarize the differences between the TMAC and INAC closure and reclamation cost estimates. TMAC will provide a detailed revised cost estimate which includes explicit comparisons of these differences by April 20, 2018. However, in the interim, TMAC has reviewed the key reasons for the costs differentials which are discussed here.

Table 30-2. Summary of the Differences in Costs between the TMAC and INAC Estimates

Capital Costs	TMAC FEIS Submission Cost	INAC FEIS Technical Comment	Difference
Open Pit	$ -	$ -	$ -
Underground Mine	$ 245,455	$ 329,785	$ (84,330)
Tailings Facility	$ 6,373,305	$ 20,481,445	$ (14,108,140)
Rock Pile	$ 12,459,577	$ 290,126	$ 12,169,451
Buildings and Equipment	$ 11,648,475	$ 14,598,548	$ (2,950,073)
Chemicals and Contaminated Soil Management	$ 2,989,659	$ 3,610,542	$ (620,883)
Surface and Groundwater Management	$ 1,923,414	$ 660,059	$ 1,263,355
Water Treatment	$ 277,151	$ -	$ 277,151
Interim Care and Maintenance	$ 3,098,609	$ 7,119,300	$ (4,020,691)
SUBTOTAL: Capital Costs	**$ 39,015,645**	**$ 47,089,803**	**$ (8,074,158)**
Mobilization/Demobilization	$ 2,178,406	$ 9,805,516	$ (7,627,110)
Post-Closure Monitoring and Maintenance	$ 8,069,693	$ 4,350,877	$ 3,718,816
Engineering	$ -	$ 2,354,490	$ (2,354,490)

Capital Costs	TMAC FEIS Submission Cost	INAC FEIS Technical Comment	Difference
Project Management	$ 1,899,428	$ 2,354,490	$ (455,062)
Health and Safety Plans/Monitoring & QA/QC	$ -	$ -	$ -
Bonding/Insurance	$ -	$ -	$ -
Contingency	$ 7,803,129	$ 9,417,961	$ (1,614,832)
Market Price Factor Adjustment	$ -	$ -	$ -
SUBTOTAL: Indirect Costs	**$ 19,950,655**	**$ 28,283,333**	**$ (8,332,678)**
TOTAL COSTS	**$ 58,966,301**	**$ 75,373,137**	**$ (16,406,836)**

With some exceptions it would appear that INAC has accepted TMAC's cost components, quantities and unit rates. INAC did however reorganize the cost categories into different components of the RECLAIM cost estimate as evidenced by the individual cost categories of Table 30-2. Focusing on the Direct Costs first, the overall difference between TMAC and INAC is about $8.07 million. The key reasons for this differential is as follows:

1. INAC agreed with, and used all TMAC's cost assumptions for the Interim Care and Maintenance period, but doubled the time from TMAC's 1.5 years to 3 years. This accounts for almost $4.02 (50%) of the cost difference. As described in TMAC's submission, TMAC maintains that 1.5 years is appropriate, and is consistent with the current agreed upon timeframe for the existing Doris Water License.

2. About $3.03 million (38%) of the cost difference is associated with three key elements:

    a. Additional haulage and disposal costs associated with the building and infrastructure components of the project. This difference stems primarily from INAC's erroneous application of haulage volumes equivalent to the pre-demolition surface areas. TMAC's cost estimate explicitly defines the difference between pre-demolition surface areas for estimating post-demolition haulage volumes.

    b. A portion of this cost differential is associated with quantities rounding and unit rates simplifications adopted by INAC, which TMAC disagrees with as the appropriate details provided, makes this unnecessary.

    c. A component of this ($0.2 million) is associated with items that may have been omitted by TMAC, such as the water discharge pipeline from Madrid North to Doris.

3. About $0.65 million (8%) of the cost differential is associated with the hydrocarbon contaminated materials. INAC erroneously assumes transport of these materials off-site, adds in a cost for doing hydrocarbon contaminated studies, which has already been accounted for in the Indirect Cost by TMAC, and uses a higher rate for pumping residual fuel that does not appear justified to TMAC.

4. About $0.25 million (3%) of the cost differential is associated with the difference in unit rate for grading of pads and roads. TMAC believes that this area of the cost estimate does warrant a review to confirm the appropriate rate.

5. About $0.11 million (1%) of the cost difference is associated with draining of the Reclaim Pond. TMAC disagreed with INAC's unit rate for manpower needed to operate the pumping system.

Similarly, INAC appears to generally have adopted TMAC's assumptions, quantities and unit rates associated with Indirect Costs, but reorganized the categories where costs have been applied. Focusing on the total differential of about $8.33 million, these differences stem from:

1. INAC added about $0.34 million (4%) to account for travel time of employees to site. TMAC unit rates for labor and equipment are fully inclusive rates and therefore accounting for travel time separately is double counting costs.

2. TMAC disagrees with INAC's unit rate for the daily food allowance, which amounts to a cost differential of $0.19 million (2%).

3. About $3.28 million (39%) of the cost difference is associated with INAC's contention that post-closure monitoring should be longer than that proposed by TMAC, and that post-closure water treatment is required. TMAC maintains that the period as proposed in the application is appropriate, and there is no requirement for water treatment.

4. About $0.46 million (5%) of the differential is attributed to INAC's position of assigning 5% of Direct Costs as the Project Management allowance. TMAC calculated the Project Management allowance based on actual hours and is therefore more appropriate.

5. INAC has an allowance of 5% of Direct Costs for Engineering. This amounts to $2.35 million (28%) of the cost differential. TMAC does not have an engineering allowance and will revisit this aspect in the revised submission.

6. The remaining difference of $1.61 million (19%) is associated with the contingency cost, which is simply different because INAC's Direct Cost is greater.

In conclusion, TMAC will review the grading costs and add the missing components, which, at most would result in an increase of TMAC's Direct Costs by about 6%. Also, TMAC will consider adding an allowance for Engineering under the Indirect Cost category. Overall, based on the anticipated changes, as outlined above, TMAC does not expect the overall closure and reclamation cost estimate to increase by more than 5% to about $62 million.

D. TIMING OF NEXT STEPS IN REVIEW PROCESS

Review of TMAC's Hope Bay Phase 2 project by the Nunavut Impact Review Board (NIRB) and NWB is occurring concurrently. The next steps in the process review map circulated by the NIRB on January 17, 2018 are:

- April 4, 2018 : Proponent responds to NIRB technical review comments
- April 19, 2018 : Parties submit presentations for NIRB final hearing
- May 8-12, 2018 : NIRB final hearing

The NWB has not yet set dates for the steps following the submission of NWB technical comments, but in discussions with both the NWB staff and the proponent, the possibility of holding a technical meeting immediately after or shortly after the NIRB final hearing was raised.

INAC is of the opinion that holding the NWB technical meeting prior to the project certificate workshop would reduce the effectiveness of the meeting. For certain components of the project, the level of detail provided in the application is sufficient for the environment impact assessment but not for the water licencing stage. An example is the disposal of Madrid mine water. The application states it will be disposed of at sea which may be appropriate for evaluating environmental impacts, but details on how water over up to 3000 m^3/day of saline water will be stored and transported over 10 km are necessary to determine the adequacy of proposed management methods.

INAC still has three outstanding concerns related to freshwater in the NIRB review process, items to be covered by any water licence issued. These challenges will likely not be resolved until the NIRB hearing, or shortly before it, and time may be necessary to develop implementation plans for changes. We reserve the right to ask further information requests or present more technical comments on information pertaining to water presented or discussed at the NIRB final hearing.

INAC recommends that a NWB technical meeting be held after the project certificate workshop. It is included as a possibility in the process review map circulated on January 17, and would be an effective means of discussing issues raised in the water licence technical review.

31. ID #DFO-3.1.1

31.1 SUBJECT / TOPIC

Avoidance and Mitigation of Effects to Fish and Fish Habitat

31.2 REFERENCES

- FEIS Volume 5, Section 6.5.4.1 – Loss or Alteration of Fish Habitat, Table 6.5-4.
- FEIS Volume 5, Appendix V5-6Y – Freshwater Fish Community and Habitat Survey Sites, 1993-2017.
- FEIS Volume 3, Section 3.7.4.3 – Stream Crossings, p. 3 – 23.
- *HOPE BAY PROJECT: Proponent's Response to Technical Comments on the Draft Environmental Impact Statement for the Madrid-Boston (Phase 2) Proposal,* ID#DFO-3.1.2-102.7, p.317.
- DEIS Volume 3, Appendix V3-3I – Madrid-Boston All- Weather Road Preliminary Design, p. 33-34.
- FEIS Volume 5, Section 6.5.4.1 – Loss or Alteration of Fish Habitat, p. 6 – 154FEIS Volume 5, Section 6.5.3.2 – Best Management Practices, p. 6 - 141-143.

31.3 SUMMARY

A total of 21 water crossings are associated with the proposed all-weather roads as part of the Madrid-Boston Project. Based on the fish and fish habitat surveys conducted from 1993-2017 (FEIS, Vol. 5, Appendix V5-6Y, p. 1-16), the Proponent concluded that four of the streams are non-fish-bearing and the remaining streams are fish-bearing (FEIS Vol. 5, Table 6.5-4, p. 6-149). Four types of crossings are proposed to be used based on the watercourse characteristics: culverts in non-fish bearing water courses, culverts within fish-bearing watercourses, span bridges with pile foundations, and bridges with frozen abutment foundations (FEIS, Vol. 3, Section 3.7.4.3, p. 3-23).

The Proponent provided conceptual water crossing designs (DEIS Volume 3, Appendix V3-3I – Madrid-Boston All-Weather Road Preliminary Design, p. 33-34) and states that: "*Final design plans will be used to refine proposed mitigation measures as required, and the information will be provided to DFO during submission of Request for Review applications for individual crossings as deemed necessary prior to construction*" (HOPE BAY PROJECT: Proponent's Response to Technical Comments on the Draft Environmental Impact Statement for the Madrid-Boston (Phase 2) Proposal, Responses to ID# DFO- 3.1.2-DFO-FPP comments 102.7 , p.317).

DFO notes that the Proponent has also provided a list of general best management practices during the construction phase that include DFO's Measure to Avoid Causing Harm to Fish and Fish Habitat' (FEIS, Vol. 5, Section 6.5.3.2, p. 6-141- 143).

The Proponent identified the potential for water crossing structures to require inspection and maintenance to ensure barriers to water and fish passage do not form over time (Vol. 5, Section 6.5.4.1, p. 6-154). In(*HOPE BAY PROJECT: Proponent's Response to Technical Comments on the Draft Environmental Impact Statement for the Madrid-Boston (Phase*

2) Proposal, Responses to ID# DFO-3.1.2-DFO-FPP comments 102.7, p. 317, the proponent agreed to use an appropriate water crossing maintenance and a monitoring plan: "*During the authorization process, DFO will outline requirements for monitoring and will be in a position to monitor activities and as built infrastructure as they deem appropriate.*"

31.3.1 Importance of Issue to Impact Assessment

Watercourse crossings have the potential to impact fish, fish habitat and fish passage if they are not designed, sized, installed and maintained properly.

31.3.2 Detailed Review Comment

DFO-FPP acknowledges that the Proponent highlighted the use of 'DFO Measures to Avoid Causing Harm to Fish and Fish Habitat' design criteria for enabling fish passage and that water crossings require a maintenance and a monitoring program to avoid negative impacts to fish and fish habitat. DFO-FPP also acknowledges that the Proponent has provided general engineering preliminary drawings of 'bridges and culverts designs' in DEIS, Vol. 3, Appendix V3-3I, p.33-34.

DFO-FPP notes that the provided design criteria, watercourse crossing engineer drawings, and the mitigation and monitoring plan that includes mention of 'DFO Measures to Avoid Causing Harm to Fish and Fish Habitat', are conceptual and general in nature. As such, it is unclear at this time, in the absence of detailed engineering designs, what the full suite of measures are that the Proponent intends to implement to avoid, mitigate or offset *serious harm to fish* as defined in the *Fisheries Act* as a result of water crossings proposed for the Hope Bay Phase 2 Project.

Details of a site-specific, best-practices management plan during the construction, including a maintenance plan and monitoring program will be required from the Proponent to DFO-FPP during the regulatory phase.

For fish bearing streams, DFO-FPP will require site-specific detailed design plans during the regulatory phase to determine the full extent of the potential impacts below the high-water mark (HWM).

1. **Recommendation/ Request**-DFO-FPP recommends that the Proponent provide Fisheries and Oceans Canada with detailed watercourse and site specific engineering plans for all water course crossings, supported by measured or modeled stream flow data. This information is to be provided prior to construction, during the regulatory phase, should the project be approved to proceed.

2. DFO-FPP recommends that the Proponent work with Fisheries and Oceans Canada and the affected community members including the Kitikmeot Inuit Association to develop a site-specific construction work plan during the regulatory phase, should the project be approved to proceed. This construction plan should include but not be limited to, the full suite of mitigation measures that will be implemented to reduce the impact on fish and fish habitat during the construction phase.

3. 3. DFO-FPP recommends that an appropriate water crossing maintenance and monitoring plan be developed to ensure that barriers to fish passage do not form over time.

31.4 TMAC Response for DFO-3.1.1

1. TMAC will develop and provide detailed watercourse and site-specific engineering plans to Fisheries and Oceans Canada (DFO), supported by measured or modelled stream flow data prior to construction. The information will be provided prior to construction, during the regulatory phase, once the project is approved to proceed.

2. As part of TMAC's ongoing consultation process, TMAC will work with DFO, the KIA, and the Inuit Environmental Advisory Committee (IEAC) during the regulatory phase to develop a construction plan for watercourse crossings that will include mitigation measures to reduce impacts to fish and fish habitat during construction. TMAC submitted a Request for Review in 2016 associated with the Roberts Bay Discharge Access Road Culvert (02-HCAA-CA7-00117) and therefore intends to take a similar information sharing approach for all future water crossing construction activities.

3. TMAC will develop and/or update a water crossing monitoring and maintenance plan prior to construction.

32. ID #DFO-3.1.2

32.1 SUBJECT / TOPIC

Potential impacts on Freshwater Fish from Change in Water Flow and Water Volume

32.2 REFERENCE

- DEIS, Volume 1, Annex V1-7, Type A Water Licence Application, Package P5-4 – Madrid-Boston Project water and Load Balance, Hope Bay Project.
- FEIS, Volume 5, Appendix V56AA – Conceptual Fresh Water Fisheries Offsetting Approach, p. 24, 29.
- FEIS, Volume 5, Section 6.5.3.3 – Proposed Monitoring Plans and Adaptive Management, p. 6 – 143-144.
- DEIS, Volume 1, Annex V1-7, Type A Water Licence Application, Package P4-18 – Hope Bay Project Madrid-Boston Aquatic Effect Monitoring Plan, p.3-4.

32.3 SUMMARY

The effects assessment of the Madrid-Boston Project concludes that residual effects will remain after mitigation measures and that fish habitat will be altered through stream flow and lake water level alteration. Those effects have been predicted by the proponent based on simulated results from the water balance model described in DEIS, Vol. 1, Annex V1-7, Package P5-4.

Impacts on fish and fish habitat resulting from the Project and not predicted to be mitigatable are anticipated in the following watercourses (FEIS Vol. 5, Appendix V5-6AA, p.24 &29):

1. Little Roberts Outflow
2. Doris Outflow
3. Ogama Inflow/Outflow
4. P.O. Outflow
5. Patch Outflow
6. Inmiagut Outflow
7. Stickleback Outflow

8. Wolverine Outflow
9. Imniagut Outflow/Lake

In the FEIS Vol. 5, Section 6, p.143-144, the proponent highlighted the use of an Aquatic Effects Monitoring Program (AEMP) that will be carried out during all phases of the Project. The AEMP proposed water level monitoring stations only at locations where water withdrawal will occur or where water surface can be affected by underground mine.

32.3.1 Importance of Issue to Impact Assessment

It is important to monitor water levels and flows in watercourses that will be impacted, to ensure that unauthorized affects to fish and fish habitat are avoided.

32.3.2 Detailed Review Comment

DFO-FPP notes that there exist uncertainty with models based on estimates and estimated data variables. With respect to cumulative surface hydrology impacts and the potential impacts on the fish bearing watercourses, uncertainty with estimated models could result in surface flows that are lower or higher than predicted. As such, DFO-FPP notes that a robust monitoring plan should be implemented. This plan needs to identify variation from the predicted ranges in advance of unauthorized serious harm to fish. It should include low action levels which trigger the need for additional mitigation measures.

DFO-FPP recognizes that the Proponent has proposed a conceptual AEMP that acknowledges the potential for surface water quantities to be affected by the Project. DFO-FPP notes that the AEMP proposes to monitor potential effects of water withdrawal and groundwater removal on the surface water by monitoring water level in Wolverine, Patch, Doris, Windy and Aimaokatalok lakes (DEIS, Vol. 1, Annex V1-7, Package P4-18, p. 3-4).

DFO-FPP notes that it is unclear whether the Proponent intends to monitor the water flow and quantities within the fish bearing watercourses where the possible impacts are predicted by the water balance model. Without an appropriate monitoring program in place, it will be difficult to detect the potential variations in the water levels and stream flow prior to an unauthorized impacts to fish and fish habitat occurring.

32.4 RECOMMENDATIONS/REQUESTS

10. DFO-FPP recommends the Proponent include monitoring stations to monitor water levels and stream flows in the AEMP for all fish bearing lakes and streams that are predicted to be potentially impacted by the Project.

32.5 TMAC RESPONSE FOR DFO 3.1.2

In order to account for potential variations from predicted water quantity modeling results, TMAC will monitor water levels and flows in fish bearing lakes and streams that are predicted to be potentially impacted by the Project during mining (e.g., P.O., Ogama, Little Roberts, and Glenn lakes in addition to lakes and streams in the AEMP and listed in Section 2.3 above). Hydrometric monitoring will be carried out by standard methods appropriate for assessing changes in lake level/stream flow (e.g., suitable combination of pressure sensors, staff gauges, and/or manual flow measurements in lakes and/or streams).

Monitoring requirements will be developed and submitted as part of a fisheries offsetting monitoring plan submitted with a Fisheries Authorization application. Similar to AEMP plan, TMAC intends to develop a framework that will include water level and flow thresholds that if reached, they will trigger low action levels resulting in the application of additional mitigation measures as deemed necessary. In this way, monitoring requirements relevant to fish and fish habitat will form part of conditions committed to during the regulatory phase following Project approval.

33. ID #DFO-3.1.3

33.1 Subject / Topic

Avoidance and Mitigation of Effects to Fish and Fish Habitat resulting from Water Intake and Discharge Pipes

33.2 Reference

- FEIS Volume 5, Section 6.5.4.1 – Loss or Alteration of Fish Habitat, p. 6 - 154-156.
- FEIS Volume 5, Section 6.5.3.2 – Best Management Practices, p. 6 - 141-143.

33.3 Summary

Two water intake pipelines and one discharge pipe are proposed for the Madrid-Boston Project. The intake pipelines will be 0.15 m diameter and will be laid along access roads, transitioning from shoreline to lake bed. Pipelines will extend to 5 m depth in the lake (40 m total length in Windy Lake and 420 m total length in Aimaokatalok Lake). Effluent from the Boston water treatment plant will be discharged into Aimaokatalok Lake through a 0.25 diameter pipeline that will run from the treatment plant to the access roads and from shoreline to lake bed. The discharge pipeline will also extend to 5 m depth in the lake (800 m total length) (FEIS, Vol. 5, Section 6.5.4.1, p. 6-154-156). To reduce impacts to fish and fish habitat during the construction phase, the Proponent refers to the general best management practices list in the FEIS, Vol. 5, Section 6.5.3.2, p. 6-141-143.

33.3.1 Importance of Issue to Impact Assessment

In water Pipeline infrastructure has the potential to impact fish and fish habitat.

33.3.2 Detailed Review Comment

In the FEIS, Vol. 5, Section 6.5.3.2, p. 6-141-143, the Proponent refers to a broad list of best management practices to be implemented during the Madrid-Boston Project that include, but are not limited to *DFO's Measures to Avoid Causing Harm to Fish and Fish habitat* (DFO 2013). DFO-FPP understands that the proposed management practices aim to avoid unnecessary impacts to freshwater fish and fish habitat but are conceptual and not site-specific. Therefore, DFO-FPP requires a detailed site-specific plan of the full suite of mitigation measures that will be implemented during the construction of the pipelines (e.g. site isolation during the construction of the rock berms, design of the fish screens, and a sediment and erosion control plan).

33.4 RECOMMENDATIONS/REQUESTS

11. DFO-FPP recommends that the Proponent work with DFO-FPP and the potentially affected community members including the Kitikmeot Inuit Association, to develop a site-specific construction work plan during the regulatory phase, should the project be approved to proceed. This plan should include but not be limited to, the full suite of mitigation measures that will be implemented to reduce the impacts on fish and fish habitat during construction.

33.5 TMAC RESPONSE FOR DFO-3.1.3

As part of TMAC's ongoing consultation processes, TMAC will work with DFO, the KIA and the IEAC during the regulatory phase to develop a site-specific construction work plan for in-water pipeline infrastructure that will include the mitigation measures to be implemented to reduce impacts to fish and fish habitat during construction.

34. ID #DFO-3.1.4

34.1 SUBJECT / TOPIC

Potential impacts to Freshwater Fish productivity from changes in water flow and water volume

34.2 REFERENCES

- DEIS Volume 5, Section 1.5.5.3 – Characterization of Residual Effect for Surface Hydrology VEC, Streamflow alteration in Doris Watershed p. 1-69.
- FEIS Volume 5, Section 1.5.5.3 – Characterization of Residual Effect for Surface Hydrology VEC, Streamflow alteration in Doris Watershed p. 1-71
- DEIS Volume 5, Section 6.5.4.2 – Loss or Alteration of Fish Habitat, Water Withdrawal and Use, p. 6-165.
- FEIS Volume 5, Section 6.5.4.2 – Loss or Alteration of Fish Habitat, Water Withdrawal and Use, p. 6-182.

34.3 SUMMARY

In DEIS Vol. 6 Section 6.5.4.2, the Proponent identified that water quantity impacts may have timing issues that require additional assessment. Specifically, the Proponent states in DEIS Vol. 6 Section 6.5.4.2 that:

"Therefore, effects on fish habitat due to a reduction in stream flow are considered negligible based on the application of a 10% variation from baseline threshold. However, effects due to changes in the timing of flows (e.g., later onset of freshet if lake volume is reduced and does not begin flowing in streams) and decrease in the number of days stream habitat is accessible (i.e., later freshet and/or earlier freeze up) are not assessed. The resolution of the simulated monthly data from the water balance report does not allow for detailed assessment for these variables and effects on fish habitat due to a change in the timing of flows may require additional assessment to ensure that effects on access to habitat do not occur. These analyses will be refined prior to submission of the final EIS."

DFO-FPP notes that the corresponding FEIS Vol. 5, Section 6.5.4.2 eliminates all text following the first sentence above. The revised text is as follows:

'Therefore, effects on fish habitat due to a reduction in stream flow are considered negligible based on the application of a 10% variation from baseline threshold. '

34.3.1 Importance of Issue to Impact Assessment

Affecting stream flows at certain times may delay fish in accessing spawning areas and result in fish productivity loss.

34.3.2 Detailed Review Comment

Reduced flow associated with timing may impact fish productivity by impeding fish access to important habitats associated with their biological processes such as spawning, feeding or rearing sites during critical periods of their life cycle.

DFO-FPP is unclear as to whether the predicted changes in timing resulting from a reduction of stream flow as predicted as follows in the DEIS: "*However, effects due to changes in the timing of flows (e.g., later onset of freshet if lake volume is reduced and does not begin flowing in streams) and decrease in the number of days stream habitat is accessible (i.e., later freshet and/or earlier freeze up) are not assessed. The resolution of the simulated monthly data from the water balance report does not allow for detailed assessment for these variables and effects on fish habitat due to a change in the timing of flows may require additional assessment to ensure that effects on access to habitat do not occur. These analyses will be refined prior to submission of the final EIS.*" were assessed and accounted for in the FEIS.

It is unclear to DFO-FPP if the FEIS resolved expectations established in the DEIS for analysis of water quantity timing impacts on fish habitat access.

34.4 RECOMMENDATION/ REQUEST-

12. DFO-FPP requests that the Proponent clarify whether water quantity impacts that may have timing issues were accounted for in the impact assessment.

13. DFO-FPP recommends that Proponent conduct an analysis of water quantity timing impacts on fish access to key habitats.

34.5 TMAC RESPONSE FOR DFO-3.1.4

Water quantity impacts that may have timing issues were accounted for in Section 6.5.4.2 of the FEIS under the Characterization of Hope Bay Project Potential Effect for Streamflow (pages 6-173 to 6 -188). This section also includes an analysis of the water quantity timing impacts of fish access to key habitats. In this characterization, an initial assessment considered two timing periods (high and low flow) and a follow up assessment in "higher risk" watercourses further determined periods of highest risk for fish and potential effects on habitat use.

In the initial assessment a variation of 10% from baseline conditions (DFO 2013) at high flow (June) and low flow (July, August, and/or September) was used to identify waterbodies that may be affected by reduced streamflows under the two general flow regimes observed in streams in the Project area (Table 3.5-13). Where the maximum simulated reduction in monthly streamflow in either period over the life of the Project was less than 10%, effects on fish habitat were considered negligible and no additional assessment of the quantity or timing of flows was deemed necessary.

For waterbodies with a variation of 10% or greater from baseline conditions at high flow (June) or low flow (July, August, and/or September), a minimum flow threshold of 30% of mean annual discharge (MAD) was used to determine periods of highest risk (DFO 2013). This assessment was carried out on a monthly timescale to contribute to the determination of the life stages of fish and fish habitat requirements that may be affected by reduced flow (Table 6.2-24). The potential effects of reduced streamflow on fish and fish habitat at different times during the open water season for each stream were described based on the % of MAD predicted, fish species known to be present, and their life history characteristics (pages 6-182 to 6-184 of the FEIS). In each case, it was determined that the habitat function, including migratory connectivity and access to habitats, of the streams would be maintained under the reduced flow conditions. The exception was Imniagut Outflow where the reduction in streamflow was predicted to result in a permanent loss of fish habitat requiring offsetting. Although habitat function was determined to be maintained in all other streams, all predicted losses of habitat were quantified by calculating the area of potential alteration or disruption using baseline fish habitat data and hydraulic models in order to quantify potential offsetting requirements (Table 6.5-15).

References:

DFO. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.

35. ID #ECCC-WL-4.1.1

35.1 Subject/Topic

Seepage Collection

35.2 References

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

35.3 Issue

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

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

35.4 Recommendations

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

35.5 TMAC Response for ECCC-WL-4.1.1

TMAC recognizes that climate change could impact the performance of long-term structures such as the Boston tailings management area (TMA). As a result, the Boston TMA has been designed taking climate change into account (Package P5-1 Climate Change Analysis Approach Report, Hope Bay Project). For example, the thermal analysis undertaken on the Boston TMA (Package P5-26 Boston Tailings Management Area Preliminary Design Hope Bay Project, Appendix D) to estimate active layer thickness in the dry stack tailings in support of the long-term geochemical load balance which considers climate change. Based on that analysis, as well as the water and load balance modeling (Package P5-4 Madrid-Boston Project Water and Load Balance, Hope Bay Project) it was concluded that a High Density Polyethylene (HDPE) liner would be a suitable method to limit infiltration, and subsequently an infiltration analysis was completed (Package P5-26 Boston Tailings Management Area Preliminary Design Hope Bay Project, Appendix E), which confirmed that long-term post-closure seepage is not expected to be a concern. This infiltration rate is a function of imperfections in the liner and is not affected by changes to permafrost distribution as a result of climate change. Furthermore, deformation modeling for the TMA (Package P5-26 Boston Tailings Management Area Preliminary Design, Appendix F) considers climate change and confirms that expected deformation is sufficiently small so as not to affect the performance of the liner.

TMAC considers that the design and supporting analyses have conservatively and sufficiently accounted for the potential impacts of climate change on structures like dry stack tailings post closure and no additional contingency measures are required

36. ID #ECCC-WL-4.1.2

36.1 Subject/Topic

Seepage Surveys

36.2 References

- Package 4-7: Hope Bay Doris-Madrid Water Management Plan
- Package P4-8: Hope Bay Boston Water Management Plan
- Package P4-10: Hope Bay Bostin Tailings Management Area Operations and Maintenance Plan

36.3 Issue

Waste Rock Piles

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

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

Boston Tailings Management Area

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

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

36.4 Recommendations

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

36.5 TMAC Response for ECCC-WL-4.1.2

Monitoring of seepage from all waste rock storage areas and tailings management areas is already covered under existing monitoring plans as described below.

Waste Rock Piles

Freshet seepage monitoring of the Madrid North, Madrid South and Boston waste rock stockpiles is outlined in Annex V1-7, Package P4-11 Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan. The seepage program design is consistent with the waste rock seepage monitoring program currently conducted for Doris waste rock as part of Water Licence 2AM-DOH1323. This includes opportunistic sampling of seepage at the toe of the Waste Rock Pile during the freshet seepage survey.

All seepage and runoff from the waste rock and ore stockpile pads are directed to contact water ponds and managed according to the Water Management Plans (Annex V1-7, Packages P4-7 Hope Bay Project Doris-Madrid Water Management Plan, P4-8 Hope Bay Project Boston Water Management Plan). Contact Water Ponds (CWPs) will be monitored as part of the Surveillance Network Program (SNP) monitoring network. Therefore, drainage from the waste rock stockpiles will be monitored more frequently than twice per year and accordingly, a seepage monitoring program in the late fall is not warranted. As noted for Madrid North, the contact water pond is not dedicated to the waste rock pile exclusively. Since the waste rock pile is the dominant feature within the contact water pond drainage, TMAC expects that the water quality data from the collection pond will have a geochemical signature that will sufficiently quantify source water quality for waste rock.

Should the monitoring indicate higher than expected seepage and runoff, the management of the contact water would not change. The CWPs have been conservatively designed based on 100% run-off and not on seepage estimates. Collection at the toe of the pile and transport to the CWP would provide no management or environmental benefit.

Boston Tailings Management Area

Seepage through the tailings in the TMA is considered negligible due to the high placed density and the fact that tailings will freeze back and remain frozen for the foreseeable future (other than the active layer) (Annex V1-7, Package P5-26 Boston Tailings Management Area Preliminary Design Hope Bay Project).

As outlined in Section 6.1.1 (Visual Inspections) of Supporting Document P4-10 Hope Bay Boston Tailings Management Area Operations, Maintenance, and Surveillance Manual, the TMA will be visually inspected each day for signs of seepage (among other parameters), including volumes and locations. This inspection may trigger maintenance or operational actions. The engineer of record (EOR) is notified immediately after any inspection where notable changes to any of the TMA facilities outside of normal operating constraints are observed. The EOR will, in consultation with operations staff, assess the situation and develop any actions plans if deemed appropriate. This could include water quality analysis of any unexpected seepage.

While there should be no seepage through the tailings, precipitation will come into contact with tailings stored in the TMA. This contact water will be collected in CWPs. As stated in Section 3.4.2 of Package P4-8 Hope Bay Project Boston Water Management Plan, during operations a water quality sample will be collected twice annually from the CWPs; once during the spring snowmelt period and once during the regular open-water season. This bi-annual monitoring within the CWPs will sufficiently quantify source water quality from Boston flotation tailings in the Boston TMA.

Verification of modelling predictions on freezing of the dry stack will be undertaken as part of the geotechnical monitoring program. As stated in Supporting Document P5-26 Boston Tailings Management Area Preliminary Design Hope Bay Project "*thermal monitoring of the tailings profile will be carried out to confirm tailings freeze-back assumptions. All of the above will be subject to annual inspections by a qualified professional engineer as part of routine annual inspections*".

37. ID #ECCC-WL-4.1.3

37.1 Subject/Topic

Wastewater Treatment Plant – Contingency and Required Upgrades

37.2 References

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

37.3 Issue

Capacity

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

Contingency
TMAC employs several contingency options in the event that a wastewater treatment unit at Doris becomes inoperable or the plant is unable to discharge. The available contingency involves the use of holding tanks to store untreated wastewater, amounting to a total capacity of 27 m3 (equivalent to 4 days of operational capacity). In addition to the holding tanks at the Doris Camp, a third MBR WTP is available in the event that one WTP malfunctions. There is no discussion on the additional contingency that could be put in place given the increase in accommodations at the Doris Camp.

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

37.4 Recommendations

ECCC recommends that the Proponent

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

37.5 TMAC RESPONSE FOR ECCC-WL-4.1.3

a) TMAC's sewage treatment plant is modular in design and will include additional module(s) to process the additional waste water flows and meet applicable licence requirements.

b) It is not common or standard practice to have spare domestic waste treatment plant capacity in place as prolonged periods of downtime is highly unlikely. The only reason this was available at Doris previously was due to the fact that the additional plant was purchased long before TMAC made a commitment to increase the camp size. TMAC's primary contingency for periods of prolonged downtime of the treatment plant is trucking and discharging the untreated water in the Doris TIA.

c) Should the Boston sewage treatment plant be down for any extended period of time, any untreated water will be trucked to the Doris for treatment there, or alternately to the Doris TIA for disposal. TMAC will have a 60 m^3 water truck available to transport this water, and assuming a 3 hour cycle time between Boston and Doris, the amount of water that can be disposed of daily is 480 m^3. The peak water use that may require treatment in any day is however 90 m^3, and therefore there is more than sufficient capability of transporting this water.

38. ID #ECCC-WL-4.1.4

38.1 SUBJECT/TOPIC

Boston Contact Water Pond 2 and Surge Pond

38.2 REFERENCES

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

38.3 ISSUE

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

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

38.4 RECOMMENDATIONS

ECCC recommends that the Proponent

a) Provide additional clarification on the water management at Contact Water Pond 2. Specifically, whether the intent is to operate CWP#2 and the Surge Pond as dry facilities.

b) Clarify whether CWP#2 has been designed to retain water for increased residence times and describe the potential for seepage through the berms

38.5 TMAC RESPONSE FOR ECCC-WL-4.1.4

a) TMAC acknowledges an error in the Supporting Document P4-8 Hope Bay Boston Water Management Plan, Section 2.3.2 stating that Contact Water Pond #1 (CWP#1) will pump to Contact Water Pond #2 (CWP#2). The correct flow paths are shown on Figure 1 of the same document. CWP#1 will pump to the lined surge pond, not to CWP#2. The only inflow to CWP#2 will be runoff from the infrastructure pads containing the process plant and camp, or an emergency overflow from the lined surge pond. This will be amended in the P4-8 Hope Bay Boston Water Management Plan.

To clarify, the intent is to operate all ponds as dry facilities. Following a rain event, all ponds will be dewatered, if the water requires treatment, the collected water will be pumped to the surge pond. Once the water is discharged from the surge pond via the treatment plant, the surge pond will return to a dry state. The lined surge pond will also have inflows from the process plant in an upset condition. This may mean that there are inflows to the surge pond at times unrelated to rain events. However, the pond will still be operated as a dry pond. Once the process plant water is discharged from the surge pond via the treatment plant, the surge pond will return to a dry state. It is important to note that the process plant will normally feed the water treatment plant directly. Only in an upset condition will the surge pond be used for process plant water to be directed to the water treatment plant.

b) The surge pond may hold water slightly longer than other ponds as it is the last holding point before discharge for water which requires treatment. The holding capacity of the surge pond is 2 days of average treatment plant flow. So the additional holding time for the surge pond could reasonably be expected to be approximately 2 days. It is likely that the total holding time following a rain event will be less than 14 days, as the CWPs at capacity (100-year 24-hour duration rainfall event with the daily average snowmelt) can be dewatered and treated in 14 days (Supporting Document P4-8 Hope Bay Boston Water Management Plan).

The surge pond has been designed with additional thermal inputs from process plant water sources as described in Hope Bay Project: Contact Water Pond and Surge Pond Berms Thermal Modeling, provided as Attachment 1 of P5-3 Hope Bay Project Contact Water Pond Berm Design. The surge pond was modeled with increase of water temperature to +16.5°C for a 14-day period. It should be noted that the surge pond is a fully lined facility and water containment is not dependent on the frozen foundation condition, as is the case for the CWPs. Additionally, thermal modeling has confirmed that the minimum berm design thickness of 2.5 m is suitable to maintain the geomembrane liner frozen at the critical position of Monitoring Point 1 under conservative, unexpected year-round retention of water within the event ponds (TMAC response to KIA-DEIS-54). Regardless, the design and operation of the contact water ponds continues to be a maximum water retention period of 14 days.

39. ID #ECCC-WL-4.1.5

39.1 Subject/Topic

Water Management Ponds - Monitoring and Dewatering

39.2 References

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

39.3 Issue

Contact Water Pond Dewatering

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

Boston Tailings Management Area Contact Water Pond Monitoring

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

Boston Non-contact Water Pond

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

39.4 Recommendations

ECCC recommends that the Proponent

a) Clarify dewatering procedures for Contact Water Pond #1, Madrid North Contact Water Pond and the Madrid South Primary and Secondary Contact Water Ponds. If dewatering to the tundra is proposed, a description of location, monitoring and erosion control measures should be included.

b) Discuss proposed frequency of water quality monitoring at the Boston Tailings Management Area Contact Water Ponds.

c) Discuss water quality monitoring downstream of the Non-Contact Water Pond, prior to discharge into Stickleback Lake.

d) Discuss contingency options in the event that TSS in the Non-Contact Water Pond exceeds criteria and cannot be discharged via the overflow culvert.

39.5 TMAC Response for ECCC-WL-4.1.5

a) If water in any water collection facility meets the designed criteria for discharge, excess water may be discharged to tundra at an approved location. The specific locations will be identified and presented to the inspector for approval prior to any discharge. Preventative measures will be used to prevent erosion such as reduced discharge velocities, multiple discharge points, selection of non-vulnerable discharge locations and natural energy dissipation. Furthermore, once an appropriate location has been identified, visual monitoring for erosion or any other tundra damage will be conducted by a professional engineer during the annual geotechnical inspections. Early signs of erosion will be noted and mitigation measures will be implemented by realigning the discharge pipeline, protecting erodible material or moving to another approved location.

b) As stated in Supporting Documents P4-8 Hope Bay Project Boston Water Management Plan, *"a water quality sample will be collected twice annually during operations; once during the spring snowmelt period and once during the regular open-water season. If water quality meets the designed criteria for discharge, excess water may be discharged to tundra at an approved location."*

Therefore, a water quality sample will also be collected prior to any proposed tundra discharge of the water collected in the TMA contact water ponds.

c) At a point downstream of the Non-Contact Water Pond and prior to reaching Stickleback Lake, TMAC will conduct a field Total Suspended Solids (TSS) test at the same time as the water quality sample is collected from the Non-Contact Water Pond, if present. Supporting Document P4-8 Hope Bay Project Boston Water Management Plan will be updated accordingly. It is noted that this may not be possible due to the likely low flow velocity of the seepage through the non-contact water berm. Typically, low flow seeps are not tested for TSS as they are inherently low in TSS due to the low flow velocity unable to keep solids in suspension.

d) The Non-Contact Water Pond berm is designed as a flow through structure. This is a proven method for sediment control on site (see TMAC response to #KIA-NIRB-26). The pond is also sized to store the 100-year, 24-hour duration rainfall event with the daily average snowmelt, based on no-flow through the structure. It is therefore highly unlikely that there will be flow through the overflow culvert. However, in such a case it is also considered unlikely that the TSS in the Non-Contact Water Pond exceeds criteria and cannot be discharged (see TMAC response to #KIA-NIRB-26). Based on the extreme low likelihood of this combined event occurring, no additional contingency is considered required. It should be noted that in such a scenario the total inflow into Stickleback lake from the natural catchment will also be extremely high from the occurring storm. Therefore, no environmental effects would be expected should there be any overflow with increased TSS from the overburden dump run-off.

40. ID #ECCC-WL-4.1.6

40.1 Subject/Topic

Quarries with High Risk of Acid Rock Drainage (ARD)

40.2 References

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

40.3 Issue

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

40.4 Recommendations

ECCC recommends that the Proponent

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

40.5 TMAC Response for ECCC-WL-4.1.6

As noted in Section 2.1.1 of Package 4-17: Hope Bay Project Quarry Management Plan, current geochemical test work indicates that three quarries are currently suitable for use as mine backfill only, specifically Quarry W (not Q as stated by ECCC), Z and AD. Table 1.1.2 of Package 4-17: Hope Bay Project Quarry Management Plan lists all proposed quarries for the Project, if it is suitable for use as construction material and if any additional geochemical characterization is required before development of the quarry.

As stated in Table 1.1.2, Quarry AD is the location of the Boston processing plant pad. Excavation within Quarry AD is limited to a cut for the processing plant pad only and volumes will be minimized as much as possible. As Quarry AD material is not suitable for use as construction material, it will be placed as structural backfill in the underground mine. All runoff from the contact pad will be managed as contact water and diverted to Contact Water Pond #2, where it will be used as process make-up water or treated prior to discharge.

As stated in Table 1.1.2, Quarries Q, W and Z require confirmatory test work prior to using these quarries for construction. To clarify, it is not concluded that these materials have a high risk of ARD, but in the absence of the required information, they should be managed as such. Accordingly, the term "high risk for ARD" is a quarry rock management term and not necessarily indicative of the geochemical characteristics of the quarry rock. Specifically, the additional information required is summarized as follows:

- Quarry Q: geochemical characterization program;
- Quarry W: silicate mineralogical characterization; and
- Quarry Z: geological inspection and geochemical characterization program.

TMAC notes the number of quarries presented in Table 1.1.2 currently exceeds current construction requirements for the Project.

Drainage from the waste rock stockpiles is collected and monitored as outlined in P4-11 Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan and also in technical comment ID #ECCC-WL-4.1.2. All rock within the waste rock piles will be placed as structural backfill within the stopes of the underground mine.

41. ID #ECCC-WL-4.1.7

41.1 Subject/Topic

Aquatics Effects Monitoring Program (AEMP)

41.2 References

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

41.3 Issue

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

41.4 Recommendations

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

41.5 TMAC Response for ECCC-WL-4.1.7

TMAC will submit the revised Madrid-Boston AEMP complete with an Aquatic Response Framework to interested parties prior to the Final Hearing on April 27, 2018. TMAC is committed to technical discussions that follow submission of the revised AEMP such that baseline sampling aligned with the AEMP can begin during the open-water sampling campaign. Of note, TMAC has collected additional baseline water quality, sediment quality, phytoplankton biomass, and benthic invertebrate in the proposed AEMP lakes in 2017 and will again in 2018.

42. ID #ECCC-WL-4.1.8

42.1 Subject/Topic

Post-Audit of Water Quality Modelling

42.2 References

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

42.3 Issue

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

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

42.4 Recommendations

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

42.5 TMAC RESPONSE FOR ECCC-WL-4.1.8

TMAC maintains that the updating of predictive models will be used as adaptive management to refine closure requirements. This will include the updating of predictive models for Roberts Bay and Aimaokatalok Lake. Specific details for the predictive model re-calibration frequency and scope will be determined in the water licensing stage.

43. ID #ECCC-WL-4.1.9

43.1 Subject/Topic

Mitigation and Monitoring for In-Water Works

43.2 References

- Package 4-8: Hope Bay Boston Water Management Plan
- Package 5-11: Hope Bay Madrid-Boston All-Weather Road Preliminary Design
- Package 5-14: Hope Bay Cargo Dock Access Road Memo
- Package 5-17: Madrid North Surface Infrastructure Memo
- Package 5-18: Madrid South Surface Infrastructure Memo
- Package 5-22: Madrid North TIA Road Memo
- Package 5-23: Windy Lake North Freshwater Intake Memo
- Package 5-28: Hope Bay Boston Infrastructure Memo

43.3 Issue

Intake and Discharge Pipelines

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

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

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

Road Construction

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

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

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

43.4 RECOMMENDATIONS

ECCC recommends that the Proponent

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

b) Identify mitigation measures for sediment and erosion control during construction of stream crossings.

43.5 TMAC RESPONSE FOR ECCC-WL-4.1.9

a) TMAC will abide by guidelines and or requirements provided by DFO in any authorization that is granted. Typically, a EPP is prepared for the specific works which is reviewed and approved by DFO prior to construction commencing.

b) As stated in Package P4-18 Hope Bay Project Aquatic Effects Monitoring Plan, "*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.*" A detailed construction plan will be developed for stream crossings in accordance with DFO recommendations, as has been undertaken for existing crossings on site. Mitigation measures will vary depending on the specific site and the type of crossing. Typical mitigation measures for culvert installation would include: avoidance of fish spawning season for construction and use of sediment control measures such as sand bag coffer dams, energy dissipaters, and silt fences during construction. Free span structure crossings will not directly impact the stream during construction.

   As stated Hope Bay Project: Stream Crossing Preliminary Design Brief provided as Appendix A of P5-19 Hope Bay Project Madrid Water Management Design, "*For the first few years after construction, silt fences will be installed along the toe* *of the roadway to ensure that sediments do not enter the streams. The silt fences will start a minimum of 3 m before the abutment of the clear-span structure."* Additionally, the site wide technical specifications (SRK 2011) for all construction on site also specify sediment control measures in Section 7.2.15

References:

SRK Consulting (Canada) Inc., 2011. Technical Specifications Earthworks and Geotechnical Engineering, Hope Bay Project Nunavut, Canada, Revision G – Issued for Construction. Report Prepared for Hope Bay Mining Limited. Project No.: 1CH008.033. March 2011.

44. ID #ECCC-WL-4.1.10

44.1 Subject/Topic

Tailings Pipeline Catch Basins

44.2 References

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

44.3 Issue

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

44.4 Recommendations

ECCC recommends that the Proponent

a) Clarify the circumstances that would require the use of the tailings catch basins
b) Describe the process of cleaning out and disposing of tailings deposited in the catch basins.

44.5 TMAC Response for ECCC-WL-4.1.10

a) As stated in P5-22 Hope Bay Project: Madrid North-Tailings Impoundment Area All-Weather Road Preliminary Design "Tailings catch basins have been designed to provide locations along the pipeline where a controlled volume of tailings can be discharged into a contained area." The primary reason this would be required is if the tailings pipeline requires repairs and needs to be drained.

b) The cleaning out process would likely be through re-slurrying the tailings collected in the catch-basin and pumping into a truck for transport to the TIA. Damage to the liner system is therefore unlikely and as stated in P5-22 Hope Bay Project:

Madrid North-Tailings Impoundment Area All-Weather Road Preliminary Design "Following an emergency spillage and clean-out the HDPE geomembrane will be inspected and repaired or replaced as required." Additionally, each catch basin can accommodate a minimum of 2 pipe draining events based on the longest section of pipe between catch basins.

45. ID #ECCC-WL-4.1.11

45.1 SUBJECT/TOPIC

Necessity of Site Specific Water Quality Objective for Copper

45.2 REFERENCES

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

45.3 ISSUE

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

1. Copper is naturally elevated above CCME water quality guidelines in certain waterbodies within the Madrid-Boston project area.

2. The Water and Load Balance predicts that copper concentrations will become elevated above baseline concentrations in Doris Creek, Wolverine Lake, and Stickleback Lake.

The Proponent chose to use a Water Effect Ratio (WER) procedure to develop a site specific guideline to account for the increases in the impacted creeks, rather than a Background Procedure to account for naturally elevated copper concentrations. The Proponent derived the SSWQO of 0.009 mg/L and used it for characterization of effects for all water bodies in the Madrid-Boston Project.

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

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

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

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

In Stickleback Lake and Wolverine Lake the observed median baseline concentrations are below the CCME water quality objective, however, the predicted baseline (median) concentrations approach and even exceed the CCME water quality objective (an order of magnitude difference). These differences between observed and modelled baseline concentrations potentially indicate that the model is not a good fit, as it would be expected that the predicted baseline copper concentrations would be comparable to the observed baseline concentrations.

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

ECCC questions the necessity for a copper SSWQO given that it appears that the modelling may be artificially inflating the predicted baseline copper concentrations and potentially the predicted base case predictions. Several lakes in the Madrid-Boston project area do have naturally elevated copper concentrations and a Background

Procedure approach may be appropriate for those lakes; however, given the abnormally high predicted baseline concentrations in relation to copper in the observed baseline, additional justification for a SSWQO in these two impacted lakes is required.

45.4 Recommendations

ECCC recommends that the Proponent

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

45.5 TMAC Response for ECCC-WL-4.1.11

A SSWQO for copper was used as an assessment threshold for the FEIS freshwater water quality assessment largely because the water quality modelling showed the predicted base case copper concentrations in Wolverine and Stickleback lakes were above the CCME minimum guideline of 0.002 mg/L for most of the project's life and the predicted base case concentrations were greater than 10% of the predicted baseline concentration in each lake (>20% for Wolverine Lake; >80% for Stickleback Lake). However, TMAC acknowledges that the modelled baseline copper concentrations were several fold greater than observed concentrations in Wolverine and Stickleback lakes, and that likely lead to inflated predicted base case concentrations. Thus, TMAC has re-considered its position of adopting a copper SSWQO for the Madrid-Boston Project, and will instead monitor potential changes to copper in the Project lakes through the AEMP. If copper levels increase significantly over time in a Project lake relative to the reference condition, and increase to 75% of the hardness-dependent CCME water guideline, the development of an SSWQO could be considered as a medium or high action level response through the Aquatic Response Framework within the AEMP (currently being revised).

46. ID #ECCC-WL-4.1.12

46.1 Subject/Topic

Arsenic Site Specific Water Quality Objective

46.2 References

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

46.3 Issue

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

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

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

1. The arsenic SSWQO of 0.028 mg/L that is referenced was developed for the Back River Project. However, the Proponent has referenced the February 2017 version of that document, which established an arsenic water quality guideline of 0.028 mg/L. This value underwent further scrutiny and was amended to exclude an ecologically irrelevant amphibian species and to ensure protectiveness of zooplankton. After this review a concentration of 0.025 mg/L was agreed upon by the parties as being more appropriate to that particular site.

2. The proposed objective is over 2 times higher than the maximum modelled concentrations of the post-closure upper case in Doris Creek and 77 times higher than the baseline upper case. While a similar SSWQO may have been deemed

appropriate for a similar Arctic site, given the predicted concentrations, the SSWQO could be reduced to reflect reasonably achievable levels.

3. ECCC questions the necessity of a site specific water quality objective given that exceedances of CCME are only anticipated in maximum under ice, and upper case predictions. The highest predictions for total arsenic in Doris creek are still half of the threshold that is being proposed.

4. Given that the exceedances of the water quality objective are only anticipated to occur during the post-closure period the Proponent should investigate additional measures which could be used to reduce releases of arsenic prior to closure, to meet closure objectives and reduce environmental impacts during the post-closure period.

46.4 RECOMMENDATIONS

ECCC recommends

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

46.5 TMAC RESPONSE FOR ECCC-WL-4.1.12

TMAC has re-considered applying an SSWQO for arsenic at this early juncture of the Madrid-Boston Project. Instead, it will monitor potential changes to arsenic in the Project lakes through the AEMP. If arsenic levels increase significantly over time in a Project lake relative to the reference condition, or increase to 75% (0.00375 mg/L) of the CCME water guideline (0.005 mg/L), the development of an SSWQO could be considered as a medium or high action level response through the Aquatic Response Framework within the AEMP (currently being revised). TMAC re-considered this position because increases in arsenic above the CCME guideline are only predicted for Doris Creek for approximately one month per year during post closure and the maximum predicted concentrations for the rest of the Project lakes are less than 50% the CCME guideline during all Project phases (Appendix V5-4D) and are therefore safe for aquatic life. It is also likely the maximum arsenic concentrations in Doris Creek during post closure are overestimated. This is because during the water quality modelling exercise (Package P5-

4) the TIA overflow was conservatively routed directly to Doris Creek instead of to northern Doris Lake (which is the actual pathway) where arsenic would be reduced before flowing into Doris Creek.

Nonetheless, from a water quality effects standpoint, the maximum arsenic concentration modelled in Doris Creek during post-closure (0.00999 mg/L) is far below the 0.019 mg/L arsenic SSWQO recommended by the KIA (see KIA-NWB-04) and the 0.025 mg/L agreed to for the Back River Project, both of which implicitly consider toxicological information to create thresholds safe for aquatic life. Given the uncertainty of the modelling results in Doris Creek and these previously developed SSWQOs, this would be considered an infrequent, low to moderate magnitude residual effect using the assessment criteria outlined in Table 4.5-12 of the FEIS water quality assessment (Volume 5, Chapter 4), and would not result in significant effects in Doris Creek, and more broadly, in other lakes in the Madrid-Boston Project area.

Although TMAC will investigate additional measures that could be implemented to reduce arsenic releases, TMAC anticipates that closure objectives can be met based on FEIS predictions, which are well below the aquatic health chronic effects threshold developed for the Back River Project. Project-specific information will continued to be collected by TMAC during operations that will confirm if closure objectives are on target, and can be used to refine future predictions for post-closure and future mitigation, if necessary.

47. ID #ECCC-WL-4.1.13

47.1 SUBJECT/TOPIC

Water Quality Predictions

47.2 REFERENCES

- Volume 5, Section 4, Table 4.2-10
- P5-4: Hope Bay Water and Load Balance Report

47.3 ISSUE

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

ECCC notes that in Appendix C-1, Page C1.6 indicates CCME water quality guideline for nitrite of 10 mg/L NO3-N, the correct concentration is 0.06 mg/L NO3-N.

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

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

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

47.4 RECOMMENDATIONS

ECCC recommends that the Proponent

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

47.5 TMAC RESPONSE FOR ECCC-WL-4.1.13

TMAC acknowledges the apparent inconsistencies, however there are not inconsistencies in the water and load balance model as presented in Supporting Document P5-4: Hope Bay Water and Load Balance Report.

The results for Aimaokatalok Lake presented in Appendix C-1 of Supporting Document P5-4 contain a copy error. The copy error was limited to Appendix C and not reflected in the results package used as the basis for the assessment. Please find the updated Appendix C-1 presented as Attachment ECCC-WL-4.1.13 – 1. This will resolve the cadmium and mercury errors referenced.

The presented table was revised to include the FEIS Baseline and Base Case predictions for the referenced elements. Chloride, total phosphorous, total aluminum, total boron, total iron and total zinc FEIS Baseline predictions are comparable to those presented in the observed baseline data. TDS concentrations in the observed baseline data set are higher than the FEIS Baseline predictions. More importantly, all model parameters have a baseline prediction that is the same as or lower than the base case predictions.

The primary reason for the TDS inconsistencies as identified by the reviewer, is the water and load balance model (P5-4) and the baseline analysis (V5-4) use different sources for the derivation of baseline data.

- Water and Load Balance Source: Aimaokatalok Lake water quality was based on samples collected at the outlet of the lake into the Koignuk River (Station Aimaokatalok OF). Water quality spanned the period from 1998 to 2017 and data with high DLs was removed from the data set. Monthly median and 75th percentile concentrations were applied in the model. Water quality is presented in Appendix A of P5-4.

- Baseline Data Source: Aimaokatalok Lake water quality included all lake samples and lake outflow samples from the period spanning 2007 and 2017. Samples were screened for high DLs.

Based on the explanation above, TMAC is confident the model accurately predicts water quality for Aimaokatalok Lake and no model calibration or adjustment is required.

Parameter	Baseline Data Average Water Quality Concentration (Volume 5, Section 4)	Revised Predicted Baseline Average Water Quality Concentration during Operations (Attachment ECCC-WL-4.1.13-1)	Revised Predicted Base Case Average Water Quality Concentration during Operations (Attachment ECCC-WL-4.1.13-1)
TDS	33.4 mg/L	20 mg/L	20 mg/L
Total Phosphorus	0.011 mg/L	0.011	0.011 mg/L
Chloride	10.1 mg/L	8 mg/L	8.2 mg/L
Total Aluminum	0.045 mg/L	0.045 mg/L	0.045 mg/L
Total Boron	0.0058 mg/L	0.0048 mg/L	0.0058 mg/L
Total Iron	0.08 mg/L	0.098 mg/L	0.099 mg/L
Total Zinc	0.0021 mg/L	0.002 mg/L	0.002 mg/L

48. ID #ECCC-WL-4.1.14

48.1 SUBJECT/TOPIC

Nitrite

48.2 REFERENCES

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

48.3 ISSUE

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

48.4 RECOMMENDATIONS

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

TMAC RESPONSE FOR ECCC-WL-4.1.14

The model incorporates conservatism by using the minimum process guarantee (higher than expected effluent concentration) by the RBC supplier for nitrite. Applying a lower nitrite source term to the Boston effluent would lower the nitrite value in Aimaokatalok Lake. This conservative approach is standard in water quality modelling. It reflects maximum concentrations that may be observed during temporary periods when the process is not at steady operating conditions. Furthermore, nitrite was screened out of the Aimaokatalok Lake hydrodynamic modelling, which included key project parameters for further evaluation. Therefore, to reproduce results with a lower nitrite source term would have no effect on the outcome of the assessment.

TMAC does not consider it necessary to revise the water and load balance model to include a lower nitrite source term.

ATTACHMENT ECCC-WL-4.3.13

Appendix C-1

Wolverine Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case														
			Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	5.8	5.8	1 x	15	14	0.98 x	7.4	7.3	1 x	17	17	1 x
TDS	mg/L	-	200	200	1 x	500	490	0.98 x	250	240	0.97 x	580	560	0.97 x
Fluoride	mg/L	0.12	0.069	0.069	1 x	***0.17***	***0.17***	0.98 x	0.086	0.085	0.99 x	***0.2***	***0.2***	0.99 x
Chloride	mg/L	120	81	80	1 x	***200***	***200***	0.98 x	100	100	1 x	***230***	***230***	1 x
Free Cyanide	mg/L	0.005	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
Total Cyanide	mg/L	0.005	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0065	0.0065	1 x	0.016	0.016	0.99 x	0.0081	0.008	1 x	0.019	0.019	1 x
Nitrate	mg/L as N	3	0.0065	0.0065	1 x	0.016	0.016	0.99 x	0.0081	0.008	1 x	0.019	0.019	1 x
Nitrite	mg/L as N	10	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
Sulphate	mg/L	1000	3.5	3.5	1 x	8.6	8.7	1 x	4.3	4.9	1.1 x	10	12	1.2 x
Alkalinity	mg/L	-	38	38	1 x	94	94	0.99 x	47	50	1.1 x	110	120	1.1 x
Hardness	mg/L	-	63	62	1 x	160	150	0.98 x	78	78	1 x	180	180	1 x
Dissolved Aluminum	mg/L	0.1	0.075	0.075	1 x	***0.19***	***0.18***	0.98 x	0.092	0.091	0.98 x	***0.21***	***0.21***	0.98 x
Dissolved Antimony	mg/L	-	0.00003	0.00003	1 x	0.000077	0.000077	1 x	0.000039	0.000043	1.1 x	0.000091	0.0001	1.1 x
Dissolved Arsenic	mg/L	0.005	0.00036	0.00036	1 x	0.00091	0.00091	0.99 x	0.00046	0.00048	1.1 x	0.0011	0.0011	1.1 x
Dissolved Barium	mg/L	-	0.0046	0.0046	1 x	0.011	0.011	0.99 x	0.0056	0.0058	1 x	0.013	0.013	1 x
Dissolved Beryllium	mg/L	0.1	0.0000065	0.0000067	1 x	0.000016	0.000018	1.1 x	0.0000081	0.000014	1.7 x	0.000019	0.000034	1.8 x
Dissolved Boron	mg/L	0.5	0.04	0.04	1 x	0.1	0.1	0.99 x	0.05	0.05	1 x	0.12	0.12	1 x
Dissolved Cadmium	mg/L	0.00012	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000083	1 x	0.000019	0.000019	1 x
Dissolved Calcium	mg/L	-	11	11	1 x	28	28	1 x	14	15	1.1 x	33	35	1.1 x
Dissolved Chromium	mg/L	0.001	0.00065	0.00065	1 x	***0.0016***	***0.0016***	0.98 x	0.00081	0.00079	0.97 x	***0.0019***	***0.0018***	0.97 x
Dissolved Cobalt	mg/L	0.05	0.000065	0.000065	1 x	0.00016	0.00016	1 x	0.000081	0.000089	1.1 x	0.00019	0.00021	1.1 x
Dissolved Copper	mg/L	0.002	0.0018	0.0018	1 x	***0.0045***	***0.0046***	1 x	***0.0023***	***0.0027***	1.2 x	***0.0053***	***0.0064***	1.2 x
Dissolved Iron	mg/L	0.3	0.21	0.21	1 x	***0.51***	***0.5***	0.98 x	0.25	0.24	0.97 x	***0.57***	***0.56***	0.97 x
Dissolved Lead	mg/L	0.001	0.000065	0.000065	1 x	0.00016	0.00016	0.99 x	0.000081	0.00008	1 x	0.00019	0.00019	1 x
Dissolved Lithium	mg/L	2.5	0.0048	0.0048	1 x	0.012	0.012	0.98 x	0.006	0.0059	0.97 x	0.014	0.014	0.97 x
Dissolved Magnesium	mg/L	-	8.3	8.3	1 x	21	21	0.98 x	10	10	0.99 x	24	24	0.99 x
Dissolved Manganese	mg/L	0.2	0.026	0.026	1 x	0.066	0.066	0.99 x	0.033	0.034	1 x	0.078	0.079	1 x
Dissolved Mercury	mg/L	0.000016	0.0000009	0.00000091	1 x	0.0000022	0.0000024	1.1 x	0.0000011	0.0000016	1.5 x	0.0000026	0.000004	1.6 x
Dissolved Molybdenum	mg/L	0.01	0.00023	0.00023	1 x	0.00057	0.00057	1 x	0.00029	0.00031	1.1 x	0.00068	0.00072	1.1 x
Dissolved Nickel	mg/L	0.025	0.00069	0.00069	1 x	0.0017	0.0017	0.99 x	0.00086	0.00089	1 x	0.002	0.0021	1 x
Dissolved Selenium	mg/L	0.001	0.00026	0.00026	1 x	0.00065	0.00064	0.98 x	0.00032	0.00032	0.99 x	0.00075	0.00074	0.99 x
Dissolved Silver	mg/L	0.00025	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000083	1 x	0.000019	0.000019	1 x
Dissolved Sodium	mg/L	-	43	42	1 x	110	100	0.98 x	53	53	1 x	120	120	1 x
Dissolved Thallium	mg/L	0.0008	0.0000026	0.0000026	1 x	0.0000065	0.0000066	1 x	0.0000032	0.0000037	1.1 x	0.0000075	0.0000087	1.2 x
Dissolved Uranium	mg/L	0.01	0.000044	0.000044	1 x	0.00011	0.00011	1 x	0.000055	0.000063	1.1 x	0.00013	0.00015	1.2 x
Dissolved Vanadium	mg/L	0.1	0.00023	0.00023	1 x	0.00058	0.00059	1 x	0.00029	0.00034	1.2 x	0.00067	0.0008	1.2 x
Dissolved Zinc	mg/L	0.03	0.0039	0.0039	1 x	0.0097	0.0096	0.98 x	0.0048	0.0048	0.99 x	0.011	0.011	0.99 x
Dissolved Phosphorous	mg/L	Variable	0.029	0.029	1 x	0.074	0.073	0.98 x	0.037	0.037	1 x	0.087	0.087	1 x
Total Aluminum	mg/L	0.1	0.075	0.075	1 x	***0.19***	***0.18***	0.98 x	0.092	0.091	0.99 x	***0.21***	***0.21***	0.99 x
Total Antimony	mg/L	-	0.00003	0.00003	1 x	0.000077	0.000077	1 x	0.000039	0.000043	1.1 x	0.000091	0.0001	1.1 x
Total Arsenic	mg/L	0.005	0.00036	0.00036	1 x	0.00091	0.00092	1 x	0.00046	0.00051	1.1 x	0.0011	0.0012	1.1 x
Total Barium	mg/L	-	0.0046	0.0046	1 x	0.011	0.011	0.99 x	0.0056	0.0058	1 x	0.013	0.013	1 x
Total Beryllium	mg/L	0.1	0.0000065	0.0000067	1 x	0.000016	0.000018	1.1 x	0.0000081	0.000014	1.7 x	0.000019	0.000034	1.8 x
Total Boron	mg/L	0.5	0.04	0.04	1 x	0.1	0.1	0.99 x	0.05	0.05	1 x	0.12	0.12	1 x
Total Cadmium	mg/L	0.00012	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000084	1 x	0.000019	0.00002	1 x
Total Calcium	mg/L	-	11	11	1 x	28	28	1 x	14	15	1.1 x	33	35	1.1 x
Total Chromium	mg/L	0.001	0.00065	0.00065	1 x	***0.0016***	***0.0016***	0.99 x	0.00081	0.00082	1 x	***0.0019***	***0.0019***	1 x
Total Cobalt	mg/L	0.05	0.000065	0.000065	1 x	0.00016	0.00016	1 x	0.000081	0.000092	1.1 x	0.00019	0.00022	1.2 x
Total Copper	mg/L	0.002	0.0018	0.0018	1 x	***0.0045***	***0.0046***	1 x	***0.0023***	***0.0027***	1.2 x	***0.0053***	***0.0064***	1.2 x
Total Iron	mg/L	0.3	0.21	0.21	1 x	***0.51***	***0.51***	0.99 x	0.25	0.25	1 x	***0.57***	***0.59***	1 x
Total Lead	mg/L	0.001	0.000065	0.000065	1 x	0.00016	0.00016	0.99 x	0.000081	0.000081	1 x	0.00019	0.00019	1 x
Total Lithium	mg/L	2.5	0.0048	0.0048	1 x	0.012	0.012	0.98 x	0.006	0.0059	0.97 x	0.014	0.014	0.97 x
Total Magnesium	mg/L	-	8.3	8.3	1 x	21	21	0.98 x	10	10	0.99 x	24	24	0.99 x
Total Manganese	mg/L	0.2	0.026	0.026	1 x	0.066	0.066	0.99 x	0.033	0.034	1 x	0.078	0.08	1 x
Total Mercury	mg/L	0.000016	0.0000009	0.000001	1.1 x	0.0000022	0.0000033	1.5 x	0.0000011	0.0000043	4 x	0.0000026	0.000012	4.5 x
Total Molybdenum	mg/L	0.01	0.00023	0.00023	1 x	0.00057	0.00057	1 x	0.00029	0.00031	1.1 x	0.00068	0.00072	1.1 x
Total Nickel	mg/L	0.025	0.00069	0.00069	1 x	0.0017	0.0017	0.99 x	0.00086	0.0009	1.1 x	0.002	0.0021	1.1 x
Total Selenium	mg/L	0.001	0.00026	0.00026	1 x	0.00065	0.00064	0.98 x	0.00032	0.00032	0.99 x	0.00075	0.00074	0.99 x
Total Silver	mg/L	0.00025	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000084	1 x	0.000019	0.00002	1 x
Total Sodium	mg/L	-	43	42	1 x	110	100	0.98 x	53	53	1 x	120	120	1 x
Total Thallium	mg/L	0.0008	0.0000026	0.0000026	1 x	0.0000065	0.0000066	1 x	0.0000032	0.0000037	1.2 x	0.0000075	0.0000088	1.2 x
Total Uranium	mg/L	0.01	0.000044	0.000044	1 x	0.00011	0.00011	1 x	0.000055	0.000063	1.1 x	0.00013	0.00015	1.2 x
Total Vanadium	mg/L	0.1	0.00023	0.00023	1 x	0.00058	0.00059	1 x	0.00029	0.00034	1.2 x	0.00067	0.00081	1.2 x
Total Zinc	mg/L	0.03	0.0039	0.0039	1 x	0.0097	0.0096	0.98 x	0.0048	0.0048	0.99 x	0.011	0.011	0.99 x
Total Phosphorous	mg/L	Variable	0.029	0.029	1 x	0.074	0.073	0.98 x	0.037	0.037	1 x	0.087	0.087	1 x

[1] ***CCME Exceedance shown in bold italics***

Wolverine Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case														
			Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	6.3	6.3	1 x	16	16	0.98 x	8.1	8	1 x	19	19	1 x
TDS	mg/L	-	210	210	1 x	530	520	0.98 x	260	260	0.97 x	610	600	0.97 x
Fluoride	mg/L	0.12	0.07	0.07	1 x	***0.18***	***0.17***	0.98 x	0.088	0.088	0.99 x	***0.21***	***0.2***	1 x
Chloride	mg/L	120	82	82	1 x	***210***	***200***	0.98 x	100	100	1 x	***240***	***240***	1 x
Free Cyanide	mg/L	0.005	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
Total Cyanide	mg/L	0.005	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0065	0.0065	1 x	0.016	0.016	0.99 x	0.0082	0.0081	1 x	0.019	0.019	1 x
Nitrate	mg/L as N	3	0.0065	0.0065	1 x	0.016	0.016	0.99 x	0.0081	0.008	1 x	0.019	0.019	1 x
Nitrite	mg/L as N	10	0.0013	0.0013	1 x	0.0032	0.0032	0.98 x	0.0016	0.0016	1 x	0.0038	0.0037	1 x
Sulphate	mg/L	1000	3.5	3.5	1.01 x	8.7	9.1	1.04 x	4.3	5.8	1.32 x	10	14	1.38 x
Alkalinity	mg/L	-	38	38	1 x	96	96	1 x	48	51	1.06 x	110	120	1.07 x
Hardness	mg/L	-	64	64	1 x	160	160	0.98 x	80	80	1 x	190	190	1 x
Dissolved Aluminum	mg/L	0.1	0.1	0.099	1 x	***0.25***	***0.24***	0.98 x	***0.12***	***0.12***	0.99 x	***0.28***	***0.28***	0.99 x
Dissolved Antimony	mg/L	-	0.000039	0.000039	1 x	0.000097	0.000098	1.01 x	0.000048	0.000054	1.12 x	0.00011	0.00013	1.13 x
Dissolved Arsenic	mg/L	0.005	0.00041	0.00041	1 x	0.001	0.0011	1.02 x	0.00053	0.00062	1.18 x	0.0012	0.0015	1.21 x
Dissolved Barium	mg/L	-	0.005	0.005	1 x	0.012	0.012	0.99 x	0.0062	0.0064	1.03 x	0.014	0.015	1.04 x
Dissolved Beryllium	mg/L	0.1	0.0000069	0.000007	1.02 x	0.000018	0.00002	1.09 x	0.0000093	0.000015	1.59 x	0.000022	0.000037	1.68 x
Dissolved Boron	mg/L	0.5	0.044	0.044	1 x	0.11	0.11	0.99 x	0.056	0.056	1.01 x	0.13	0.13	1.01 x
Dissolved Cadmium	mg/L	0.00012	0.0000065	0.0000065	1 x	0.000016	0.000016	1 x	0.0000081	0.0000088	1.09 x	0.000019	0.000021	1.1 x
Dissolved Calcium	mg/L	-	12	12	1 x	29	29	1 x	15	16	1.09 x	34	37	1.11 x
Dissolved Chromium	mg/L	0.001	0.00065	0.00065	1 x	***0.0016***	***0.0016***	0.98 x	0.00081	0.0008	0.99 x	***0.0019***	***0.0019***	0.99 x
Dissolved Cobalt	mg/L	0.05	0.000072	0.000073	1 x	0.00018	0.00018	1.01 x	0.000089	0.000099	1.12 x	0.00021	0.00023	1.13 x
Dissolved Copper	mg/L	0.002	0.0019	0.0019	1.01 x	***0.0049***	***0.005***	1.04 x	***0.0025***	***0.0032***	1.29 x	***0.0057***	***0.0077***	1.34 x
Dissolved Iron	mg/L	0.3	0.25	0.25	1 x	***0.61***	***0.6***	0.98 x	0.29	0.29	0.99 x	***0.68***	***0.67***	0.99 x
Dissolved Lead	mg/L	0.001	0.000087	0.000087	1 x	0.00022	0.00022	0.99 x	0.00011	0.00011	1.03 x	0.00026	0.00027	1.03 x
Dissolved Lithium	mg/L	2.5	0.0052	0.0052	1 x	0.013	0.013	0.98 x	0.0064	0.0063	0.98 x	0.015	0.015	0.98 x
Dissolved Magnesium	mg/L	-	8.6	8.5	1 x	21	21	0.99 x	11	11	0.99 x	25	25	1 x
Dissolved Manganese	mg/L	0.2	0.036	0.036	1 x	0.089	0.089	0.99 x	0.045	0.047	1.05 x	0.1	0.11	1.05 x
Dissolved Mercury	mg/L	0.000016	0.0000011	0.0000012	1.01 x	0.0000028	0.000003	1.05 x	0.0000014	0.0000019	1.38 x	0.0000032	0.0000046	1.44 x
Dissolved Molybdenum	mg/L	0.01	0.00023	0.00023	1 x	0.00059	0.00059	1.01 x	0.0003	0.00034	1.16 x	0.00069	0.00082	1.18 x
Dissolved Nickel	mg/L	0.025	0.00087	0.00087	1 x	0.0022	0.0022	1 x	0.0011	0.0012	1.09 x	0.0025	0.0028	1.1 x
Dissolved Selenium	mg/L	0.001	0.00026	0.00026	1 x	0.00065	0.00064	0.99 x	0.00032	0.00033	1.01 x	0.00075	0.00076	1.02 x
Dissolved Silver	mg/L	0.00025	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000083	1.03 x	0.000019	0.000019	1.04 x
Dissolved Sodium	mg/L	-	44	43	1 x	110	110	0.98 x	54	54	1 x	130	130	1 x
Dissolved Thallium	mg/L	0.0008	0.0000029	0.0000029	1 x	0.0000072	0.0000072	1.01 x	0.0000035	0.000004	1.12 x	0.0000082	0.0000094	1.14 x
Dissolved Uranium	mg/L	0.01	0.000049	0.000049	1.01 x	0.00012	0.00013	1.03 x	0.000062	0.000078	1.27 x	0.00014	0.00019	1.32 x
Dissolved Vanadium	mg/L	0.1	0.00029	0.00029	1 x	0.00072	0.00072	1.01 x	0.00035	0.0004	1.14 x	0.00082	0.00095	1.16 x
Dissolved Zinc	mg/L	0.03	0.0039	0.0039	1 x	0.0097	0.0096	0.99 x	0.0048	0.0049	1.02 x	0.011	0.012	1.02 x
Dissolved Phosphorous	mg/L	Variable	0.033	0.033	1 x	0.083	0.081	0.98 x	0.042	0.041	1 x	0.097	0.096	1 x
Total Aluminum	mg/L	0.1	0.1	0.099	1 x	***0.25***	***0.24***	0.99 x	***0.12***	***0.12***	1 x	***0.28***	***0.28***	1 x
Total Antimony	mg/L	-	0.000039	0.000039	1 x	0.000097	0.000098	1.01 x	0.000048	0.000054	1.12 x	0.00011	0.00013	1.14 x
Total Arsenic	mg/L	0.005	0.00041	0.00041	1.01 x	0.001	0.0011	1.03 x	0.00053	0.00065	1.23 x	0.0012	0.0016	1.27 x
Total Barium	mg/L	-	0.005	0.005	1 x	0.012	0.012	0.99 x	0.0062	0.0064	1.03 x	0.014	0.015	1.04 x
Total Beryllium	mg/L	0.1	0.0000069	0.000007	1.02 x	0.000018	0.00002	1.09 x	0.0000093	0.000015	1.59 x	0.000022	0.000037	1.68 x
Total Boron	mg/L	0.5	0.044	0.044	1 x	0.11	0.11	0.99 x	0.056	0.056	1.01 x	0.13	0.13	1.01 x
Total Cadmium	mg/L	0.00012	0.0000065	0.0000065	1 x	0.000016	0.000016	1 x	0.0000081	0.0000089	1.1 x	0.000019	0.000021	1.11 x
Total Calcium	mg/L	-	12	12	1 x	29	29	1 x	15	16	1.09 x	34	38	1.11 x
Total Chromium	mg/L	0.001	0.00065	0.00065	1 x	***0.0016***	***0.0016***	0.99 x	0.00081	0.00083	1.03 x	***0.0019***	***0.0019***	1.03 x
Total Cobalt	mg/L	0.05	0.000072	0.000073	1 x	0.00018	0.00018	1.01 x	0.000089	0.0001	1.16 x	0.00021	0.00024	1.19 x
Total Copper	mg/L	0.002	0.0019	0.0019	1.01 x	***0.0049***	***0.0051***	1.04 x	***0.0025***	***0.0032***	1.3 x	***0.0057***	***0.0077***	1.35 x
Total Iron	mg/L	0.3	0.25	0.25	1 x	***0.61***	***0.6***	0.99 x	0.29	***0.31***	1.04 x	***0.68***	***0.71***	1.04 x
Total Lead	mg/L	0.001	0.000087	0.000087	1 x	0.00022	0.00022	0.99 x	0.00011	0.00011	1.03 x	0.00026	0.00027	1.04 x
Total Lithium	mg/L	2.5	0.0052	0.0052	1 x	0.013	0.013	0.98 x	0.0064	0.0063	0.98 x	0.015	0.015	0.98 x
Total Magnesium	mg/L	-	8.6	8.5	1 x	21	21	0.99 x	11	11	1 x	25	25	1 x
Total Manganese	mg/L	0.2	0.036	0.036	1 x	0.089	0.089	1 x	0.045	0.047	1.06 x	0.1	0.11	1.06 x
Total Mercury	mg/L	0.000016	0.0000011	0.0000013	1.1 x	0.0000028	0.000004	1.41 x	0.0000014	0.0000049	3.51 x	0.0000032	0.000013	3.98 x
Total Molybdenum	mg/L	0.01	0.00023	0.00023	1 x	0.00059	0.00059	1.01 x	0.0003	0.00034	1.16 x	0.00069	0.00082	1.19 x
Total Nickel	mg/L	0.025	0.00087	0.00087	1 x	0.0022	0.0022	1 x	0.0011	0.0012	1.11 x	0.0025	0.0028	1.12 x
Total Selenium	mg/L	0.001	0.00026	0.00026	1 x	0.00065	0.00064	0.99 x	0.00032	0.00033	1.01 x	0.00075	0.00076	1.02 x
Total Silver	mg/L	0.00025	0.0000065	0.0000065	1 x	0.000016	0.000016	0.99 x	0.0000081	0.0000084	1.04 x	0.000019	0.00002	1.04 x
Total Sodium	mg/L	-	44	43	1 x	110	110	0.98 x	54	54	1 x	130	130	1 x
Total Thallium	mg/L	0.0008	0.0000029	0.0000029	1 x	0.0000072	0.0000072	1.01 x	0.0000035	0.000004	1.13 x	0.0000082	0.0000095	1.15 x
Total Uranium	mg/L	0.01	0.000049	0.000049	1.01 x	0.00012	0.00013	1.03 x	0.000062	0.000078	1.27 x	0.00014	0.00019	1.32 x
Total Vanadium	mg/L	0.1	0.00029	0.00029	1 x	0.00072	0.00073	1.01 x	0.00035	0.00041	1.16 x	0.00082	0.00097	1.18 x
Total Zinc	mg/L	0.03	0.0039	0.0039	1 x	0.0097	0.0096	0.99 x	0.0048	0.005	1.02 x	0.011	0.012	1.03 x
Total Phosphorous	mg/L	Variable	0.033	0.033	1 x	0.083	0.081	0.98 x	0.042	0.041	1 x	0.097	0.097	1 x

[1] CCME Exceedance shown in bold italics

Patch Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case														
			Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	5	5	0.99 x	7.8	7.7	0.99 x	5.6	5.6 x	1 x	8.5	8.5	1 x
TDS	mg/L	-	170	170	0.99 x	270	260	1 x	190	190	n/a	290	280	1 x
Fluoride	mg/L	0.12	0.06	0.059	0.99 x	0.092	0.09	1 x	0.065	0.065	n/a	0.098	0.097	1 x
Chloride	mg/L	120	70	69	0.99 x	110	110	n/a	76	76	n/a	110	110	n/a
Free Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0017	0.0017	n/a	0.0012	0.0012	n/a	0.0018	0.0018	n/a
Total Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0017	0.0017	n/a	0.0012	0.0012	n/a	0.0018	0.0018	n/a
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0056	0.0056	0.99 x	0.0086	0.0085	1 x	0.0061	0.0061	n/a	0.0092	0.0092	n/a
Nitrate	mg/L as N	3	0.0056	0.0056	0.99 x	0.0086	0.0085	1 x	0.0061	0.0061	n/a	0.0092	0.0092	n/a
Nitrite	mg/L as N	10	0.0011	0.0011	0.99 x	0.0017	0.0017	n/a	0.0012	0.0012	n/a	0.0018	0.0018	n/a
Sulphate	mg/L	1000	3	3	1 x	4.6	4.6	n/a	3.3	3.4	1 x	4.9	5.1	1 x
Alkalinity	mg/L	-	33	32	1 x	50	50	n/a	36	36	n/a	54	55	1 x
Hardness	mg/L	-	54	54	0.99 x	83	82	1 x	59	59	n/a	89	89	n/a
Dissolved Aluminum	mg/L	0.1	0.065	0.064	0.99 x	0.099	0.097	1 x	0.07	0.069	1 x	0.1	0.1	n/a
Dissolved Antimony	mg/L	-	0.000026	0.000026	1 x	0.000041	0.000042	1 x	0.000029	0.000032	1.1 x	0.000045	0.00005	1.1 x
Dissolved Arsenic	mg/L	0.005	0.00031	0.00032	1 x	0.00049	0.00054	1.1 x	0.00035	0.00071	2 x	0.00053	0.0011	2.1 x
Dissolved Barium	mg/L	-	0.004	0.0039	1 x	0.006	0.006	n/a	0.0043	0.0043	n/a	0.0064	0.0065	1 x
Dissolved Beryllium	mg/L	0.1	0.0000056	0.0000058	1 x	0.0000086	0.0000094	1.1 x	0.0000061	0.0000072	1.2 x	0.0000092	0.000011	1.2 x
Dissolved Boron	mg/L	0.5	0.035	0.035	0.99 x	0.054	0.053	1 x	0.038	0.038	n/a	0.058	0.058	n/a
Dissolved Cadmium	mg/L	0.00012	0.0000056	0.0000056	1 x	0.0000086	0.0000086	n/a	0.0000061	0.0000062	1 x	0.0000092	0.0000093	1 x
Dissolved Calcium	mg/L	-	9.8	9.7	1 x	15	15	n/a	11	11	n/a	16	16	n/a
Dissolved Chromium	mg/L	0.001	0.00056	0.00056	0.99 x	0.00086	0.00085	1 x	0.00061	0.00061	n/a	0.00092	0.00091	1 x
Dissolved Cobalt	mg/L	0.05	0.000056	0.000056	1 x	0.000086	0.000087	1 x	0.000061	0.000068	1.1 x	0.000092	0.0001	1.1 x
Dissolved Copper	mg/L	0.002	0.0016	0.0016	1 x	***0.0024***	***0.0024***	n/a	0.0017	0.0018	1.1 x	***0.0026***	***0.0027***	1 x
Dissolved Iron	mg/L	0.3	0.18	0.18	0.99 x	0.27	0.27	n/a	0.19	0.18	0.9 x	0.27	0.27	n/a
Dissolved Lead	mg/L	0.001	0.000056	0.000056	0.99 x	0.000086	0.000085	1 x	0.000061	0.000061	n/a	0.000092	0.000092	n/a
Dissolved Lithium	mg/L	2.5	0.0042	0.0041	0.99 x	0.0064	0.0063	1 x	0.0046	0.0045	1 x	0.0069	0.0068	1 x
Dissolved Magnesium	mg/L	-	7.2	7.2	0.99 x	11	11	n/a	7.9	7.8	1 x	12	12	n/a
Dissolved Manganese	mg/L	0.2	0.023	0.023	0.99 x	0.036	0.035	1 x	0.025	0.025	n/a	0.038	0.038	n/a
Dissolved Mercury	mg/L	0.000016	0.00000077	0.0000008	1 x	0.0000012	0.0000013	1.1 x	0.00000083	0.00000094	1.1 x	0.0000012	0.0000014	1.2 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00031	0.00031	n/a	0.00022	0.00022	n/a	0.00033	0.00034	1 x
Dissolved Nickel	mg/L	0.025	0.0006	0.00059	1 x	0.00092	0.00091	1 x	0.00065	0.00066	1 x	0.00098	0.00099	1 x
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	0.99 x	0.00035	0.00034	1 x	0.00024	0.00024	n/a	0.00037	0.00037	n/a
Dissolved Silver	mg/L	0.00025	0.0000056	0.0000056	1 x	0.0000086	0.0000086	n/a	0.0000061	0.0000062	1 x	0.0000092	0.0000093	1 x
Dissolved Sodium	mg/L	-	37	37	0.99 x	56	56	n/a	40	40	n/a	60	60	n/a
Dissolved Thallium	mg/L	0.0008	0.0000022	0.0000023	1 x	0.0000035	0.0000035	n/a	0.0000024	0.0000025	1 x	0.0000037	0.0000039	1.1 x
Dissolved Uranium	mg/L	0.01	0.000038	0.000038	1 x	0.000059	0.000059	n/a	0.000042	0.000044	1 x	0.000063	0.000066	1 x
Dissolved Vanadium	mg/L	0.1	0.0002	0.0002	1 x	0.00031	0.00031	n/a	0.00022	0.00023	1 x	0.00033	0.00035	1.1 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0033	0.99 x	0.0052	0.0051	1 x	0.0037	0.0037	n/a	0.0055	0.0055	n/a
Dissolved Phosphorous	mg/L	Variable	0.025	0.025	0.99 x	0.04	0.039	1 x	0.028	0.028	n/a	0.043	0.043	n/a
Total Aluminum	mg/L	0.1	0.065	0.065	0.99 x	0.099	0.097	1 x	0.07	0.069	1 x	0.1	0.1	n/a
Total Antimony	mg/L	-	0.000026	0.000026	1 x	0.000041	0.000042	1 x	0.000029	0.000032	1.1 x	0.000045	0.00005	1.1 x
Total Arsenic	mg/L	0.005	0.00031	0.00032	1 x	0.00049	0.00054	1.1 x	0.00035	0.00071	2 x	0.00053	0.0012	2.3 x
Total Barium	mg/L	-	0.004	0.0039	1 x	0.006	0.006	n/a	0.0043	0.0043	n/a	0.0064	0.0065	1 x
Total Beryllium	mg/L	0.1	0.0000056	0.0000058	1 x	0.0000086	0.0000094	1.1 x	0.0000061	0.0000072	1.2 x	0.0000092	0.000011	1.2 x
Total Boron	mg/L	0.5	0.035	0.035	0.99 x	0.054	0.053	1 x	0.038	0.038	n/a	0.058	0.058	n/a
Total Cadmium	mg/L	0.00012	0.0000056	0.0000056	1 x	0.0000086	0.0000086	n/a	0.0000061	0.0000062	1 x	0.0000092	0.0000093	1 x
Total Calcium	mg/L	-	9.8	9.7	1 x	15	15	n/a	11	11	n/a	16	16	n/a
Total Chromium	mg/L	0.001	0.00056	0.00056	0.99 x	0.00086	0.00085	1 x	0.00061	0.00061	n/a	0.00092	0.00092	n/a
Total Cobalt	mg/L	0.05	0.000056	0.000056	1 x	0.000086	0.000088	1 x	0.000061	0.000069	1.1 x	0.000092	0.00011	1.2 x
Total Copper	mg/L	0.002	0.0016	0.0016	1 x	***0.0024***	***0.0024***	n/a	0.0017	0.0018	1.1 x	***0.0026***	***0.0027***	1 x
Total Iron	mg/L	0.3	0.18	0.18	1 x	0.27	0.27	n/a	0.19	0.19	n/a	0.27	0.28	1 x
Total Lead	mg/L	0.001	0.000056	0.000056	0.99 x	0.000086	0.000085	1 x	0.000061	0.000061	n/a	0.000092	0.000092	n/a
Total Lithium	mg/L	2.5	0.0042	0.0041	0.99 x	0.0064	0.0063	1 x	0.0046	0.0045	1 x	0.0069	0.0068	1 x
Total Magnesium	mg/L	-	7.2	7.2	0.99 x	11	11	n/a	7.9	7.8	1 x	12	12	n/a
Total Manganese	mg/L	0.2	0.023	0.023	1 x	0.036	0.035	1 x	0.025	0.025	n/a	0.038	0.038	n/a
Total Mercury	mg/L	0.000016	0.00000077	0.00000093	1.2 x	0.0000012	0.0000017	1.4 x	0.00000083	0.0000015	1.8 x	0.0000012	0.0000024	2 x
Total Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00031	0.00031	n/a	0.00022	0.00022	n/a	0.00033	0.00034	1 x
Total Nickel	mg/L	0.025	0.0006	0.00059	1 x	0.00092	0.00091	1 x	0.00065	0.00066	1 x	0.00098	0.001	1 x
Total Selenium	mg/L	0.001	0.00022	0.00022	0.99 x	0.00035	0.00034	1 x	0.00024	0.00024	n/a	0.00037	0.00037	n/a
Total Silver	mg/L	0.00025	0.0000056	0.0000056	1 x	0.0000086	0.0000086	n/a	0.0000061	0.0000062	1 x	0.0000092	0.0000093	1 x
Total Sodium	mg/L	-	37	37	0.99 x	56	56	n/a	40	40	n/a	60	60	n/a
Total Thallium	mg/L	0.0008	0.0000022	0.0000023	1 x	0.0000035	0.0000035	n/a	0.0000024	0.0000025	1 x	0.0000037	0.0000039	1.1 x
Total Uranium	mg/L	0.01	0.000038	0.000038	1 x	0.000059	0.000059	n/a	0.000042	0.000044	1 x	0.000063	0.000066	1 x
Total Vanadium	mg/L	0.1	0.0002	0.0002	1 x	0.00031	0.00031	n/a	0.00022	0.00023	1 x	0.00033	0.00035	1.1 x
Total Zinc	mg/L	0.03	0.0034	0.0033	0.99 x	0.0052	0.0051	1 x	0.0037	0.0037	n/a	0.0055	0.0055	n/a
Total Phosphorous	mg/L	Variable	0.025	0.025	0.99 x	0.04	0.039	1 x	0.028	0.028	n/a	0.043	0.043	n/a

[1] ***CCME Exceedance shown in bold italics***

Patch Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case														
			Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	5.5	5.4	0.99 x	8.5	8.4	0.99 x	6.1	6.1	1 x	9.3	9.3	1 x
TDS	mg/L	-	180	180	0.99 x	280	280	0.98 x	200	200	0.99 x	300	300	0.99 x
Fluoride	mg/L	0.12	0.061	0.061	0.99 x	0.094	0.093	0.99 x	0.067	0.067	1 x	0.1	0.1	n/a
Chloride	mg/L	120	71	71	0.99 x	110	110	0.99 x	78	77	1 x	120	120	n/a
Free Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0017	0.0017	0.99 x	0.0012	0.0012	1 x	0.0018	0.0018	1 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0017	0.0017	0.99 x	0.0012	0.0012	1 x	0.0018	0.0018	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0056	0.0056	0.99 x	0.0087	0.0086	0.99 x	0.0062	0.0062	1 x	0.0093	0.0093	1 x
Nitrate	mg/L as N	3	0.0056	0.0056	0.99 x	0.0086	0.0085	0.99 x	0.0061	0.0061	1 x	0.0092	0.0092	1 x
Nitrite	mg/L as N	10	0.0011	0.0011	0.99 x	0.0017	0.0017	0.99 x	0.0012	0.0012	1 x	0.0018	0.0018	1 x
Sulphate	mg/L	1000	3	3.1	1.02 x	4.6	4.8	1.04 x	3.3	3.6	1.09 x	5	5.5	1.11 x
Alkalinity	mg/L	-	33	33	1 x	51	51	1 x	36	37	1.02 x	55	56	1.03 x
Hardness	mg/L	-	55	55	0.99 x	85	84	0.99 x	60	60	1 x	91	91	1 x
Dissolved Aluminum	mg/L	0.1	0.086	0.085	0.99 x	***0.13***	***0.13***	0.99 x	0.09	0.09	1 x	***0.13***	***0.13***	1 x
Dissolved Antimony	mg/L	-	0.000034	0.000034	1 x	0.000052	0.000053	1.02 x	0.000037	0.000042	1.14 x	0.000055	0.000064	1.17 x
Dissolved Arsenic	mg/L	0.005	0.00035	0.00036	1.02 x	0.00056	0.00067	1.21 x	0.0004	0.0011	2.83 x	0.00061	0.0019	3.07 x
Dissolved Barium	mg/L	-	0.0043	0.0043	1 x	0.0066	0.0066	0.99 x	0.0046	0.0047	1.01 x	0.0069	0.007	1.01 x
Dissolved Beryllium	mg/L	0.1	0.000006	0.0000062	1.04 x	0.0000097	0.00001	1.08 x	0.0000071	0.0000083	1.16 x	0.000011	0.000013	1.19 x
Dissolved Boron	mg/L	0.5	0.038	0.038	0.99 x	0.059	0.059	0.99 x	0.042	0.043	1.01 x	0.064	0.065	1.01 x
Dissolved Cadmium	mg/L	0.00012	0.0000056	0.0000056	1 x	0.0000086	0.0000086	1 x	0.0000061	0.0000063	1.03 x	0.0000092	0.0000095	1.04 x
Dissolved Calcium	mg/L	-	10	10	1 x	16	16	1 x	11	11	1.03 x	17	17	1.03 x
Dissolved Chromium	mg/L	0.001	0.00056	0.00056	0.99 x	0.00086	0.00085	0.99 x	0.00061	0.00061	1 x	0.00092	0.00092	1 x
Dissolved Cobalt	mg/L	0.05	0.000062	0.000063	1 x	0.000095	0.000097	1.02 x	0.000067	0.00008	1.19 x	0.0001	0.00012	1.22 x
Dissolved Copper	mg/L	0.002	0.0017	0.0017	1.01 x	***0.0026***	***0.0027***	1.03 x	0.0019	0.002	1.08 x	***0.0028***	***0.0031***	1.1 x
Dissolved Iron	mg/L	0.3	0.21	0.21	0.99 x	***0.32***	***0.32***	0.99 x	0.22	0.22	1 x	***0.32***	***0.32***	1 x
Dissolved Lead	mg/L	0.001	0.000076	0.000075	1 x	0.00012	0.00012	0.99 x	0.000084	0.000085	1.01 x	0.00013	0.00013	1.01 x
Dissolved Lithium	mg/L	2.5	0.0045	0.0045	0.99 x	0.0069	0.0068	0.98 x	0.0049	0.0048	0.99 x	0.0073	0.0073	1 x
Dissolved Magnesium	mg/L	-	7.4	7.4	0.99 x	11	11	0.99 x	8.1	8.1	1 x	12	12	1 x
Dissolved Manganese	mg/L	0.2	0.031	0.031	1 x	0.048	0.047	0.99 x	0.034	0.034	1.01 x	0.05	0.051	1.02 x
Dissolved Mercury	mg/L	0.000016	0.00000098	0.000001	1.02 x	0.0000015	0.0000016	1.05 x	0.000001	0.0000012	1.11 x	0.0000015	0.0000018	1.14 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.0002	1.01 x	0.00031	0.00032	1.01 x	0.00023	0.00024	1.05 x	0.00034	0.00036	1.06 x
Dissolved Nickel	mg/L	0.025	0.00075	0.00075	1 x	0.0012	0.0012	1 x	0.00081	0.00084	1.03 x	0.0012	0.0013	1.04 x
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00035	0.00034	0.99 x	0.00024	0.00025	1.01 x	0.00037	0.00037	1.01 x
Dissolved Silver	mg/L	0.00025	0.0000056	0.0000056	1 x	0.0000086	0.0000086	0.99 x	0.0000061	0.0000062	1.01 x	0.0000092	0.0000093	1.02 x
Dissolved Sodium	mg/L	-	38	37	0.99 x	58	57	0.99 x	41	41	1 x	61	61	1 x
Dissolved Thallium	mg/L	0.0008	0.0000025	0.0000025	1 x	0.0000038	0.0000038	1.01 x	0.0000027	0.0000028	1.04 x	0.000004	0.0000042	1.05 x
Dissolved Uranium	mg/L	0.01	0.000042	0.000043	1.01 x	0.000066	0.000067	1.03 x	0.000047	0.00005	1.08 x	0.00007	0.000077	1.1 x
Dissolved Vanadium	mg/L	0.1	0.00025	0.00025	1 x	0.00038	0.00038	1.01 x	0.00027	0.00028	1.04 x	0.0004	0.00042	1.06 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0033	1 x	0.0052	0.0051	0.99 x	0.0037	0.0037	1.01 x	0.0055	0.0056	1.01 x
Dissolved Phosphorous	mg/L	Variable	0.028	0.028	0.99 x	0.044	0.044	0.99 x	0.032	0.031	1 x	0.048	0.048	1 x
Total Aluminum	mg/L	0.1	0.086	0.085	0.99 x	***0.13***	***0.13***	0.99 x	0.09	0.09	1 x	***0.13***	***0.13***	1 x
Total Antimony	mg/L	-	0.000034	0.000034	1 x	0.000052	0.000053	1.02 x	0.000037	0.000042	1.15 x	0.000055	0.000064	1.17 x
Total Arsenic	mg/L	0.005	0.00035	0.00036	1.02 x	0.00056	0.00068	1.22 x	0.0004	0.0011	2.85 x	0.00061	0.0019	3.08 x
Total Barium	mg/L	-	0.0043	0.0043	1 x	0.0066	0.0066	0.99 x	0.0046	0.0047	1.01 x	0.0069	0.007	1.01 x
Total Beryllium	mg/L	0.1	0.000006	0.0000062	1.04 x	0.0000097	0.00001	1.08 x	0.0000071	0.0000083	1.16 x	0.000011	0.000013	1.19 x
Total Boron	mg/L	0.5	0.038	0.038	0.99 x	0.059	0.059	0.99 x	0.042	0.043	1.01 x	0.064	0.065	1.01 x
Total Cadmium	mg/L	0.00012	0.0000056	0.0000056	1 x	0.0000086	0.0000086	1 x	0.0000061	0.0000063	1.03 x	0.0000092	0.0000095	1.04 x
Total Calcium	mg/L	-	10	10	1 x	16	16	1 x	11	11	1.03 x	17	17	1.03 x
Total Chromium	mg/L	0.001	0.00056	0.00056	1 x	0.00086	0.00085	0.99 x	0.00061	0.00061	1.01 x	0.00092	0.00093	1.01 x
Total Cobalt	mg/L	0.05	0.000062	0.000063	1.01 x	0.000095	0.000098	1.03 x	0.000067	0.000081	1.2 x	0.0001	0.00012	1.24 x
Total Copper	mg/L	0.002	0.0017	0.0017	1.02 x	***0.0026***	***0.0027***	1.03 x	0.0019	0.002	1.08 x	***0.0028***	***0.0031***	1.1 x
Total Iron	mg/L	0.3	0.21	0.21	1 x	***0.32***	***0.32***	0.99 x	0.22	0.22	1.01 x	***0.32***	***0.33***	1.01 x
Total Lead	mg/L	0.001	0.000076	0.000075	1 x	0.00012	0.00012	0.99 x	0.000084	0.000085	1.01 x	0.00013	0.00013	1.02 x
Total Lithium	mg/L	2.5	0.0045	0.0045	0.99 x	0.0069	0.0068	0.98 x	0.0049	0.0048	0.99 x	0.0073	0.0073	1 x
Total Magnesium	mg/L	-	7.4	7.4	0.99 x	11	11	0.99 x	8.1	8.1	1 x	12	12	1 x
Total Manganese	mg/L	0.2	0.031	0.031	1 x	0.048	0.047	1 x	0.034	0.034	1.01 x	0.05	0.051	1.02 x
Total Mercury	mg/L	0.000016	0.00000098	0.0000011	1.16 x	0.0000015	0.000002	1.36 x	0.000001	0.0000017	1.68 x	0.0000015	0.0000028	1.83 x
Total Molybdenum	mg/L	0.01	0.0002	0.0002	1.01 x	0.00031	0.00032	1.01 x	0.00023	0.00024	1.05 x	0.00034	0.00036	1.06 x
Total Nickel	mg/L	0.025	0.00075	0.00075	1 x	0.0012	0.0012	1 x	0.00081	0.00084	1.04 x	0.0012	0.0013	1.04 x
Total Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00035	0.00034	0.99 x	0.00024	0.00025	1.01 x	0.00037	0.00037	1.01 x
Total Silver	mg/L	0.00025	0.0000056	0.0000056	1 x	0.0000086	0.0000086	0.99 x	0.0000061	0.0000062	1.01 x	0.0000092	0.0000093	1.02 x
Total Sodium	mg/L	-	38	37	0.99 x	58	57	0.99 x	41	41	1 x	61	61	1 x
Total Thallium	mg/L	0.0008	0.0000025	0.0000025	1 x	0.0000038	0.0000038	1.01 x	0.0000027	0.0000028	1.04 x	0.000004	0.0000042	1.05 x
Total Uranium	mg/L	0.01	0.000042	0.000043	1.01 x	0.000066	0.000067	1.03 x	0.000047	0.00005	1.08 x	0.00007	0.000077	1.1 x
Total Vanadium	mg/L	0.1	0.00025	0.00025	1.01 x	0.00038	0.00038	1.01 x	0.00027	0.00028	1.05 x	0.0004	0.00042	1.06 x
Total Zinc	mg/L	0.03	0.0034	0.0033	1 x	0.0052	0.0051	0.99 x	0.0037	0.0037	1.01 x	0.0055	0.0056	1.01 x
Total Phosphorous	mg/L	Variable	0.028	0.028	0.99 x	0.044	0.044	0.99 x	0.032	0.031	1 x	0.048	0.048	1 x

[1] ***CCME Exceedance shown in bold italics***

PO Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case														
			Operations						Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	5.1	5.1	n/a	14	14	n/a	5.6	5.6	n/a	15	15	n/a
TDS	mg/L	-	170	170	n/a	490	480	1 x	190	190	n/a	520	510	1 x
Fluoride	mg/L	0.12	0.06	0.06	n/a	***0.17***	***0.16***	0.9 x	0.065	0.065	n/a	***0.18***	***0.17***	0.9 x
Chloride	mg/L	120	70	70	n/a	***190***	***190***	n/a	76	76	n/a	***200***	***200***	n/a
Free Cyanide	mg/L	0.005	0.0011	0.0011	n/a	0.0031	0.0031	n/a	0.0012	0.0012	n/a	0.0033	0.0033	n/a
Total Cyanide	mg/L	0.005	0.0011	0.0011	n/a	0.0031	0.0031	n/a	0.0012	0.0012	n/a	0.0033	0.0033	n/a
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0057	0.0056	1 x	0.016	0.015	0.9 x	0.0061	0.0061	n/a	0.016	0.016	n/a
Nitrate	mg/L as N	3	0.0057	0.0056	1 x	0.016	0.015	0.9 x	0.0061	0.0061	n/a	0.016	0.016	n/a
Nitrite	mg/L as N	10	0.0011	0.0011	n/a	0.0031	0.0031	n/a	0.0012	0.0012	n/a	0.0033	0.0033	n/a
Sulphate	mg/L	1000	3	3	n/a	8.4	8.4	n/a	3.3	3.4	1 x	8.8	9.2	1 x
Alkalinity	mg/L	-	33	33	n/a	91	91	n/a	36	36	n/a	97	98	1 x
Hardness	mg/L	-	55	54	1 x	150	150	n/a	59	59	n/a	160	160	n/a
Dissolved Aluminum	mg/L	0.1	0.065	0.065	n/a	***0.18***	***0.18***	n/a	0.07	0.069	1 x	***0.19***	***0.19***	n/a
Dissolved Antimony	mg/L	-	0.000027	0.000027	n/a	0.000075	0.000075	n/a	0.00003	0.000032	1.1 x	0.000081	0.000089	1.1 x
Dissolved Arsenic	mg/L	0.005	0.00032	0.00032	n/a	0.00089	0.00092	1 x	0.00035	0.00066	1.9 x	0.00095	0.0019	2 x
Dissolved Barium	mg/L	-	0.004	0.004	n/a	0.011	0.011	n/a	0.0043	0.0043	n/a	0.011	0.012	1.1 x
Dissolved Beryllium	mg/L	0.1	0.0000057	0.0000058	1 x	0.000016	0.000017	1.1 x	0.0000061	0.0000071	1.2 x	0.000016	0.00002	1.3 x
Dissolved Boron	mg/L	0.5	0.035	0.035	n/a	0.098	0.097	1 x	0.038	0.038	n/a	0.1	0.1	n/a
Dissolved Cadmium	mg/L	0.00012	0.0000057	0.0000056	1 x	0.000016	0.000016	n/a	0.0000061	0.0000062	1 x	0.000016	0.000017	1.1 x
Dissolved Calcium	mg/L	-	9.8	9.8	n/a	27	27	n/a	11	11	n/a	29	29	n/a
Dissolved Chromium	mg/L	0.001	0.00057	0.00056	1 x	***0.0016***	***0.0015***	0.9 x	0.00061	0.00061	n/a	***0.0016***	***0.0016***	n/a
Dissolved Cobalt	mg/L	0.05	0.000057	0.000057	n/a	0.00016	0.00016	n/a	0.000061	0.000067	1.1 x	0.00016	0.00018	1.1 x
Dissolved Copper	mg/L	0.002	0.0016	0.0016	n/a	***0.0044***	***0.0044***	n/a	0.0017	0.0018	1.1 x	***0.0047***	***0.0049***	1 x
Dissolved Iron	mg/L	0.3	0.18	0.18	n/a	***0.48***	***0.48***	n/a	0.19	0.18	0.9 x	***0.48***	***0.48***	n/a
Dissolved Lead	mg/L	0.001	0.000057	0.000056	1 x	0.00016	0.00015	0.9 x	0.000061	0.000061	n/a	0.00016	0.00017	1.1 x
Dissolved Lithium	mg/L	2.5	0.0042	0.0042	n/a	0.012	0.011	0.9 x	0.0046	0.0045	1 x	0.012	0.012	n/a
Dissolved Magnesium	mg/L	-	7.3	7.2	1 x	20	20	n/a	7.9	7.9	n/a	21	21	n/a
Dissolved Manganese	mg/L	0.2	0.023	0.023	n/a	0.065	0.064	1 x	0.025	0.025	n/a	0.069	0.069	n/a
Dissolved Mercury	mg/L	0.000016	0.00000078	0.0000008	1 x	0.0000021	0.0000022	1 x	0.00000083	0.00000093	1.1 x	0.0000022	0.0000025	1.1 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.0002	n/a	0.00056	0.00056	n/a	0.00022	0.00022	n/a	0.00061	0.00062	1 x
Dissolved Nickel	mg/L	0.025	0.0006	0.0006	n/a	0.0017	0.0017	n/a	0.00065	0.00066	1 x	0.0018	0.0018	n/a
Dissolved Selenium	mg/L	0.001	0.00023	0.00023	n/a	0.00063	0.00062	1 x	0.00024	0.00024	n/a	0.00066	0.00066	n/a
Dissolved Silver	mg/L	0.00025	0.0000057	0.0000056	1 x	0.000016	0.000016	n/a	0.0000061	0.0000062	1 x	0.000016	0.000017	1.1 x
Dissolved Sodium	mg/L	-	37	37	n/a	100	100	n/a	40	40	n/a	110	110	n/a
Dissolved Thallium	mg/L	0.0008	0.0000023	0.0000023	n/a	0.0000063	0.0000063	n/a	0.0000024	0.0000025	1 x	0.0000066	0.0000069	1 x
Dissolved Uranium	mg/L	0.01	0.000038	0.000039	1 x	0.00011	0.00011	n/a	0.000042	0.000043	1 x	0.00011	0.00012	1.1 x
Dissolved Vanadium	mg/L	0.1	0.0002	0.0002	n/a	0.00056	0.00056	n/a	0.00022	0.00023	1 x	0.00059	0.00062	1.1 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0034	n/a	0.0094	0.0093	1 x	0.0037	0.0037	n/a	0.0099	0.0099	n/a
Dissolved Phosphorous	mg/L	Variable	0.026	0.025	1 x	0.072	0.071	1 x	0.028	0.028	n/a	0.078	0.078	n/a
Total Aluminum	mg/L	0.1	0.065	0.065	n/a	***0.18***	***0.18***	n/a	0.07	0.07	n/a	***0.19***	***0.19***	n/a
Total Antimony	mg/L	-	0.000027	0.000027	n/a	0.000075	0.000075	n/a	0.00003	0.000032	1.1 x	0.000081	0.000089	1.1 x
Total Arsenic	mg/L	0.005	0.00032	0.00032	n/a	0.00089	0.00093	1 x	0.00035	0.00067	1.9 x	0.00095	0.0019	2 x
Total Barium	mg/L	-	0.004	0.004	n/a	0.011	0.011	n/a	0.0043	0.0043	n/a	0.011	0.012	1.1 x
Total Beryllium	mg/L	0.1	0.0000057	0.0000058	1 x	0.000016	0.000017	1.1 x	0.0000061	0.0000071	1.2 x	0.000016	0.00002	1.3 x
Total Boron	mg/L	0.5	0.035	0.035	n/a	0.098	0.097	1 x	0.038	0.038	n/a	0.1	0.1	n/a
Total Cadmium	mg/L	0.00012	0.0000057	0.0000056	1 x	0.000016	0.000016	n/a	0.0000061	0.0000062	1 x	0.000016	0.000017	1.1 x
Total Calcium	mg/L	-	9.8	9.8	n/a	27	27	n/a	11	11	n/a	29	29	n/a
Total Chromium	mg/L	0.001	0.00057	0.00056	1 x	***0.0016***	***0.0015***	0.9 x	0.00061	0.00061	n/a	***0.0016***	***0.0017***	1.1 x
Total Cobalt	mg/L	0.05	0.000057	0.000057	n/a	0.00016	0.00016	n/a	0.000061	0.000068	1.1 x	0.00016	0.00019	1.2 x
Total Copper	mg/L	0.002	0.0016	0.0016	n/a	***0.0044***	***0.0044***	n/a	0.0017	0.0018	1.1 x	***0.0047***	***0.0049***	1 x
Total Iron	mg/L	0.3	0.18	0.18	n/a	***0.48***	***0.48***	n/a	0.19	0.19	n/a	***0.48***	***0.49***	1 x
Total Lead	mg/L	0.001	0.000057	0.000056	1 x	0.00016	0.00015	0.9 x	0.000061	0.000061	n/a	0.00016	0.00017	1.1 x
Total Lithium	mg/L	2.5	0.0042	0.0042	n/a	0.012	0.011	0.9 x	0.0046	0.0045	1 x	0.012	0.012	n/a
Total Magnesium	mg/L	-	7.3	7.2	1 x	20	20	n/a	7.9	7.9	n/a	21	21	n/a
Total Manganese	mg/L	0.2	0.023	0.023	n/a	0.065	0.064	1 x	0.025	0.025	n/a	0.069	0.069	n/a
Total Mercury	mg/L	0.000016	0.00000078	0.0000009	1.2 x	0.0000021	0.0000029	1.4 x	0.00000083	0.0000014	1.7 x	0.0000022	0.000004	1.8 x
Total Molybdenum	mg/L	0.01	0.0002	0.0002	n/a	0.00056	0.00056	n/a	0.00022	0.00022	n/a	0.00061	0.00062	1 x
Total Nickel	mg/L	0.025	0.0006	0.0006	n/a	0.0017	0.0017	n/a	0.00065	0.00066	1 x	0.0018	0.0018	n/a
Total Selenium	mg/L	0.001	0.00023	0.00023	n/a	0.00063	0.00062	1 x	0.00024	0.00024	n/a	0.00066	0.00066	n/a
Total Silver	mg/L	0.00025	0.0000057	0.0000056	1 x	0.000016	0.000016	n/a	0.0000061	0.0000062	1 x	0.000016	0.000017	1.1 x
Total Sodium	mg/L	-	37	37	n/a	100	100	n/a	40	40	n/a	110	110	n/a
Total Thallium	mg/L	0.0008	0.0000023	0.0000023	n/a	0.0000063	0.0000063	n/a	0.0000024	0.0000025	1 x	0.0000066	0.0000069	1 x
Total Uranium	mg/L	0.01	0.000038	0.000039	1 x	0.00011	0.00011	n/a	0.000042	0.000043	1 x	0.00011	0.00012	1.1 x
Total Vanadium	mg/L	0.1	0.0002	0.0002	n/a	0.00056	0.00057	1 x	0.00022	0.00023	1 x	0.00059	0.00062	1.1 x
Total Zinc	mg/L	0.03	0.0034	0.0034	n/a	0.0094	0.0093	1 x	0.0037	0.0037	n/a	0.0099	0.0099	n/a
Total Phosphorous	mg/L	Variable	0.026	0.025	1 x	0.072	0.071	1 x	0.028	0.028	n/a	0.078	0.078	n/a

1 CCME Exceedance shown in bold italics

PO Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case

Parameter	Units	Min CCME[1]	Operations						Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	5.5	5.5	0.99 x	16	15	0.99 x	6.1	6.1	1 x	17	17	1 x
TDS	mg/L	-	180	180	0.99 x	510	500	0.99 x	200	200	0.99 x	540	540	0.99 x
Fluoride	mg/L	0.12	0.062	0.061	0.99 x	***0.17***	***0.17***	0.99 x	0.067	0.067	1 x	***0.18***	***0.18***	1 x
Chloride	mg/L	120	72	71	0.99 x	***200***	***200***	0.99 x	78	78	1 x	***210***	***210***	1 x
Free Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0031	0.0031	0.99 x	0.0012	0.0012	1 x	0.0033	0.0033	1 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	0.99 x	0.0031	0.0031	0.99 x	0.0012	0.0012	1 x	0.0033	0.0033	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0057	0.0057	0.99 x	0.016	0.016	0.99 x	0.0062	0.0062	1 x	0.017	0.017	1 x
Nitrate	mg/L as N	3	0.0057	0.0056	0.99 x	0.016	0.015	0.99 x	0.0061	0.0061	1 x	0.016	0.016	1 x
Nitrite	mg/L as N	10	0.0011	0.0011	0.99 x	0.0031	0.0031	0.99 x	0.0012	0.0012	1 x	0.0033	0.0033	1 x
Sulphate	mg/L	1000	3	3.1	1.01 x	8.4	8.7	1.03 x	3.3	3.5	1.08 x	8.9	9.7	1.09 x
Alkalinity	mg/L	-	33	33	1 x	93	93	1 x	36	37	1.02 x	98	100	1.02 x
Hardness	mg/L	-	56	56	0.99 x	150	150	0.99 x	61	60	1 x	160	160	1 x
Dissolved Aluminum	mg/L	0.1	0.086	0.086	0.99 x	***0.23***	***0.23***	0.99 x	0.09	0.09	1 x	***0.24***	***0.24***	1 x
Dissolved Antimony	mg/L	-	0.000034	0.000034	1 x	0.000094	0.000095	1.01 x	0.000037	0.000041	1.12 x	0.000099	0.00011	1.14 x
Dissolved Arsenic	mg/L	0.005	0.00036	0.00036	1.01 x	0.001	0.0011	1.08 x	0.0004	0.001	2.58 x	0.0011	0.003	2.71 x
Dissolved Barium	mg/L	-	0.0044	0.0044	1 x	0.012	0.012	0.99 x	0.0046	0.0047	1.01 x	0.012	0.013	1.01 x
Dissolved Beryllium	mg/L	0.1	0.0000061	0.0000063	1.03 x	0.000018	0.000019	1.06 x	0.0000071	0.0000081	1.14 x	0.00002	0.000024	1.15 x
Dissolved Boron	mg/L	0.5	0.039	0.039	1 x	0.11	0.11	0.99 x	0.042	0.043	1.01 x	0.12	0.12	1.01 x
Dissolved Cadmium	mg/L	0.00012	0.0000057	0.0000057	1 x	0.000016	0.000016	n/a	0.0000061	0.0000063	1.02 x	0.000016	0.000017	1.03 x
Dissolved Calcium	mg/L	-	10	10	1 x	28	28	1 x	11	11	1.02 x	30	31	1.03 x
Dissolved Chromium	mg/L	0.001	0.00057	0.00056	0.99 x	***0.0016***	***0.0015***	0.99 x	0.00061	0.00061	1 x	***0.0016***	***0.0016***	1 x
Dissolved Cobalt	mg/L	0.05	0.000063	0.000063	1 x	0.00017	0.00017	1.01 x	0.000067	0.000078	1.17 x	0.00018	0.00021	1.19 x
Dissolved Copper	mg/L	0.002	0.0017	0.0017	1.01 x	***0.0047***	***0.0049***	1.03 x	0.0019	0.002	1.07 x	***0.0051***	***0.0055***	1.08 x
Dissolved Iron	mg/L	0.3	0.22	0.21	0.99 x	***0.57***	***0.57***	n/a	0.22	0.22	1 x	***0.57***	***0.57***	0.99 x
Dissolved Lead	mg/L	0.001	0.000076	0.000076	1 x	0.00021	0.00021	0.99 x	0.000084	0.000084	1.01 x	0.00023	0.00023	1.01 x
Dissolved Lithium	mg/L	2.5	0.0045	0.0045	0.99 x	0.012	0.012	0.99 x	0.0049	0.0049	1 x	0.013	0.013	1 x
Dissolved Magnesium	mg/L	-	7.5	7.4	0.99 x	21	20	0.99 x	8.1	8.1	1 x	22	22	1 x
Dissolved Manganese	mg/L	0.2	0.031	0.031	1 x	0.086	0.086	0.99 x	0.034	0.034	1.01 x	0.091	0.092	1.01 x
Dissolved Mercury	mg/L	0.000016	0.00000099	0.000001	1.02 x	0.0000027	0.0000028	1.04 x	0.000001	0.0000011	1.1 x	0.0000027	0.0000031	1.12 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00058	0.00058	1.01 x	0.00023	0.00024	1.04 x	0.00062	0.00065	1.05 x
Dissolved Nickel	mg/L	0.025	0.00076	0.00076	1 x	0.0021	0.0021	n/a	0.00081	0.00084	1.03 x	0.0022	0.0023	1.03 x
Dissolved Selenium	mg/L	0.001	0.00023	0.00023	1 x	0.00063	0.00062	0.99 x	0.00024	0.00025	1.01 x	0.00066	0.00066	1.01 x
Dissolved Silver	mg/L	0.00025	0.0000057	0.0000056	1 x	0.000016	0.000016	0.99 x	0.0000061	0.0000062	1.01 x	0.000016	0.000017	1.01 x
Dissolved Sodium	mg/L	-	38	38	0.99 x	100	100	0.99 x	41	41	1 x	110	110	n/a
Dissolved Thallium	mg/L	0.0008	0.0000025	0.0000025	1 x	0.0000069	0.0000069	1 x	0.0000027	0.0000028	1.03 x	0.0000071	0.0000074	1.04 x
Dissolved Uranium	mg/L	0.01	0.000043	0.000043	1.01 x	0.00012	0.00012	1.02 x	0.000047	0.00005	1.07 x	0.00013	0.00014	1.08 x
Dissolved Vanadium	mg/L	0.1	0.00025	0.00025	1 x	0.00068	0.00069	1.01 x	0.00027	0.00028	1.04 x	0.00071	0.00074	1.05 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0034	1 x	0.0094	0.0093	0.99 x	0.0037	0.0037	1 x	0.0099	0.01	1.01 x
Dissolved Phosphorous	mg/L	Variable	0.029	0.029	0.99 x	0.08	0.079	0.99 x	0.032	0.031	1 x	0.086	0.086	1 x
Total Aluminum	mg/L	0.1	0.086	0.086	0.99 x	***0.23***	***0.23***	0.99 x	0.09	0.09	1 x	***0.24***	***0.24***	1 x
Total Antimony	mg/L	-	0.000034	0.000034	1 x	0.000094	0.000095	1.01 x	0.000037	0.000041	1.13 x	0.000099	0.00011	1.14 x
Total Arsenic	mg/L	0.005	0.00036	0.00036	1.02 x	0.001	0.0011	1.09 x	0.0004	0.001	2.59 x	0.0011	0.003	2.72 x
Total Barium	mg/L	-	0.0044	0.0044	1 x	0.012	0.012	0.99 x	0.0046	0.0047	1.01 x	0.012	0.013	1.01 x
Total Beryllium	mg/L	0.1	0.0000061	0.0000063	1.03 x	0.000018	0.000019	1.06 x	0.0000071	0.0000081	1.14 x	0.00002	0.000024	1.15 x
Total Boron	mg/L	0.5	0.039	0.039	1 x	0.11	0.11	0.99 x	0.042	0.043	1.01 x	0.12	0.12	1.01 x
Total Cadmium	mg/L	0.00012	0.0000057	0.0000057	1 x	0.000016	0.000016	1 x	0.0000061	0.0000063	1.03 x	0.000016	0.000017	1.03 x
Total Calcium	mg/L	-	10	10	1 x	28	28	1 x	11	11	1.02 x	30	31	1.03 x
Total Chromium	mg/L	0.001	0.00057	0.00056	1 x	***0.0016***	***0.0016***	0.99 x	0.00061	0.00062	1.01 x	***0.0016***	***0.0017***	1.01 x
Total Cobalt	mg/L	0.05	0.000063	0.000063	1 x	0.00017	0.00017	1.01 x	0.000067	0.000079	1.18 x	0.00018	0.00021	1.2 x
Total Copper	mg/L	0.002	0.0017	0.0017	1.01 x	***0.0047***	***0.0049***	1.03 x	0.0019	0.002	1.07 x	***0.0051***	***0.0055***	1.08 x
Total Iron	mg/L	0.3	0.22	0.21	1 x	***0.57***	***0.57***	n/a	0.22	0.22	1.01 x	***0.57***	***0.58***	1 x
Total Lead	mg/L	0.001	0.000076	0.000076	1 x	0.00021	0.00021	0.99 x	0.000084	0.000085	1.01 x	0.00023	0.00023	1.01 x
Total Lithium	mg/L	2.5	0.0045	0.0045	0.99 x	0.012	0.012	0.99 x	0.0049	0.0049	1 x	0.013	0.013	1 x
Total Magnesium	mg/L	-	7.5	7.4	0.99 x	21	20	0.99 x	8.1	8.1	1 x	22	22	1 x
Total Manganese	mg/L	0.2	0.031	0.031	1 x	0.086	0.086	1 x	0.034	0.034	1.01 x	0.091	0.092	1.02 x
Total Mercury	mg/L	0.000016	0.00000099	0.0000011	1.13 x	0.0000027	0.0000035	1.31 x	0.000001	0.0000017	1.59 x	0.0000027	0.0000047	1.71 x
Total Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00058	0.00058	1.01 x	0.00023	0.00024	1.04 x	0.00062	0.00065	1.05 x
Total Nickel	mg/L	0.025	0.00076	0.00076	1 x	0.0021	0.0021	1 x	0.00081	0.00084	1.03 x	0.0022	0.0023	1.04 x
Total Selenium	mg/L	0.001	0.00023	0.00023	1 x	0.00063	0.00062	0.99 x	0.00024	0.00025	1.01 x	0.00066	0.00066	1.01 x
Total Silver	mg/L	0.00025	0.0000057	0.0000056	1 x	0.000016	0.000016	0.99 x	0.0000061	0.0000062	1.01 x	0.000016	0.000017	1.01 x
Total Sodium	mg/L	-	38	38	0.99 x	100	100	0.99 x	41	41	1 x	110	110	n/a
Total Thallium	mg/L	0.0008	0.0000025	0.0000025	1 x	0.0000069	0.0000069	1.01 x	0.0000027	0.0000028	1.03 x	0.0000071	0.0000074	1.04 x
Total Uranium	mg/L	0.01	0.000043	0.000043	1.01 x	0.00012	0.00012	1.02 x	0.000047	0.00005	1.07 x	0.00013	0.00014	1.08 x
Total Vanadium	mg/L	0.1	0.00025	0.00025	1 x	0.00068	0.00069	1.01 x	0.00027	0.00028	1.04 x	0.00071	0.00074	1.05 x
Total Zinc	mg/L	0.03	0.0034	0.0034	1 x	0.0094	0.0093	0.99 x	0.0037	0.0037	1.01 x	0.0099	0.01	1.01 x
Total Phosphorous	mg/L	Variable	0.029	0.029	0.99 x	0.08	0.079	0.99 x	0.032	0.031	1 x	0.086	0.086	1 x

[1] ***CCME Exceedance shown in bold italics***

Ogama Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case														
Parameter	Units	Min CCME[1]	Operations						Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	4.9	4.9	n/a	13	13	n/a	5.1	5.1	n/a	13	13	n/a
TDS	mg/L	-	170	170	n/a	440	430	1 x	170	170	n/a	440	440	n/a
Fluoride	mg/L	0.12	0.058	0.058	n/a	***0.15***	***0.15***	n/a	0.059	0.059	n/a	***0.15***	***0.15***	n/a
Chloride	mg/L	120	67	67	n/a	***170***	***170***	n/a	69	69	n/a	***180***	***180***	n/a
Free Cyanide	mg/L	0.005	0.0011	0.0011	n/a	0.0028	0.0028	n/a	0.0011	0.0011	n/a	0.0028	0.0028	n/a
Total Cyanide	mg/L	0.005	0.0011	0.0011	n/a	0.0028	0.0028	n/a	0.0011	0.0011	n/a	0.0028	0.0028	n/a
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0054	0.0054	n/a	0.014	0.014	n/a	0.0055	0.0055	n/a	0.014	0.014	n/a
Nitrate	mg/L as N	3	0.0054	0.0054	n/a	0.014	0.014	n/a	0.0055	0.0055	n/a	0.014	0.014	n/a
Nitrite	mg/L as N	10	0.0011	0.0011	n/a	0.0028	0.0028	n/a	0.0011	0.0011	n/a	0.0028	0.0028	n/a
Sulphate	mg/L	1000	2.9	2.9	n/a	7.5	7.5	n/a	3	3	n/a	7.6	7.7	1 x
Alkalinity	mg/L	-	32	31	1 x	82	82	n/a	32	33	1 x	83	84	1 x
Hardness	mg/L	-	52	52	n/a	140	130	0.9 x	54	54	n/a	140	140	n/a
Dissolved Aluminum	mg/L	0.1	0.062	0.062	n/a	***0.16***	***0.16***	n/a	0.063	0.063	n/a	***0.16***	***0.16***	n/a
Dissolved Antimony	mg/L	-	0.000026	0.000026	n/a	0.000068	0.000068	n/a	0.000027	0.000028	1 x	0.00007	0.000073	1 x
Dissolved Arsenic	mg/L	0.005	0.00031	0.00031	n/a	0.00081	0.00081	n/a	0.00032	0.00044	1.4 x	0.00082	0.0012	1.5 x
Dissolved Barium	mg/L	-	0.0038	0.0038	n/a	0.0098	0.0097	1 x	0.0039	0.0039	n/a	0.0098	0.0098	n/a
Dissolved Beryllium	mg/L	0.1	0.0000054	0.0000055	1 x	0.000014	0.000014	n/a	0.0000055	0.0000059	1.1 x	0.000014	0.000015	1.1 x
Dissolved Boron	mg/L	0.5	0.034	0.034	n/a	0.088	0.087	1 x	0.035	0.035	n/a	0.089	0.089	n/a
Dissolved Cadmium	mg/L	0.00012	0.0000054	0.0000054	n/a	0.000014	0.000014	n/a	0.0000055	0.0000056	1 x	0.000014	0.000014	n/a
Dissolved Calcium	mg/L	-	9.4	9.4	n/a	24	24	n/a	9.7	9.7	n/a	25	25	n/a
Dissolved Chromium	mg/L	0.001	0.00054	0.00054	n/a	***0.0014***	***0.0014***	n/a	0.00055	0.00055	n/a	***0.0014***	***0.0014***	n/a
Dissolved Cobalt	mg/L	0.05	0.000054	0.000054	n/a	0.00014	0.00014	n/a	0.000055	0.000058	1.1 x	0.00014	0.00015	1.1 x
Dissolved Copper	mg/L	0.002	0.0015	0.0015	n/a	***0.0039***	***0.004***	1 x	0.0016	0.0016	n/a	***0.004***	***0.0041***	1 x
Dissolved Iron	mg/L	0.3	0.17	0.17	n/a	***0.43***	***0.43***	n/a	0.17	0.17	n/a	***0.42***	***0.42***	n/a
Dissolved Lead	mg/L	0.001	0.000054	0.000054	n/a	0.00014	0.00014	n/a	0.000055	0.000055	n/a	0.00014	0.00014	n/a
Dissolved Lithium	mg/L	2.5	0.004	0.004	n/a	0.01	0.01	n/a	0.0041	0.0041	n/a	0.011	0.011	n/a
Dissolved Magnesium	mg/L	-	7	7	n/a	18	18	n/a	7.1	7.1	n/a	18	18	n/a
Dissolved Manganese	mg/L	0.2	0.022	0.022	n/a	0.059	0.058	1 x	0.023	0.023	n/a	0.059	0.06	1 x
Dissolved Mercury	mg/L	0.000016	0.00000075	0.00000075	n/a	0.0000019	0.0000019	n/a	0.00000075	0.00000079	1.1 x	0.0000019	0.000002	1.1 x
Dissolved Molybdenum	mg/L	0.01	0.00019	0.00019	n/a	0.00051	0.00051	n/a	0.0002	0.0002	n/a	0.00052	0.00053	1 x
Dissolved Nickel	mg/L	0.025	0.00058	0.00057	1 x	0.0015	0.0015	n/a	0.00059	0.00059	n/a	0.0015	0.0015	n/a
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	n/a	0.00056	0.00056	n/a	0.00022	0.00022	n/a	0.00057	0.00057	n/a
Dissolved Silver	mg/L	0.00025	0.0000054	0.0000054	n/a	0.000014	0.000014	n/a	0.0000055	0.0000056	1 x	0.000014	0.000014	n/a
Dissolved Sodium	mg/L	-	35	35	n/a	91	91	n/a	36	36	n/a	92	92	n/a
Dissolved Thallium	mg/L	0.0008	0.0000022	0.0000022	n/a	0.0000056	0.0000056	n/a	0.0000022	0.0000022	n/a	0.0000057	0.0000057	n/a
Dissolved Uranium	mg/L	0.01	0.000037	0.000037	n/a	0.000096	0.000097	1 x	0.000038	0.000039	1 x	0.000098	0.000099	1 x
Dissolved Vanadium	mg/L	0.1	0.00019	0.00019	n/a	0.0005	0.0005	n/a	0.0002	0.0002	n/a	0.00051	0.00051	n/a
Dissolved Zinc	mg/L	0.03	0.0033	0.0032	1 x	0.0084	0.0084	n/a	0.0033	0.0033	n/a	0.0085	0.0085	n/a
Dissolved Phosphorous	mg/L	Variable	0.025	0.025	n/a	0.066	0.066	n/a	0.026	0.026	n/a	0.068	0.068	n/a
Total Aluminum	mg/L	0.1	0.062	0.062	n/a	***0.16***	***0.16***	n/a	0.063	0.063	n/a	***0.16***	***0.16***	n/a
Total Antimony	mg/L	-	0.000026	0.000026	n/a	0.000068	0.000068	n/a	0.000027	0.000028	1 x	0.00007	0.000073	1 x
Total Arsenic	mg/L	0.005	0.00031	0.00031	n/a	0.00081	0.00081	n/a	0.00032	0.00044	1.4 x	0.00082	0.0012	1.5 x
Total Barium	mg/L	-	0.0038	0.0038	n/a	0.0098	0.0097	1 x	0.0039	0.0039	n/a	0.0098	0.0098	n/a
Total Beryllium	mg/L	0.1	0.0000054	0.0000055	1 x	0.000014	0.000014	n/a	0.0000055	0.0000059	1.1 x	0.000014	0.000015	1.1 x
Total Boron	mg/L	0.5	0.034	0.034	n/a	0.088	0.087	1 x	0.035	0.035	n/a	0.089	0.089	n/a
Total Cadmium	mg/L	0.00012	0.0000054	0.0000054	n/a	0.000014	0.000014	n/a	0.0000055	0.0000056	1 x	0.000014	0.000014	n/a
Total Calcium	mg/L	-	9.4	9.4	n/a	24	24	n/a	9.7	9.7	n/a	25	25	n/a
Total Chromium	mg/L	0.001	0.00054	0.00054	n/a	***0.0014***	***0.0014***	n/a	0.00055	0.00055	n/a	***0.0014***	***0.0014***	n/a
Total Cobalt	mg/L	0.05	0.000054	0.000054	n/a	0.00014	0.00014	n/a	0.000055	0.000058	1.1 x	0.00014	0.00015	1.1 x
Total Copper	mg/L	0.002	0.0015	0.0015	n/a	***0.0039***	***0.004***	1 x	0.0016	0.0016	n/a	***0.004***	***0.0041***	1 x
Total Iron	mg/L	0.3	0.17	0.17	n/a	***0.43***	***0.43***	n/a	0.17	0.17	n/a	***0.42***	***0.42***	n/a
Total Lead	mg/L	0.001	0.000054	0.000054	n/a	0.00014	0.00014	n/a	0.000055	0.000055	n/a	0.00014	0.00014	n/a
Total Lithium	mg/L	2.5	0.004	0.004	n/a	0.01	0.01	n/a	0.0041	0.0041	n/a	0.011	0.011	n/a
Total Magnesium	mg/L	-	7	7	n/a	18	18	n/a	7.1	7.1	n/a	18	18	n/a
Total Manganese	mg/L	0.2	0.022	0.022	n/a	0.059	0.058	1 x	0.023	0.023	n/a	0.059	0.06	1 x
Total Mercury	mg/L	0.000016	0.00000075	0.00000079	1.1 x	0.0000019	0.0000022	1.2 x	0.00000075	0.00000098	1.3 x	0.0000019	0.0000025	1.3 x
Total Molybdenum	mg/L	0.01	0.00019	0.00019	n/a	0.00051	0.00051	n/a	0.0002	0.0002	n/a	0.00052	0.00053	1 x
Total Nickel	mg/L	0.025	0.00058	0.00058	n/a	0.0015	0.0015	n/a	0.00059	0.00059	n/a	0.0015	0.0015	n/a
Total Selenium	mg/L	0.001	0.00022	0.00022	n/a	0.00056	0.00056	n/a	0.00022	0.00022	n/a	0.00057	0.00057	n/a
Total Silver	mg/L	0.00025	0.0000054	0.0000054	n/a	0.000014	0.000014	n/a	0.0000055	0.0000056	1 x	0.000014	0.000014	n/a
Total Sodium	mg/L	-	35	35	n/a	91	91	n/a	36	36	n/a	92	92	n/a
Total Thallium	mg/L	0.0008	0.0000022	0.0000022	n/a	0.0000056	0.0000056	n/a	0.0000022	0.0000023	1 x	0.0000057	0.0000058	1 x
Total Uranium	mg/L	0.01	0.000037	0.000037	n/a	0.000096	0.000097	1 x	0.000038	0.000039	1 x	0.000098	0.000099	1 x
Total Vanadium	mg/L	0.1	0.00019	0.00019	n/a	0.0005	0.0005	n/a	0.0002	0.0002	n/a	0.00051	0.00051	n/a
Total Zinc	mg/L	0.03	0.0033	0.0032	1 x	0.0084	0.0084	n/a	0.0033	0.0033	n/a	0.0085	0.0085	n/a
Total Phosphorous	mg/L	Variable	0.025	0.025	n/a	0.066	0.066	n/a	0.026	0.026	n/a	0.068	0.068	n/a

[1] ***CCME Exceedance shown in bold italics***

Ogama Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case														
			Operations						Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	5.3	5.3	1 x	14	14	0.99 x	5.5	5.5	1 x	15	15	1 x
TDS	mg/L	-	180	180	1 x	460	460	0.99 x	180	180	1 x	470	460	1 x
Fluoride	mg/L	0.12	0.059	0.059	1 x	***0.15***	***0.15***	0.99 x	0.061	0.061	1 x	***0.16***	***0.16***	1 x
Chloride	mg/L	120	69	69	1 x	***180***	***180***	0.99 x	70	70	1 x	***180***	***180***	1 x
Free Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0028	0.0028	0.99 x	0.0011	0.0011	1 x	0.0028	0.0028	1 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0028	0.0028	0.99 x	0.0011	0.0011	1 x	0.0028	0.0028	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0055	0.0055	1 x	0.014	0.014	0.99 x	0.0056	0.0056	1 x	0.014	0.014	1 x
Nitrate	mg/L as N	3	0.0054	0.0054	1 x	0.014	0.014	0.99 x	0.0055	0.0055	1 x	0.014	0.014	1 x
Nitrite	mg/L as N	10	0.0011	0.0011	1 x	0.0028	0.0028	0.99 x	0.0011	0.0011	1 x	0.0028	0.0028	1 x
Sulphate	mg/L	1000	2.9	2.9	1 x	7.6	7.7	1.01 x	3	3.1	1.03 x	7.7	7.9	1.03 x
Alkalinity	mg/L	-	32	32	1 x	83	83	1 x	33	33	1.01 x	85	85	1.01 x
Hardness	mg/L	-	54	53	1 x	140	140	0.99 x	55	55	1 x	140	140	1 x
Dissolved Aluminum	mg/L	0.1	0.082	0.081	1 x	***0.21***	***0.21***	n/a	0.082	0.082	1 x	***0.2***	***0.2***	1 x
Dissolved Antimony	mg/L	-	0.000033	0.000033	1 x	0.000084	0.000084	1 x	0.000033	0.000035	1.05 x	0.000085	0.00009	1.06 x
Dissolved Arsenic	mg/L	0.005	0.00035	0.00035	1 x	0.00093	0.00095	1.02 x	0.00036	0.00061	1.68 x	0.00096	0.0016	1.72 x
Dissolved Barium	mg/L	-	0.0042	0.0042	1 x	0.011	0.011	1 x	0.0042	0.0042	1 x	0.011	0.011	n/a
Dissolved Beryllium	mg/L	0.1	0.000006	0.000006	1.01 x	0.000017	0.000017	1.02 x	0.0000064	0.0000068	1.06 x	0.000018	0.000019	1.06 x
Dissolved Boron	mg/L	0.5	0.037	0.037	1 x	0.098	0.097	1 x	0.038	0.038	1 x	0.1	0.1	1 x
Dissolved Cadmium	mg/L	0.00012	0.0000054	0.0000054	1 x	0.000014	0.000014	1 x	0.0000055	0.0000056	1.01 x	0.000014	0.000014	1.01 x
Dissolved Calcium	mg/L	-	9.8	9.8	1 x	25	25	1 x	10	10	1.01 x	26	26	1.01 x
Dissolved Chromium	mg/L	0.001	0.00054	0.00054	1 x	***0.0014***	***0.0014***	0.99 x	0.00055	0.00055	1 x	***0.0014***	***0.0014***	1 x
Dissolved Cobalt	mg/L	0.05	0.00006	0.00006	1 x	0.00015	0.00015	1 x	0.000061	0.000065	1.07 x	0.00015	0.00016	1.07 x
Dissolved Copper	mg/L	0.002	0.0016	0.0016	1 x	***0.0043***	***0.0044***	1.01 x	0.0017	0.0017	1.03 x	***0.0044***	***0.0045***	1.03 x
Dissolved Iron	mg/L	0.3	0.2	0.2	1 x	***0.51***	***0.51***	n/a	0.2	0.2	1 x	***0.49***	***0.49***	1 x
Dissolved Lead	mg/L	0.001	0.000073	0.000073	1 x	0.00019	0.00019	1 x	0.000076	0.000076	1 x	0.0002	0.0002	1 x
Dissolved Lithium	mg/L	2.5	0.0043	0.0043	1 x	0.011	0.011	0.99 x	0.0044	0.0044	1 x	0.011	0.011	1 x
Dissolved Magnesium	mg/L	-	7.2	7.1	1 x	19	18	0.99 x	7.3	7.3	1 x	19	19	1 x
Dissolved Manganese	mg/L	0.2	0.03	0.03	1 x	0.078	0.077	1 x	0.031	0.031	1 x	0.078	0.078	1 x
Dissolved Mercury	mg/L	0.000016	0.00000094	0.00000095	1 x	0.0000024	0.0000024	1.01 x	0.00000095	0.00000099	1.04 x	0.0000024	0.0000024	1.03 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00052	0.00053	1 x	0.0002	0.00021	1.02 x	0.00054	0.00055	1.02 x
Dissolved Nickel	mg/L	0.025	0.00072	0.00072	1 x	0.0019	0.0019	1 x	0.00074	0.00075	1.01 x	0.0019	0.0019	1.01 x
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00056	0.00056	1 x	0.00022	0.00022	1 x	0.00057	0.00057	1 x
Dissolved Silver	mg/L	0.00025	0.0000054	0.0000054	1 x	0.000014	0.000014	1 x	0.0000055	0.0000056	1 x	0.000014	0.000014	1 x
Dissolved Sodium	mg/L	-	36	36	1 x	94	93	0.99 x	37	37	1 x	94	94	1 x
Dissolved Thallium	mg/L	0.0008	0.0000024	0.0000024	1 x	0.0000061	0.0000061	1 x	0.0000024	0.0000025	1.01 x	0.0000061	0.0000062	1.01 x
Dissolved Uranium	mg/L	0.01	0.000041	0.000041	1 x	0.00011	0.00011	1.01 x	0.000042	0.000044	1.03 x	0.00011	0.00011	1.03 x
Dissolved Vanadium	mg/L	0.1	0.00024	0.00024	1 x	0.0006	0.0006	1 x	0.00024	0.00025	1.02 x	0.00061	0.00061	1.01 x
Dissolved Zinc	mg/L	0.03	0.0033	0.0032	1 x	0.0084	0.0084	1 x	0.0033	0.0033	1 x	0.0085	0.0085	1 x
Dissolved Phosphorous	mg/L	Variable	0.028	0.028	1 x	0.073	0.072	0.99 x	0.029	0.029	1 x	0.074	0.074	1 x
Total Aluminum	mg/L	0.1	0.082	0.081	1 x	***0.21***	***0.21***	n/a	0.082	0.082	1 x	***0.2***	***0.2***	1 x
Total Antimony	mg/L	-	0.000033	0.000033	1 x	0.000084	0.000084	1 x	0.000033	0.000035	1.05 x	0.000085	0.00009	1.06 x
Total Arsenic	mg/L	0.005	0.00035	0.00035	1 x	0.00093	0.00095	1.02 x	0.00036	0.00061	1.69 x	0.00096	0.0017	1.72 x
Total Barium	mg/L	-	0.0042	0.0042	1 x	0.011	0.011	1 x	0.0042	0.0042	1 x	0.011	0.011	n/a
Total Beryllium	mg/L	0.1	0.000006	0.000006	1.01 x	0.000017	0.000017	1.02 x	0.0000064	0.0000068	1.06 x	0.000018	0.000019	1.06 x
Total Boron	mg/L	0.5	0.037	0.037	1 x	0.098	0.097	1 x	0.038	0.038	1 x	0.1	0.1	1 x
Total Cadmium	mg/L	0.00012	0.0000054	0.0000054	1 x	0.000014	0.000014	n/a	0.0000055	0.0000056	1.01 x	0.000014	0.000014	1.01 x
Total Calcium	mg/L	-	9.8	9.8	1 x	25	25	1 x	10	10	1.01 x	26	26	1.01 x
Total Chromium	mg/L	0.001	0.00054	0.00054	1 x	***0.0014***	***0.0014***	1 x	0.00055	0.00056	1 x	***0.0014***	***0.0014***	1 x
Total Cobalt	mg/L	0.05	0.00006	0.00006	1 x	0.00015	0.00015	1 x	0.000061	0.000065	1.08 x	0.00015	0.00017	1.08 x
Total Copper	mg/L	0.002	0.0016	0.0016	1 x	***0.0043***	***0.0044***	1.01 x	0.0017	0.0017	1.03 x	***0.0044***	***0.0045***	1.03 x
Total Iron	mg/L	0.3	0.2	0.2	1 x	***0.51***	***0.51***	n/a	0.2	0.2	1 x	***0.49***	***0.49***	1 x
Total Lead	mg/L	0.001	0.000073	0.000073	1 x	0.00019	0.00019	1 x	0.000076	0.000076	1 x	0.0002	0.0002	1 x
Total Lithium	mg/L	2.5	0.0043	0.0043	1 x	0.011	0.011	0.99 x	0.0044	0.0044	1 x	0.011	0.011	1 x
Total Magnesium	mg/L	-	7.2	7.1	1 x	19	18	0.99 x	7.3	7.3	1 x	19	19	1 x
Total Manganese	mg/L	0.2	0.03	0.03	1 x	0.078	0.077	1 x	0.031	0.031	1.01 x	0.078	0.079	1 x
Total Mercury	mg/L	0.000016	0.00000094	0.00000099	1.05 x	0.0000024	0.0000027	1.13 x	0.00000095	0.0000012	1.25 x	0.0000024	0.0000029	1.24 x
Total Molybdenum	mg/L	0.01	0.0002	0.0002	1 x	0.00052	0.00053	1 x	0.0002	0.00021	1.02 x	0.00054	0.00055	1.02 x
Total Nickel	mg/L	0.025	0.00072	0.00072	1 x	0.0019	0.0019	1 x	0.00074	0.00075	1.01 x	0.0019	0.0019	1.01 x
Total Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00056	0.00056	1 x	0.00022	0.00022	1 x	0.00057	0.00057	1 x
Total Silver	mg/L	0.00025	0.0000054	0.0000054	1 x	0.000014	0.000014	1 x	0.0000055	0.0000056	1 x	0.000014	0.000014	1 x
Total Sodium	mg/L	-	36	36	1 x	94	93	0.99 x	37	37	1 x	94	94	1 x
Total Thallium	mg/L	0.0008	0.0000024	0.0000024	1 x	0.0000061	0.0000061	1 x	0.0000024	0.0000025	1.01 x	0.0000061	0.0000062	1.01 x
Total Uranium	mg/L	0.01	0.000041	0.000041	1 x	0.00011	0.00011	1.01 x	0.000042	0.000044	1.03 x	0.00011	0.00011	1.03 x
Total Vanadium	mg/L	0.1	0.00024	0.00024	1 x	0.0006	0.00061	1 x	0.00024	0.00025	1.02 x	0.00061	0.00061	1.01 x
Total Zinc	mg/L	0.03	0.0033	0.0032	1 x	0.0084	0.0084	1 x	0.0033	0.0033	1 x	0.0085	0.0085	1 x
Total Phosphorous	mg/L	Variable	0.028	0.028	1 x	0.073	0.072	0.99 x	0.029	0.029	1 x	0.074	0.074	1 x

[1] ***CCME Exceedance shown in bold italics***

Doris TIA Average and Maximum Concentrations During Operations (to Contact Water Pond) and Post-Closure (to TL-2)											
Parameter	Units	MMER		Operations				Post-Closure			
				Average		Maximum		Average		Maximum	
		Current[1]	Proposed[2]	Base Case	Upper Case	Base Case	Upper Case	Base Case	Upper Case	Base Case	Upper Case
TSS	mg/L	15	15	2.8	3.3	11	14	3.3	4.3	3.9	4.9
TDS	mg/L	-	-	540	560	3100	3100	130	140	130	140
Fluoride	mg/L	-	-	0.091	0.094	0.33	0.33	0.049	0.06	0.051	0.061
Chloride	mg/L	-	-	190	190	1700	1700	39	40	39	40
Free Cyanide	mg/L	-	-	0.0015	0.0015	0.0096	0.0096	0.00062	0.00062	0.00062	0.00062
Total Cyanide	mg/L	1	0.5	0.0054	0.0054	0.42	0.42	0.00062	0.00062	0.00062	0.00062
WAD Cyanide	mg/L	-	-	0.081	0.081	0.45	0.45	-	-	-	-
Cyanate	mg/L	-	-	0.24	0.24	19	19	-	-	-	-
Thiocyanate	mg/L	-	-	0.22	0.22	15	15	-	-	-	-
Ammonia	mg/L as N	-	Variable	3.8	3.8	35	35	0.0031	0.0032	0.0031	0.0035
Nitrate	mg/L as N	-	-	4.3	4.3	18	18	0.0031	0.0031	0.0031	0.0031
Nitrite	mg/L as N	-	-	0.35	0.35	3.1	3.1	0.00062	0.00062	0.00062	0.00062
Sulphate	mg/L	-	-	140	150	1000	1000	6.8	12	6.9	13
Alkalinity	mg/L	-	-	89	90	570	570	53	54	54	54
Hardness	mg/L	-	-	310	310	1500	1500	130	130	130	130
Dissolved Aluminum	mg/L	-	-	0.13	0.14	1.6	1.6	0.071	0.081	0.073	0.086
Dissolved Antimony	mg/L	-	-	0.0087	0.0088	0.064	0.065	0.00095	0.0011	0.00096	0.0011
Dissolved Arsenic	mg/L	0.5	0.1	0.19	0.2	***1.2***	***1.2***	0.064	0.079	0.064	0.079
Dissolved Barium	mg/L	-	-	0.033	0.04	0.15	0.21	0.051	0.077	0.051	0.077
Dissolved Beryllium	mg/L	-	-	0.0017	0.0017	0.028	0.028	0.000043	0.000044	0.000043	0.000046
Dissolved Boron	mg/L	-	-	0.12	0.13	0.44	0.45	0.083	0.086	0.084	0.089
Dissolved Cadmium	mg/L	-	-	0.00012	0.00012	0.00072	0.00073	0.000014	0.000017	0.000014	0.000017
Dissolved Calcium	mg/L	-	-	82	84	620	630	22	24	22	24
Dissolved Chromium	mg/L	-	-	0.0038	0.0038	0.019	0.019	0.00068	0.00087	0.00068	0.00087
Dissolved Cobalt	mg/L	-	-	0.0041	0.0041	0.018	0.018	0.00015	0.00018	0.00015	0.00019
Dissolved Copper	mg/L	0.3	0.1	0.0092	0.01	0.041	0.042	0.0042	0.0066	0.0043	0.0067
Dissolved Iron	mg/L	-	-	0.48	0.51	2.8	2.9	0.1	0.16	0.12	0.18
Dissolved Lead	mg/L	0.2	0.08	0.00035	0.00046	0.003	0.0031	0.000072	0.00011	0.000072	0.00012
Dissolved Lithium	mg/L	-	-	0.013	0.013	0.05	0.051	0.0037	0.0042	0.0038	0.0042
Dissolved Magnesium	mg/L	-	-	41	41	210	210	18	19	18	19
Dissolved Manganese	mg/L	-	-	0.063	0.075	0.28	0.3	0.027	0.054	0.029	0.057
Dissolved Mercury	mg/L	-	-	0.000025	0.000026	0.000096	0.000097	0.0000044	0.0000053	0.0000045	0.0000053
Dissolved Molybdenum	mg/L	-	-	0.041	0.041	0.23	0.24	0.0015	0.0027	0.0015	0.0027
Dissolved Nickel	mg/L	0.5	0.25	0.016	0.016	0.088	0.09	0.00087	0.0014	0.00088	0.0014
Dissolved Selenium	mg/L	-	-	0.0033	0.0034	0.018	0.018	0.00032	0.00043	0.00032	0.00043
Dissolved Silver	mg/L	-	-	0.00032	0.00032	0.0016	0.0016	0.000011	0.000018	0.000011	0.000018
Dissolved Sodium	mg/L	-	-	110	110	760	760	20	21	21	21
Dissolved Thallium	mg/L	-	-	0.00013	0.00015	0.00065	0.00066	0.00001	0.000013	0.00001	0.000013
Dissolved Uranium	mg/L	-	-	0.00036	0.00039	0.003	0.0031	0.000089	0.00016	0.00009	0.00016
Dissolved Vanadium	mg/L	-	-	0.0036	0.0038	0.036	0.037	0.00051	0.0012	0.00051	0.0012
Dissolved Zinc	mg/L	0.5	0.4	0.013	0.013	0.091	0.093	0.0031	0.0038	0.0031	0.0038
Dissolved Phosphorous	mg/L	-	-	0.028	0.03	0.13	0.13	0.015	0.017	0.017	0.018
Total Aluminum	mg/L	-	-	0.13	0.14	1.7	1.7	0.073	0.085	0.075	0.09
Total Antimony	mg/L	-	-	0.0087	0.0088	0.064	0.065	0.00095	0.0011	0.00096	0.0011
Total Arsenic	mg/L	0.5	0.1	0.19	0.2	***1.2***	***1.2***	0.064	0.079	0.064	0.079
Total Barium	mg/L	-	-	0.033	0.04	0.15	0.21	0.051	0.077	0.051	0.077
Total Beryllium	mg/L	-	-	0.0017	0.0017	0.028	0.028	0.000043	0.000044	0.000043	0.000046
Total Boron	mg/L	-	-	0.12	0.13	0.44	0.46	0.083	0.086	0.084	0.089
Total Cadmium	mg/L	-	-	0.00012	0.00012	0.00072	0.00073	0.000014	0.000017	0.000014	0.000017
Total Calcium	mg/L	-	-	83	85	620	630	22	24	22	24
Total Chromium	mg/L	-	-	0.004	0.004	0.02	0.02	0.00073	0.001	0.00074	0.001
Total Cobalt	mg/L	-	-	0.0041	0.0041	0.018	0.018	0.00016	0.0002	0.00016	0.0002
Total Copper	mg/L	0.3	0.1	0.0093	0.01	0.041	0.042	0.0042	0.0066	0.0043	0.0067
Total Iron	mg/L	-	-	0.57	0.61	3.1	3.1	0.13	0.22	0.15	0.24
Total Lead	mg/L	0.2	0.08	0.00036	0.00046	0.003	0.0031	0.000074	0.00011	0.000074	0.00012
Total Lithium	mg/L	-	-	0.013	0.013	0.05	0.051	0.0037	0.0042	0.0038	0.0042
Total Magnesium	mg/L	-	-	41	41	210	210	18	19	18	19
Total Manganese	mg/L	-	-	0.066	0.078	0.29	0.3	0.027	0.056	0.03	0.059
Total Mercury	mg/L	-	-	0.000044	0.000047	0.00017	0.00018	0.0000095	0.000018	0.0000097	0.000018
Total Molybdenum	mg/L	-	-	0.041	0.041	0.23	0.24	0.0015	0.0027	0.0015	0.0027
Total Nickel	mg/L	0.5	0.25	0.016	0.017	0.089	0.09	0.00091	0.0014	0.00092	0.0014
Total Selenium	mg/L	-	-	0.0033	0.0034	0.018	0.018	0.00032	0.00044	0.00032	0.00044
Total Silver	mg/L	-	-	0.00032	0.00032	0.0016	0.0016	0.000011	0.000018	0.000011	0.000018
Total Sodium	mg/L	-	-	110	110	760	760	20	21	21	21
Total Thallium	mg/L	-	-	0.00013	0.00015	0.00065	0.00066	0.00001	0.000013	0.00001	0.000013
Total Uranium	mg/L	-	-	0.00036	0.00039	0.003	0.0031	0.000089	0.00016	0.00009	0.00016
Total Vanadium	mg/L	-	-	0.0036	0.0038	0.036	0.037	0.00052	0.0012	0.00052	0.0012
Total Zinc	mg/L	0.5	0.4	0.013	0.013	0.091	0.093	0.0031	0.0039	0.0031	0.0039
Total Phosphorous	mg/L	-	-	0.028	0.031	0.13	0.14	0.015	0.017	0.017	0.018

[1] ***Current MMER Exceedance Shown in bold italics***

[2] Proposed MMER Exceedance shown in grey highlight

Doris Creek (TL-2) Average and Maximum Concenrations During Operations and Post-Closure - Base Case														
Parameter	Units	Min CCME[2]	Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	5.1	5.1	1 x	6.3	8.3	1.3 x	5.2	4.9	0.95 x	6.3	5.1	0.82 x
TDS	mg/L	-	170	170	1 x	210	280	1.3 x	180	170	0.95 x	210	170	0.8 x
Fluoride	mg/L	0.12	0.06	0.06	1 x	0.074	0.097	1.3 x	0.06	0.058	0.97 x	0.074	0.06	0.82 x
Chloride	mg/L	120	70	71	1 x	86	110	1.3 x	70	66	0.95 x	86	68	0.79 x
Free Cyanide	mg/L	0.005	0.0011	0.0012	1 x	0.0014	0.0018	1.3 x	0.0011	0.0011	0.95 x	0.0014	0.0011	0.79 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0013	0.0018	1.4 x	0.0011	0.0011	0.98 x	0.0013	0.0011	0.82 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	0.000011	0.0000046	0.4 x	0.000016	0.000056	3.6 x	0.000012		x	0.000016		x
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0054	0.0057	1.1 x	0.0066	0.0091	1.4 x	0.0054	0.0053	0.99 x	0.0066	0.0055	0.82 x
Nitrate	mg/L as N	3	0.0056	0.022	3.9 x	0.0069	0.28	40 x	0.0056	0.0053	0.95 x	0.0069	0.0055	0.79 x
Nitrite	mg/L as N	10	0.0011	0.0016	1.4 x	0.0014	0.0072	5.2 x	0.0011	0.0011	0.95 x	0.0014	0.0011	0.79 x
Sulphate	mg/L	1000	3	3.2	1.1 x	3.7	5.3	1.4 x	3	7.6	2.5 x	3.7	8.4	2.3 x
Alkalinity	mg/L	-	33	33	1 x	40	54	1.3 x	33	34	1.1 x	40	38	0.93 x
Hardness	mg/L	-	54	55	1 x	67	88	1.3 x	54	57	1.1 x	67	66	0.99 x
Dissolved Aluminum	mg/L	0.1	0.065	0.065	1 x	0.079	0.1	1.3 x	0.064	0.063	0.98 x	0.079	0.067	0.85 x
Dissolved Antimony	mg/L	-	0.000027	0.000033	1.2 x	0.000033	0.00015	4.5 x	0.000027	0.000091	3.3 x	0.000033	0.00018	5.3 x
Dissolved Arsenic	mg/L	0.005	0.00032	0.00048	1.5 x	0.00039	***0.0084***	21 x	0.00032	0.0042	13 x	0.00039	***0.01***	25 x
Dissolved Barium	mg/L	-	0.004	0.0042	1.1 x	0.0049	0.01	2.1 x	0.0039	0.0068	1.7 x	0.0048	0.011	2.3 x
Dissolved Beryllium	mg/L	0.1	0.0000056	0.000015	2.6 x	0.0000069	0.00012	17 x	0.0000056	0.0000099	1.8 x	0.0000069	0.000013	1.9 x
Dissolved Boron	mg/L	0.5	0.035	0.036	1 x	0.043	0.057	1.3 x	0.035	0.038	1.1 x	0.043	0.044	1 x
Dissolved Cadmium	mg/L	0.00012	0.0000056	0.0000058	1 x	0.0000069	0.0000092	1.3 x	0.0000056	0.0000068	1.2 x	0.0000069	0.0000078	1.1 x
Dissolved Calcium	mg/L	-	9.8	10	1 x	12	16	1.3 x	9.8	12	1.2 x	12	13	1.1 x
Dissolved Chromium	mg/L	0.001	0.00056	0.00057	1 x	0.00069	0.00091	1.3 x	0.00056	0.00055	0.98 x	0.00069	0.00059	0.85 x
Dissolved Cobalt	mg/L	0.05	0.000056	0.000082	1.5 x	0.000069	0.00028	4 x	0.000056	0.0004	7 x	0.000069	0.00043	6.3 x
Dissolved Copper	mg/L	0.002	0.0016	0.0016	1.1 x	0.0019	***0.0026***	1.4 x	0.0016	0.0018	1.2 x	0.0019	***0.0021***	1.1 x
Dissolved Iron	mg/L	0.3	0.18	0.18	1 x	0.22	0.28	1.3 x	0.17	0.16	0.94 x	0.21	0.17	0.79 x
Dissolved Lead	mg/L	0.001	0.000056	0.000057	1 x	0.000069	0.000091	1.3 x	0.000056	0.000056	1 x	0.000069	0.00006	0.87 x
Dissolved Lithium	mg/L	2.5	0.0042	0.0043	1 x	0.0052	0.0068	1.3 x	0.0042	0.0043	1 x	0.0051	0.0045	0.87 x
Dissolved Magnesium	mg/L	-	7.3	7.4	1 x	8.9	12	1.3 x	7.3	8.1	1.1 x	8.9	9.4	1.1 x
Dissolved Manganese	mg/L	0.2	0.023	0.024	1 x	0.029	0.038	1.3 x	0.023	0.03	1.3 x	0.029	0.031	1.1 x
Dissolved Mercury	mg/L	0.000016	0.00000078	0.000001	1.3 x	0.00000095	0.0000031	3.3 x	0.00000076	0.0000012	1.6 x	0.00000094	0.0000015	1.6 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.00025	1.2 x	0.00025	0.00072	2.9 x	0.0002	0.00029	1.4 x	0.00025	0.00041	1.7 x
Dissolved Nickel	mg/L	0.025	0.0006	0.00065	1.1 x	0.00074	0.0011	1.6 x	0.0006	0.0018	3.1 x	0.00073	0.002	2.7 x
Dissolved Selenium	mg/L	0.001	0.00023	0.00023	1 x	0.00028	0.00036	1.3 x	0.00023	0.00036	1.6 x	0.00028	0.00039	1.4 x
Dissolved Silver	mg/L	0.00025	0.0000056	0.0000059	1 x	0.0000069	0.0000092	1.3 x	0.0000056	0.0000059	1.1 x	0.0000069	0.0000066	0.96 x
Dissolved Sodium	mg/L	-	37	37	1 x	45	60	1.3 x	37	35	0.95 x	45	36	0.79 x
Dissolved Thallium	mg/L	0.0008	0.0000023	0.0000032	1.4 x	0.0000028	0.000013	4.8 x	0.0000023	0.0000037	1.6 x	0.0000028	0.0000045	1.6 x
Dissolved Uranium	mg/L	0.01	0.000038	0.000041	1.1 x	0.000047	0.000064	1.4 x	0.000039	0.000044	1.1 x	0.000047	0.00005	1.1 x
Dissolved Vanadium	mg/L	0.1	0.0002	0.00022	1.1 x	0.00025	0.00034	1.4 x	0.0002	0.00023	1.2 x	0.00025	0.00027	1.1 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0034	1 x	0.0042	0.0055	1.3 x	0.0034	0.0034	1 x	0.0041	0.0035	0.85 x
Dissolved Phosphorous	mg/L	Variable	0.026	0.026	1 x	0.032	0.042	1.3 x	0.026	0.025	0.95 x	0.032	0.026	0.8 x
Total Aluminum	mg/L	0.1	0.065	0.066	1 x	0.079	0.1	1.3 x	0.064	0.063	0.98 x	0.079	0.067	0.85 x
Total Antimony	mg/L	-	0.000027	0.000033	1.2 x	0.000033	0.00015	4.5 x	0.000027	0.000091	3.4 x	0.000033	0.00018	5.3 x
Total Arsenic	mg/L	0.005	0.00032	0.00049	1.5 x	0.00039	***0.0084***	21 x	0.00032	0.0042	13 x	0.00039	***0.01***	25 x
Total Barium	mg/L	-	0.004	0.0042	1.1 x	0.0049	0.01	2.1 x	0.0039	0.0068	1.7 x	0.0048	0.011	2.3 x
Total Beryllium	mg/L	0.1	0.0000056	0.000015	2.6 x	0.0000069	0.00012	17 x	0.0000056	0.0000099	1.8 x	0.0000069	0.000013	1.9 x
Total Boron	mg/L	0.5	0.035	0.036	1 x	0.043	0.057	1.3 x	0.035	0.038	1.1 x	0.043	0.044	1 x
Total Cadmium	mg/L	0.00012	0.0000056	0.0000058	1 x	0.0000069	0.0000092	1.3 x	0.0000056	0.0000068	1.2 x	0.0000069	0.0000079	1.1 x
Total Calcium	mg/L	-	9.8	10	1 x	12	16	1.3 x	9.8	12	1.2 x	12	13	1.1 x
Total Chromium	mg/L	0.001	0.00056	0.00058	1 x	0.00069	0.00091	1.3 x	0.00056	0.00057	1 x	0.00069	0.00061	0.88 x
Total Cobalt	mg/L	0.05	0.000056	0.000083	1.5 x	0.000069	0.00028	4 x	0.000056	0.0004	7 x	0.000069	0.00044	6.3 x
Total Copper	mg/L	0.002	0.0016	0.0016	1.1 x	0.0019	***0.0026***	1.4 x	0.0016	0.0018	1.2 x	0.0019	***0.0021***	1.1 x
Total Iron	mg/L	0.3	0.18	0.18	1 x	0.22	0.28	1.3 x	0.17	0.17	0.97 x	0.21	0.18	0.82 x
Total Lead	mg/L	0.001	0.000056	0.000058	1 x	0.000069	0.000091	1.3 x	0.000056	0.000056	1 x	0.000069	0.00006	0.88 x
Total Lithium	mg/L	2.5	0.0042	0.0043	1 x	0.0052	0.0068	1.3 x	0.0042	0.0043	1 x	0.0051	0.0045	0.87 x
Total Magnesium	mg/L	-	7.3	7.4	1 x	8.9	12	1.3 x	7.3	8.1	1.1 x	8.9	9.4	1.1 x
Total Manganese	mg/L	0.2	0.023	0.024	1 x	0.029	0.038	1.3 x	0.023	0.03	1.3 x	0.029	0.032	1.1 x
Total Mercury	mg/L	0.000016	0.00000078	0.0000014	1.8 x	0.00000095	0.0000034	3.6 x	0.00000076	0.0000023	3 x	0.00000094	0.000003	3.2 x
Total Molybdenum	mg/L	0.01	0.0002	0.00025	1.2 x	0.00025	0.00072	2.9 x	0.0002	0.00029	1.4 x	0.00025	0.00041	1.7 x
Total Nickel	mg/L	0.025	0.0006	0.00065	1.1 x	0.00074	0.0011	1.6 x	0.0006	0.0018	3.1 x	0.00073	0.002	2.7 x
Total Selenium	mg/L	0.001	0.00023	0.00023	1 x	0.00028	0.00036	1.3 x	0.00023	0.00036	1.6 x	0.00028	0.00039	1.4 x
Total Silver	mg/L	0.00025	0.0000056	0.0000059	1 x	0.0000069	0.0000092	1.3 x	0.0000056	0.0000059	1.1 x	0.0000069	0.0000066	0.96 x
Total Sodium	mg/L	-	37	37	1 x	45	60	1.3 x	37	35	0.95 x	45	36	0.79 x
Total Thallium	mg/L	0.0008	0.0000023	0.0000032	1.4 x	0.0000028	0.000013	4.8 x	0.0000023	0.0000037	1.6 x	0.0000028	0.0000045	1.6 x
Total Uranium	mg/L	0.01	0.000038	0.000041	1.1 x	0.000047	0.000064	1.4 x	0.000039	0.000044	1.1 x	0.000047	0.00005	1.1 x
Total Vanadium	mg/L	0.1	0.0002	0.00022	1.1 x	0.00025	0.00034	1.4 x	0.0002	0.00023	1.2 x	0.00025	0.00027	1.1 x
Total Zinc	mg/L	0.03	0.0034	0.0034	1 x	0.0042	0.0055	1.3 x	0.0034	0.0034	1 x	0.0041	0.0035	0.85 x
Total Phosphorous	mg/L	Variable	0.026	0.026	1 x	0.032	0.042	1.3 x	0.026	0.025	0.95 x	0.032	0.026	0.81 x

[1] ***CCME Exceedance shown in bold italics***

Doris Creek (TL-2) Average and Maximum Concenrations During Operations and Post-Closure - Upper Case														
Parameter	Units	Min CCME[2]	Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	5.5	5.6	1.01 x	6.9	9	1.32 x	5.7	5.4	0.96 x	6.9	5.6	0.82 x
TDS	mg/L	-	180	180	1 x	230	300	1.31 x	180	180	0.95 x	230	180	0.8 x
Fluoride	mg/L	0.12	0.061	0.062	1.01 x	0.076	0.1	1.32 x	0.062	0.06	0.97 x	0.076	0.063	0.83 x
Chloride	mg/L	120	71	72	1.01 x	88	120	1.31 x	72	68	0.95 x	88	69	0.79 x
Free Cyanide	mg/L	0.005	0.0011	0.0012	1.04 x	0.0014	0.0018	1.31 x	0.0011	0.0011	0.95 x	0.0014	0.0011	0.79 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	1.03 x	0.0013	0.0018	1.36 x	0.0011	0.0011	0.98 x	0.0013	0.0011	0.82 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	0.000011	0.0000045	0.39 x	0.000016	0.000056	3.55 x	0.000012		0 x	0.000016		0 x
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0055	0.0058	1.05 x	0.0067	0.0092	1.37 x	0.0055	0.0054	0.99 x	0.0067	0.0055	0.82 x
Nitrate	mg/L as N	3	0.0056	0.021	3.81 x	0.0069	0.28	39.99 x	0.0056	0.0053	0.95 x	0.0069	0.0055	0.79 x
Nitrite	mg/L as N	10	0.0011	0.0016	1.41 x	0.0014	0.0072	5.22 x	0.0011	0.0011	0.95 x	0.0014	0.0011	0.79 x
Sulphate	mg/L	1000	3	3.3	1.09 x	3.7	5.2	1.41 x	3	3.9	1.3 x	3.7	4.9	1.31 x
Alkalinity	mg/L	-	33	34	1.02 x	41	55	1.33 x	33	35	1.04 x	41	38	0.92 x
Hardness	mg/L	-	56	57	1.02 x	69	90	1.31 x	56	59	1.06 x	68	68	1 x
Dissolved Aluminum	mg/L	0.1	0.085	0.086	1.01 x	0.1	***0.14***	1.31 x	0.083	0.081	0.97 x	0.1	0.086	0.83 x
Dissolved Antimony	mg/L	-	0.000034	0.000044	1.3 x	0.000042	0.00018	4.23 x	0.000034	0.0001	2.99 x	0.000041	0.0002	4.91 x
Dissolved Arsenic	mg/L	0.005	0.00036	0.00076	2.11 x	0.00045	***0.01***	23.14 x	0.00037	***0.0052***	14.04 x	0.00045	***0.012***	27.41 x
Dissolved Barium	mg/L	-	0.0043	0.0049	1.13 x	0.0053	0.014	2.56 x	0.0043	0.0085	2 x	0.0053	0.015	2.93 x
Dissolved Beryllium	mg/L	0.1	0.0000062	0.000015	2.45 x	0.0000078	0.00012	14.79 x	0.0000066	0.00001	1.56 x	0.0000078	0.000014	1.73 x
Dissolved Boron	mg/L	0.5	0.039	0.04	1.03 x	0.048	0.063	1.32 x	0.039	0.041	1.05 x	0.048	0.047	0.98 x
Dissolved Cadmium	mg/L	0.00012	0.0000056	0.0000059	1.05 x	0.0000069	0.0000093	1.34 x	0.0000056	0.0000064	1.13 x	0.0000069	0.0000076	1.1 x
Dissolved Calcium	mg/L	-	10	11	1.05 x	12	17	1.34 x	10	11	1.09 x	12	13	1.02 x
Dissolved Chromium	mg/L	0.001	0.00056	0.00057	1.02 x	0.00069	0.00091	1.31 x	0.00056	0.00056	1 x	0.00069	0.00062	0.89 x
Dissolved Cobalt	mg/L	0.05	0.000062	0.000081	1.3 x	0.000076	0.00028	3.67 x	0.000062	0.000073	1.18 x	0.000076	0.000086	1.13 x
Dissolved Copper	mg/L	0.002	0.0017	0.0018	1.08 x	***0.0021***	***0.0029***	1.4 x	0.0017	***0.0022***	1.27 x	***0.0021***	***0.0027***	1.27 x
Dissolved Iron	mg/L	0.3	0.21	0.21	1.01 x	0.26	***0.34***	1.3 x	0.2	0.19	0.96 x	0.25	0.21	0.81 x
Dissolved Lead	mg/L	0.001	0.000076	0.000081	1.06 x	0.000094	0.00012	1.33 x	0.000077	0.000078	1.01 x	0.000094	0.000084	0.9 x
Dissolved Lithium	mg/L	2.5	0.0045	0.0046	1.02 x	0.0055	0.0072	1.31 x	0.0045	0.0043	0.96 x	0.0055	0.0045	0.82 x
Dissolved Magnesium	mg/L	-	7.4	7.6	1.02 x	9.2	12	1.31 x	7.5	7.9	1.06 x	9.1	9.3	1.01 x
Dissolved Manganese	mg/L	0.2	0.031	0.032	1.03 x	0.038	0.051	1.33 x	0.031	0.032	1.04 x	0.038	0.036	0.93 x
Dissolved Mercury	mg/L	0.000016	0.00000098	0.0000012	1.27 x	0.0000012	0.0000033	2.74 x	0.00000096	0.0000013	1.41 x	0.0000012	0.0000018	1.5 x
Dissolved Molybdenum	mg/L	0.01	0.0002	0.00026	1.29 x	0.00025	0.00072	2.87 x	0.00021	0.00036	1.73 x	0.00025	0.00059	2.33 x
Dissolved Nickel	mg/L	0.025	0.00075	0.00079	1.05 x	0.00092	0.0012	1.34 x	0.00075	0.0008	1.06 x	0.00092	0.00088	0.96 x
Dissolved Selenium	mg/L	0.001	0.00023	0.00023	1.03 x	0.00028	0.00037	1.32 x	0.00023	0.00023	1.04 x	0.00028	0.00026	0.95 x
Dissolved Silver	mg/L	0.00025	0.0000056	0.0000059	1.05 x	0.0000069	0.0000092	1.32 x	0.0000056	0.0000063	1.12 x	0.0000069	0.0000077	1.12 x
Dissolved Sodium	mg/L	-	38	38	1.01 x	46	61	1.31 x	38	36	0.95 x	46	36	0.79 x
Dissolved Thallium	mg/L	0.0008	0.0000025	0.0000042	1.69 x	0.000003	0.000024	7.91 x	0.0000025	0.0000031	1.28 x	0.000003	0.0000042	1.39 x
Dissolved Uranium	mg/L	0.01	0.000043	0.000047	1.11 x	0.000053	0.000073	1.39 x	0.000043	0.000054	1.25 x	0.000053	0.000065	1.24 x
Dissolved Vanadium	mg/L	0.1	0.00025	0.00027	1.08 x	0.00031	0.00041	1.35 x	0.00025	0.00031	1.26 x	0.0003	0.0004	1.34 x
Dissolved Zinc	mg/L	0.03	0.0034	0.0035	1.02 x	0.0042	0.0055	1.32 x	0.0034	0.0034	0.99 x	0.0041	0.0035	0.86 x
Dissolved Phosphorous	mg/L	Variable	0.029	0.029	1.01 x	0.035	0.047	1.32 x	0.029	0.028	0.95 x	0.035	0.028	0.8 x
Total Aluminum	mg/L	0.1	0.085	0.086	1.01 x	0.1	***0.14***	1.31 x	0.083	0.081	0.98 x	0.1	0.086	0.84 x
Total Antimony	mg/L	-	0.000034	0.000044	1.3 x	0.000042	0.00018	4.23 x	0.000034	0.0001	2.99 x	0.000041	0.0002	4.92 x
Total Arsenic	mg/L	0.005	0.00036	0.00076	2.12 x	0.00045	***0.01***	23.18 x	0.00037	***0.0052***	14.08 x	0.00045	***0.012***	27.48 x
Total Barium	mg/L	-	0.0043	0.0049	1.13 x	0.0053	0.014	2.56 x	0.0043	0.0085	2 x	0.0053	0.015	2.93 x
Total Beryllium	mg/L	0.1	0.0000062	0.000015	2.45 x	0.0000078	0.00012	14.79 x	0.0000066	0.00001	1.56 x	0.0000078	0.000014	1.73 x
Total Boron	mg/L	0.5	0.039	0.04	1.03 x	0.048	0.063	1.32 x	0.039	0.041	1.05 x	0.048	0.047	0.98 x
Total Cadmium	mg/L	0.00012	0.0000056	0.0000059	1.05 x	0.0000069	0.0000093	1.34 x	0.0000056	0.0000064	1.13 x	0.0000069	0.0000076	1.11 x
Total Calcium	mg/L	-	10	11	1.05 x	12	17	1.34 x	10	11	1.09 x	12	13	1.02 x
Total Chromium	mg/L	0.001	0.00056	0.00058	1.03 x	0.00069	0.00092	1.32 x	0.00056	0.00058	1.03 x	0.00069	0.00065	0.94 x
Total Cobalt	mg/L	0.05	0.000062	0.000082	1.31 x	0.000076	0.00028	3.68 x	0.000062	0.000075	1.22 x	0.000076	0.000089	1.18 x
Total Copper	mg/L	0.002	0.0017	0.0018	1.08 x	***0.0021***	***0.0029***	1.4 x	0.0017	***0.0022***	1.27 x	***0.0021***	***0.0027***	1.27 x
Total Iron	mg/L	0.3	0.21	0.22	1.02 x	0.26	***0.34***	1.32 x	0.2	0.2	1 x	0.25	0.22	0.86 x
Total Lead	mg/L	0.001	0.000076	0.000081	1.06 x	0.000094	0.00012	1.33 x	0.000077	0.000079	1.02 x	0.000094	0.000085	0.9 x
Total Lithium	mg/L	2.5	0.0045	0.0046	1.02 x	0.0055	0.0072	1.31 x	0.0045	0.0043	0.96 x	0.0055	0.0045	0.82 x
Total Magnesium	mg/L	-	7.4	7.6	1.02 x	9.2	12	1.31 x	7.5	7.9	1.06 x	9.1	9.3	1.01 x
Total Manganese	mg/L	0.2	0.031	0.032	1.03 x	0.038	0.051	1.33 x	0.031	0.033	1.05 x	0.038	0.036	0.94 x
Total Mercury	mg/L	0.000016	0.00000098	0.0000017	1.71 x	0.0000012	0.0000038	3.19 x	0.00000096	0.000003	3.1 x	0.0000012	0.0000045	3.75 x
Total Molybdenum	mg/L	0.01	0.0002	0.00026	1.29 x	0.00025	0.00072	2.87 x	0.00021	0.00036	1.74 x	0.00025	0.00059	2.33 x
Total Nickel	mg/L	0.025	0.00075	0.00079	1.05 x	0.00092	0.0012	1.35 x	0.00075	0.00081	1.08 x	0.00092	0.0009	0.98 x
Total Selenium	mg/L	0.001	0.00023	0.00023	1.03 x	0.00028	0.00037	1.32 x	0.00023	0.00023	1.04 x	0.00028	0.00026	0.95 x
Total Silver	mg/L	0.00025	0.0000056	0.0000059	1.05 x	0.0000069	0.0000092	1.33 x	0.0000056	0.0000063	1.12 x	0.0000069	0.0000077	1.12 x
Total Sodium	mg/L	-	38	38	1.01 x	46	61	1.31 x	38	36	0.95 x	46	36	0.79 x
Total Thallium	mg/L	0.0008	0.0000025	0.0000042	1.69 x	0.000003	0.000024	7.91 x	0.0000025	0.0000032	1.28 x	0.000003	0.0000042	1.39 x
Total Uranium	mg/L	0.01	0.000043	0.000047	1.11 x	0.000053	0.000073	1.39 x	0.000043	0.000054	1.25 x	0.000053	0.000065	1.24 x
Total Vanadium	mg/L	0.1	0.00025	0.00027	1.08 x	0.00031	0.00041	1.36 x	0.00025	0.00031	1.27 x	0.0003	0.00041	1.36 x
Total Zinc	mg/L	0.03	0.0034	0.0035	1.02 x	0.0042	0.0055	1.32 x	0.0034	0.0034	1 x	0.0041	0.0036	0.86 x
Total Phosphorous	mg/L	Variable	0.029	0.029	1.01 x	0.035	0.047	1.32 x	0.029	0.028	0.95 x	0.035	0.028	0.8 x

[1] ***CCME Exceedance shown in bold italics***

Windy Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case											
Parameter	Units	Min CCME[1]	Operations						Post-Closure		
			Average Open Water			Maximum Under Ice			Steady State Closure		
			Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	4.9	4.8	1 x	5.9	5.9	1 x	8.9	8.9	0.99 x
TDS	mg/L	-	170	170	1 x	200	200	1 x	250	250	0.99 x
Fluoride	mg/L	0.12	0.058	0.058	1 x	0.07	0.07	1 x	0.085	0.086	1 x
Chloride	mg/L	120	68	68	1 x	82	82	1 x	96	95	0.99 x
Free Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0055	0.0055	1 x	0.0066	0.0066	1 x	0.0074	0.0074	0.99 x
Nitrate	mg/L as N	3	0.0055	0.0055	1 x	0.0066	0.0066	1 x	0.0074	0.0074	0.99 x
Nitrite	mg/L as N	10	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
Sulphate	mg/L	1000	2.9	2.9	1 x	3.5	3.6	1 x	4.2	9.3	2.2 x
Alkalinity	mg/L	-	32	32	1 x	38	38	1 x	46	47	1 x
Hardness	mg/L	-	53	53	1 x	64	64	1 x	75	74	0.99 x
Dissolved Aluminum	mg/L	0.1	0.064	0.064	1 x	0.077	0.077	1 x	0.098	0.1	1.1 x
Dissolved Antimony	mg/L	-	0.000025	0.000026	1 x	0.000031	0.000031	1 x	0.000046	0.000083	1.8 x
Dissolved Arsenic	mg/L	0.005	0.0003	0.0003	1 x	0.00037	0.0004	1.1 x	0.00059	0.0035	5.9 x
Dissolved Barium	mg/L	-	0.0039	0.0039	1 x	0.0047	0.0047	1 x	0.0051	0.0052	1 x
Dissolved Beryllium	mg/L	0.1	0.0000055	0.0000056	1 x	0.0000066	0.000007	1.1 x	0.0000093	0.000012	1.3 x
Dissolved Boron	mg/L	0.5	0.034	0.034	1 x	0.041	0.041	n/a	0.066	0.069	1 x
Dissolved Cadmium	mg/L	0.00012	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.000013	1.7 x
Dissolved Calcium	mg/L	-	9.5	9.5	1 x	11	12	1 x	14	15	1.1 x
Dissolved Chromium	mg/L	0.001	0.00055	0.00055	1 x	0.00066	0.00066	1 x	0.00074	0.00077	1 x
Dissolved Cobalt	mg/L	0.05	0.000055	0.000055	1 x	0.000066	0.00007	1.1 x	0.000074	0.00047	6.3 x
Dissolved Copper	mg/L	0.002	0.0015	0.0015	1 x	0.0018	0.0019	1 x	***0.0024***	***0.0027***	1.1 x
Dissolved Iron	mg/L	0.3	0.18	0.18	1 x	0.21	0.21	1 x	0.17	0.19	1.1 x
Dissolved Lead	mg/L	0.001	0.000055	0.000055	1 x	0.000066	0.000066	1 x	0.00017	0.0002	1.2 x
Dissolved Lithium	mg/L	2.5	0.0041	0.0041	1 x	0.0049	0.0049	1 x	0.006	0.0062	1 x
Dissolved Magnesium	mg/L	-	7	7	1 x	8.5	8.5	1 x	10	10	1 x
Dissolved Manganese	mg/L	0.2	0.022	0.022	1 x	0.027	0.027	1 x	0.039	0.046	1.2 x
Dissolved Mercury	mg/L	0.000016	0.00000076	0.00000078	1 x	0.00000091	0.00000096	1.1 x	0.00000085	0.0000014	1.7 x
Dissolved Molybdenum	mg/L	0.01	0.00019	0.00019	1 x	0.00023	0.00023	1 x	0.00033	0.00035	1.1 x
Dissolved Nickel	mg/L	0.025	0.00058	0.00058	1 x	0.0007	0.00071	1 x	0.00098	0.0024	2.4 x
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00026	0.00026	1 x	0.0003	0.00031	1 x
Dissolved Silver	mg/L	0.00025	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.000008	1.1 x
Dissolved Sodium	mg/L	-	36	36	1 x	43	43	1 x	49	48	0.99 x
Dissolved Thallium	mg/L	0.0008	0.0000022	0.0000022	1 x	0.0000026	0.0000027	1 x	0.0000041	0.0000053	1.3 x
Dissolved Uranium	mg/L	0.01	0.000037	0.000037	1 x	0.000045	0.000045	1 x	0.000054	0.000058	1.1 x
Dissolved Vanadium	mg/L	0.1	0.0002	0.0002	1 x	0.00024	0.00024	1 x	0.00029	0.00034	1.2 x
Dissolved Zinc	mg/L	0.03	0.0033	0.0033	1 x	0.004	0.004	1 x	0.0045	0.0051	1.2 x
Dissolved Phosphorous	mg/L	Variable	0.024	0.024	1 x	0.029	0.029	1 x	0.032	0.032	0.99 x
Total Aluminum	mg/L	0.1	0.064	0.064	1 x	0.077	0.077	1 x	0.098	0.1	1.1 x
Total Antimony	mg/L	-	0.000025	0.000026	1 x	0.000031	0.000031	1 x	0.000046	0.000083	1.8 x
Total Arsenic	mg/L	0.005	0.0003	0.00031	1 x	0.00037	0.0004	1.1 x	0.00059	0.0035	5.9 x
Total Barium	mg/L	-	0.0039	0.0039	1 x	0.0047	0.0047	1 x	0.0051	0.0052	1 x
Total Beryllium	mg/L	0.1	0.0000055	0.0000056	1 x	0.0000066	0.000007	1.1 x	0.0000093	0.000012	1.3 x
Total Boron	mg/L	0.5	0.034	0.034	1 x	0.041	0.041	n/a	0.066	0.069	1 x
Total Cadmium	mg/L	0.00012	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.000013	1.7 x
Total Calcium	mg/L	-	9.5	9.5	1 x	11	12	1 x	14	15	1.1 x
Total Chromium	mg/L	0.001	0.00055	0.00055	1 x	0.00066	0.00066	1 x	0.00074	0.00077	1 x
Total Cobalt	mg/L	0.05	0.000055	0.000055	1 x	0.000066	0.00007	1.1 x	0.000074	0.00047	6.3 x
Total Copper	mg/L	0.002	0.0015	0.0015	1 x	0.0018	0.0019	1 x	***0.0024***	***0.0027***	1.1 x
Total Iron	mg/L	0.3	0.18	0.18	1 x	0.21	0.22	1 x	0.17	0.19	1.1 x
Total Lead	mg/L	0.001	0.000055	0.000055	1 x	0.000066	0.000066	1 x	0.00017	0.0002	1.2 x
Total Lithium	mg/L	2.5	0.0041	0.0041	1 x	0.0049	0.0049	1 x	0.006	0.0062	1 x
Total Magnesium	mg/L	-	7	7	1 x	8.5	8.5	1 x	10	10	1 x
Total Manganese	mg/L	0.2	0.022	0.022	1 x	0.027	0.027	1 x	0.039	0.046	1.2 x
Total Mercury	mg/L	0.000016	0.00000076	0.00000085	1.1 x	0.00000091	0.0000012	1.3 x	0.00000085	0.0000014	1.7 x
Total Molybdenum	mg/L	0.01	0.00019	0.00019	1 x	0.00023	0.00023	1 x	0.00033	0.00035	1.1 x
Total Nickel	mg/L	0.025	0.00058	0.00058	1 x	0.0007	0.00071	1 x	0.00098	0.0024	2.4 x
Total Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00026	0.00026	1 x	0.0003	0.00031	1 x
Total Silver	mg/L	0.00025	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.000008	1.1 x
Total Sodium	mg/L	-	36	36	1 x	43	43	1 x	49	48	0.99 x
Total Thallium	mg/L	0.0008	0.0000022	0.0000022	1 x	0.0000026	0.0000027	1 x	0.0000041	0.0000053	1.3 x
Total Uranium	mg/L	0.01	0.000037	0.000037	1 x	0.000045	0.000045	1 x	0.000054	0.000058	1.1 x
Total Vanadium	mg/L	0.1	0.0002	0.0002	1 x	0.00024	0.00024	1 x	0.00029	0.00034	1.2 x
Total Zinc	mg/L	0.03	0.0033	0.0033	1 x	0.004	0.004	1 x	0.0045	0.0051	1.2 x
Total Phosphorous	mg/L	Variable	0.024	0.024	1 x	0.029	0.029	1 x	0.032	0.032	0.99 x

[1] ***CCME Exceedance shown in bold italics***

Windy Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case											
			Operations						Post-Closure		
			Average Open Water			Maximum Under Ice			Steady State Closure		
Parameter	Units	Min CCME[1]	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	5.3	5.3	1 x	6.4	6.4	1 x	8.9	8.9	0.99 x
TDS	mg/L	-	180	180	1 x	210	210	1 x	250	250	0.99 x
Fluoride	mg/L	0.12	0.059	0.059	1 x	0.072	0.072	1 x	0.085	0.086	1 x
Chloride	mg/L	120	69	69	1 x	84	83	1 x	96	95	0.99 x
Free Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
Total Cyanide	mg/L	0.005	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.0055	0.0055	1 x	0.0066	0.0066	1 x	0.0074	0.0074	0.99 x
Nitrate	mg/L as N	3	0.0055	0.0055	1 x	0.0066	0.0066	1 x	0.0074	0.0074	0.99 x
Nitrite	mg/L as N	10	0.0011	0.0011	1 x	0.0013	0.0013	n/a	0.0015	0.0015	0.99 x
Sulphate	mg/L	1000	2.9	3	1 x	3.5	3.7	1 x	4.2	9.4	2.3 x
Alkalinity	mg/L	-	32	32	1 x	39	39	1 x	46	48	1.1 x
Hardness	mg/L	-	54	54	1 x	65	65	1 x	75	74	0.99 x
Dissolved Aluminum	mg/L	0.1	0.085	0.085	1 x	0.1	0.1	1 x	0.098	***0.11***	1.1 x
Dissolved Antimony	mg/L	-	0.000033	0.000033	1 x	0.00004	0.00004	1 x	0.000046	0.00011	2.4 x
Dissolved Arsenic	mg/L	0.005	0.00034	0.00034	1 x	0.00041	0.0005	1.2 x	0.00059	***0.0064***	11 x
Dissolved Barium	mg/L	-	0.0043	0.0043	1 x	0.0051	0.0051	1 x	0.0051	0.0052	1 x
Dissolved Beryllium	mg/L	0.1	0.0000056	0.0000058	1 x	0.000007	0.0000074	1.1 x	0.0000093	0.000013	1.4 x
Dissolved Boron	mg/L	0.5	0.037	0.037	1 x	0.045	0.045	1 x	0.066	0.07	1.1 x
Dissolved Cadmium	mg/L	0.00012	0.0000055	0.0000055	1 x	0.0000066	0.0000067	1 x	0.0000074	0.000013	1.8 x
Dissolved Calcium	mg/L	-	9.9	9.9	1 x	12	12	1 x	14	15	1.1 x
Dissolved Chromium	mg/L	0.001	0.00055	0.00055	1 x	0.00066	0.00066	1 x	0.00074	0.00078	1.1 x
Dissolved Cobalt	mg/L	0.05	0.000061	0.000062	1 x	0.000074	0.000078	1.1 x	0.000074	0.0005	6.7 x
Dissolved Copper	mg/L	0.002	0.0016	0.0016	1 x	0.002	0.002	1 x	***0.0024***	***0.0027***	1.1 x
Dissolved Iron	mg/L	0.3	0.22	0.22	1 x	0.25	0.25	1 x	0.17	0.19	1.1 x
Dissolved Lead	mg/L	0.001	0.000074	0.000074	1 x	0.000089	0.000089	1 x	0.00017	0.0002	1.2 x
Dissolved Lithium	mg/L	2.5	0.0044	0.0044	1 x	0.0053	0.0053	1 x	0.006	0.0063	1 x
Dissolved Magnesium	mg/L	-	7.2	7.2	1 x	8.7	8.7	1 x	10	10	1 x
Dissolved Manganese	mg/L	0.2	0.03	0.03	1 x	0.036	0.036	1 x	0.039	0.046	1.2 x
Dissolved Mercury	mg/L	0.000016	0.00000097	0.00000099	1 x	0.0000012	0.0000012	1 x	0.00000085	0.0000018	2.1 x
Dissolved Molybdenum	mg/L	0.01	0.00019	0.00019	1 x	0.00023	0.00024	1 x	0.00033	0.00036	1.1 x
Dissolved Nickel	mg/L	0.025	0.00073	0.00073	1 x	0.00088	0.00089	1 x	0.00098	0.0024	2.5 x
Dissolved Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00026	0.00026	1 x	0.0003	0.00031	1.1 x
Dissolved Silver	mg/L	0.00025	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.0000083	1.1 x
Dissolved Sodium	mg/L	-	37	37	1 x	44	44	1 x	49	48	0.99 x
Dissolved Thallium	mg/L	0.0008	0.0000024	0.0000025	1 x	0.0000029	0.000003	1 x	0.0000041	0.0000056	1.4 x
Dissolved Uranium	mg/L	0.01	0.000041	0.000042	1 x	0.00005	0.000051	1 x	0.000054	0.000059	1.1 x
Dissolved Vanadium	mg/L	0.1	0.00025	0.00025	1 x	0.0003	0.0003	1 x	0.00029	0.00038	1.3 x
Dissolved Zinc	mg/L	0.03	0.0033	0.0033	1 x	0.004	0.004	1 x	0.0045	0.0052	1.2 x
Dissolved Phosphorous	mg/L	Variable	0.027	0.027	1 x	0.033	0.033	1 x	0.032	0.032	0.99 x
Total Aluminum	mg/L	0.1	0.085	0.085	1 x	0.1	0.1	n/a	0.098	***0.11***	1.1 x
Total Antimony	mg/L	-	0.000033	0.000033	1 x	0.00004	0.00004	1 x	0.000046	0.00011	2.4 x
Total Arsenic	mg/L	0.005	0.00034	0.00034	1 x	0.00041	0.0005	1.2 x	0.00059	***0.0064***	11 x
Total Barium	mg/L	-	0.0043	0.0043	1 x	0.0051	0.0051	1 x	0.0051	0.0052	1 x
Total Beryllium	mg/L	0.1	0.0000056	0.0000058	1 x	0.000007	0.0000074	1.1 x	0.0000093	0.000013	1.4 x
Total Boron	mg/L	0.5	0.037	0.037	1 x	0.045	0.045	1 x	0.066	0.07	1.1 x
Total Cadmium	mg/L	0.00012	0.0000055	0.0000055	1 x	0.0000066	0.0000067	1 x	0.0000074	0.000013	1.8 x
Total Calcium	mg/L	-	9.9	9.9	1 x	12	12	1 x	14	15	1.1 x
Total Chromium	mg/L	0.001	0.00055	0.00055	1 x	0.00066	0.00066	1 x	0.00074	0.00078	1.1 x
Total Cobalt	mg/L	0.05	0.000061	0.000062	1 x	0.000074	0.000079	1.1 x	0.000074	0.0005	6.7 x
Total Copper	mg/L	0.002	0.0016	0.0016	1 x	0.002	0.002	1 x	***0.0024***	***0.0027***	1.1 x
Total Iron	mg/L	0.3	0.22	0.22	1 x	0.25	0.26	1 x	0.17	0.19	1.1 x
Total Lead	mg/L	0.001	0.000074	0.000074	1 x	0.000089	0.000089	1 x	0.00017	0.0002	1.2 x
Total Lithium	mg/L	2.5	0.0044	0.0044	1 x	0.0053	0.0053	1 x	0.006	0.0063	1 x
Total Magnesium	mg/L	-	7.2	7.2	1 x	8.7	8.7	1 x	10	10	1 x
Total Manganese	mg/L	0.2	0.03	0.03	1 x	0.036	0.036	1 x	0.039	0.046	1.2 x
Total Mercury	mg/L	0.000016	0.00000097	0.0000011	1.1 x	0.0000012	0.0000014	1.2 x	0.00000085	0.0000018	2.1 x
Total Molybdenum	mg/L	0.01	0.00019	0.00019	1 x	0.00023	0.00024	1 x	0.00033	0.00036	1.1 x
Total Nickel	mg/L	0.025	0.00073	0.00074	1 x	0.00088	0.00089	1 x	0.00098	0.0024	2.5 x
Total Selenium	mg/L	0.001	0.00022	0.00022	1 x	0.00026	0.00026	1 x	0.0003	0.00031	1.1 x
Total Silver	mg/L	0.00025	0.0000055	0.0000055	1 x	0.0000066	0.0000066	1 x	0.0000074	0.0000083	1.1 x
Total Sodium	mg/L	-	37	37	1 x	44	44	1 x	49	48	0.99 x
Total Thallium	mg/L	0.0008	0.0000024	0.0000025	1 x	0.0000029	0.000003	1 x	0.0000041	0.0000056	1.4 x
Total Uranium	mg/L	0.01	0.000041	0.000042	1 x	0.00005	0.000051	1 x	0.000054	0.000059	1.1 x
Total Vanadium	mg/L	0.1	0.00025	0.00025	1 x	0.0003	0.0003	1 x	0.00029	0.00038	1.3 x
Total Zinc	mg/L	0.03	0.0033	0.0033	1 x	0.004	0.004	1 x	0.0045	0.0052	1.2 x
Total Phosphorous	mg/L	Variable	0.027	0.027	1 x	0.033	0.033	1 x	0.032	0.032	0.99 x

[1] ***CCME Exceedance shown in bold italics***

Marine Mixing Box Average and Maximum Concentrations During Operations and Closure											
Parameter	Units	MMER		Operations (2017-2032)				Closure (2033-2035)			
				Average		Maximum		Average		Maximum	
		Current[1]	Proposed[2]	Base Case	Upper Case	Base Case	Upper Case	Base Case	Upper Case	Base Case	Upper Case
TSS	mg/L	15	15	15	15	15	15	12	12	15	15
TDS	mg/L	-	-	8,800	8,800	32,000	32,000	310	330	1,200	1,200
Fluoride	mg/L	-	-	0.29	0.29	0.74	0.75	0.057	0.065	0.093	0.1
Chloride	mg/L	-	-	4800	4800	18000	18000	94	95	490	490
Free Cyanide	mg/L	-	-	0.00072	0.00073	0.0012	0.0012	0.00048	0.00048	0.00077	0.00077
Total Cyanide	mg/L	1	0.5	0.024	0.024	0.23	0.23	0.0011	0.0011	0.0092	0.0092
WAD Cyanide	mg/L	-	-	0.1	0.1	0.3	0.3	0.029	0.029	0.087	0.087
Cyanate	mg/L	-	-	0.95	0.95	5.4	5.4	0.15	0.15	2.1	2.1
Thiocyanate	mg/L	-	-	1.2	1.2	6.2	6.2	0.041	0.041	0.56	0.56
Ammonia	mg/L as N	-	Variable	8.7	8.7	14	14	1.5	1.5	11	11
Nitrate	mg/L as N	-	-	16	16	32	32	1.6	1.6	9.1	9.1
Nitrite	mg/L as N	-	-	0.24	0.24	0.91	0.91	0.2	0.2	0.61	0.61
Sulphate	mg/L	-	-	800	800	2000	2000	77	90	230	240
Alkalinity	mg/L	-	-	100	100	260	260	71	72	130	140
Hardness	mg/L	-	-	2900	2900	11000	11000	200	200	510	510
Dissolved Aluminum	mg/L	-	-	0.11	0.11	0.32	0.32	0.15	0.16	0.35	0.35
Dissolved Antimony	mg/L	-	-	0.0076	0.0076	0.032	0.033	0.005	0.0052	0.013	0.013
Dissolved Arsenic	mg/L	0.5	0.1	0.01	0.01	0.01	0.01	0.0081	0.0081	0.01	0.01
Dissolved Barium	mg/L	-	-	0.047	0.048	0.12	0.13	0.039	0.053	0.057	0.084
Dissolved Beryllium	mg/L	-	-	0.001	0.001	0.0047	0.0048	0.0018	0.0018	0.0054	0.0054
Dissolved Boron	mg/L	-	-	0.85	0.86	2.8	2.8	0.098	0.1	0.18	0.2
Dissolved Cadmium	mg/L	-	-	0.00012	0.00012	0.00037	0.00037	0.000057	0.00006	0.00015	0.00015
Dissolved Calcium	mg/L	-	-	640	640	2000	2000	61	63	200	210
Dissolved Chromium	mg/L	-	-	0.003	0.003	0.014	0.014	0.0017	0.0018	0.0037	0.0038
Dissolved Cobalt	mg/L	-	-	0.02	0.02	0.058	0.058	0.0021	0.0022	0.0043	0.0049
Dissolved Copper	mg/L	0.3	0.1	0.008	0.0082	0.03	0.031	0.0051	0.0069	0.0084	0.01
Dissolved Iron	mg/L	-	-	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.5
Dissolved Lead	mg/L	0.2	0.08	0.00036	0.00037	0.00087	0.00091	0.00026	0.0003	0.00064	0.00068
Dissolved Lithium	mg/L	-	-	0.095	0.096	0.34	0.35	0.0067	0.0082	0.014	0.016
Dissolved Magnesium	mg/L	-	-	380	380	1300	1300	26	27	67	68
Dissolved Manganese	mg/L	-	-	0.58	0.59	1.8	1.9	0.04	0.062	0.08	0.1
Dissolved Mercury	mg/L	-	-	0.000036	0.000036	0.000075	0.000076	0.0000054	0.0000061	0.0000085	0.00001
Dissolved Molybdenum	mg/L	-	-	0.033	0.033	0.15	0.15	0.016	0.017	0.046	0.047
Dissolved Nickel	mg/L	0.5	0.25	0.072	0.073	0.2	0.2	0.0055	0.0075	0.013	0.015
Dissolved Selenium	mg/L	-	-	0.0043	0.0043	0.014	0.014	0.0014	0.0014	0.0034	0.0035
Dissolved Silver	mg/L	-	-	0.00023	0.00024	0.00085	0.00085	0.000099	0.0001	0.00027	0.00028
Dissolved Sodium	mg/L	-	-	2200	2200	8700	8700	47	47	210	210
Dissolved Thallium	mg/L	-	-	0.00011	0.00011	0.00032	0.00032	0.000057	0.000059	0.00014	0.00014
Dissolved Uranium	mg/L	-	-	0.00029	0.0003	0.0011	0.0011	0.00027	0.00031	0.00064	0.00069
Dissolved Vanadium	mg/L	-	-	0.004	0.004	0.012	0.013	0.0029	0.0034	0.0074	0.008
Dissolved Zinc	mg/L	0.5	0.4	0.05	0.051	0.15	0.16	0.0092	0.01	0.022	0.023
Dissolved Phosphorous	mg/L	-	-	0.26	0.26	0.97	0.97	0.018	0.019	0.04	0.041
Total Aluminum	mg/L	-	-	0.35	0.35	0.55	0.55	0.15	0.16	0.36	0.37
Total Antimony	mg/L	-	-	0.0076	0.0076	0.033	0.033	0.005	0.0052	0.013	0.013
Total Arsenic	mg/L	0.5	0.1	0.014	0.014	0.015	0.015	0.0081	0.0081	0.01	0.01
Total Barium	mg/L	-	-	0.047	0.048	0.12	0.13	0.039	0.053	0.057	0.084
Total Beryllium	mg/L	-	-	0.001	0.001	0.0047	0.0048	0.0018	0.0018	0.0054	0.0054
Total Boron	mg/L	-	-	0.85	0.86	2.8	2.8	0.098	0.1	0.18	0.2
Total Cadmium	mg/L	-	-	0.00012	0.00013	0.00037	0.00037	0.000057	0.00006	0.00015	0.00015
Total Calcium	mg/L	-	-	640	650	2000	2000	61	63	200	210
Total Chromium	mg/L	-	-	0.0062	0.0063	0.017	0.017	0.0018	0.002	0.0039	0.0042
Total Cobalt	mg/L	-	-	0.021	0.021	0.059	0.059	0.0021	0.0022	0.0044	0.005
Total Copper	mg/L	0.3	0.1	0.0093	0.0095	0.031	0.032	0.0052	0.007	0.0085	0.01
Total Iron	mg/L	-	-	1.3	1.3	1.4	1.4	0.4	0.4	0.5	0.5
Total Lead	mg/L	0.2	0.08	0.00042	0.00043	0.00092	0.00096	0.00027	0.0003	0.00064	0.00069
Total Lithium	mg/L	-	-	0.095	0.096	0.34	0.35	0.0067	0.0082	0.014	0.016
Total Magnesium	mg/L	-	-	380	380	1300	1300	26	27	67	68
Total Manganese	mg/L	-	-	0.61	0.62	1.8	1.9	0.042	0.065	0.083	0.11
Total Mercury	mg/L	-	-	0.00025	0.00025	0.0003	0.0003	0.000018	0.000025	0.000034	0.00004
Total Molybdenum	mg/L	-	-	0.033	0.033	0.15	0.15	0.016	0.017	0.046	0.047
Total Nickel	mg/L	0.5	0.25	0.077	0.078	0.2	0.2	0.0056	0.0076	0.013	0.015
Total Selenium	mg/L	-	-	0.0043	0.0043	0.014	0.014	0.0014	0.0014	0.0034	0.0035
Total Silver	mg/L	-	-	0.00024	0.00024	0.00085	0.00085	0.000099	0.0001	0.00027	0.00028
Total Sodium	mg/L	-	-	2200	2200	8700	8700	47	47	210	210
Total Thallium	mg/L	-	-	0.00011	0.00011	0.00032	0.00033	0.000057	0.000059	0.00014	0.00014
Total Uranium	mg/L	-	-	0.0003	0.00031	0.0011	0.0011	0.00027	0.00031	0.00064	0.00069
Total Vanadium	mg/L	-	-	0.0052	0.0053	0.013	0.014	0.0029	0.0034	0.0074	0.008
Total Zinc	mg/L	0.5	0.4	0.051	0.051	0.16	0.16	0.0093	0.01	0.022	0.023
Total Phosphorous	mg/L	-	-	0.27	0.27	0.98	0.98	0.018	0.019	0.04	0.041

[1] ***Current MMER Exceedance Shown in bold italics***

[2] Proposed MMER Exceedance shown in grey highlight

Stickleback Lake Average and Maximum Concentrations During Operations and Post-Closure - Base Case

Parameter	Units	Min CCME[1]	Operations						Post-Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	2.5	2.5	1 x	7.2	7.3	1 x	2.9	2.9	1 x	8.2	8.2	1 x
TDS	mg/L	-	27	50	1.8 x	80	150	1.9 x	33	39	1.2 x	92	120	1.3 x
Fluoride	mg/L	0.12	0.038	0.045	1.2 x	0.11	***0.13***	1.1 x	0.046	0.048	1.1 x	***0.13***	***0.13***	1 x
Chloride	mg/L	120	11	30	2.7 x	32	99	3.1 x	13	16	1.2 x	38	61	1.6 x
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.0013	0.0013	1 x	0.0039	0.0039	1 x	0.0016	0.0016	1 x	0.0045	0.0045	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.016	0.021	1.3 x	0.045	0.058	1.3 x	0.018	0.019	1 x	0.048	0.053	1.1 x
Nitrate	mg/L as N	3	0.017	0.017	1 x	0.048	0.049	1 x	0.019	0.019	1 x	0.05	0.05	1 x
Nitrite	mg/L as N	10	0.0013	0.0013	1 x	0.0039	0.0039	1 x	0.0016	0.0016	1 x	0.0045	0.0045	1 x
Sulphate	mg/L	1000	3.9	4	1 x	12	12	1.1 x	4.8	6.2	1.3 x	14	18	1.3 x
Alkalinity	mg/L	-	13	18	1.4 x	38	49	1.3 x	15	25	1.6 x	43	74	1.7 x
Hardness	mg/L	-	17	26	1.5 x	49	74	1.5 x	20	21	1.1 x	56	63	1.1 x
Dissolved Aluminum	mg/L	0.1	0.061	0.061	1 x	***0.18***	***0.18***	1 x	0.077	0.075	1 x	***0.22***	***0.21***	1 x
Dissolved Antimony	mg/L	-	0.000014	0.000015	1.1 x	0.000048	0.000053	1.1 x	0.000021	0.000033	1.6 x	0.000061	0.0001	1.7 x
Dissolved Arsenic	mg/L	0.005	0.00021	0.00025	1.2 x	0.00063	0.00073	1.2 x	0.00026	0.00035	1.3 x	0.00074	0.001	1.4 x
Dissolved Barium	mg/L	-	0.0028	0.0039	1.4 x	0.0084	0.011	1.3 x	0.0034	0.0041	1.2 x	0.0097	0.012	1.2 x
Dissolved Beryllium	mg/L	0.1	0.0000066	0.0000074	1.1 x	0.000019	0.000025	1.3 x	0.0000081	0.000021	2.6 x	0.000023	0.000067	3 x
Dissolved Boron	mg/L	0.5	0.0066	0.0088	1.3 x	0.02	0.025	1.3 x	0.008	0.013	1.6 x	0.023	0.037	1.6 x
Dissolved Cadmium	mg/L	0.00012	0.0000091	0.0000092	1 x	0.000025	0.000026	1 x	0.0000098	0.00001	1.1 x	0.000026	0.000028	1.1 x
Dissolved Calcium	mg/L	-	3.4	6.5	1.9 x	10	19	1.9 x	4.1	7.6	1.8 x	12	22	1.9 x
Dissolved Chromium	mg/L	0.001	0.00031	0.00031	1 x	0.00095	0.00096	1 x	0.0004	0.0004	1 x	***0.0012***	***0.0012***	1 x
Dissolved Cobalt	mg/L	0.05	0.000076	0.0001	1.3 x	0.00021	0.00028	1.3 x	0.000085	0.00011	1.3 x	0.00023	0.0003	1.3 x
Dissolved Copper	mg/L	0.002	0.0012	0.0013	1.1 x	***0.0036***	***0.0041***	1.1 x	0.0015	***0.0025***	1.7 x	***0.0042***	***0.0077***	1.8 x
Dissolved Iron	mg/L	0.3	0.14	0.14	1 x	***0.41***	***0.42***	1 x	0.16	0.16	1 x	***0.45***	***0.43***	0.9 x
Dissolved Lead	mg/L	0.001	0.000044	0.00005	1.1 x	0.00013	0.00014	1.1 x	0.000055	0.000058	1.1 x	0.00016	0.00016	1.1 x
Dissolved Lithium	mg/L	2.5	0.0096	0.0096	1 x	0.028	0.028	1 x	0.011	0.011	0.9 x	0.032	0.029	0.9 x
Dissolved Magnesium	mg/L	-	2.1	2.7	1.3 x	6.2	7.4	1.2 x	2.5	3.1	1.2 x	7.2	8.8	1.2 x
Dissolved Manganese	mg/L	0.2	0.02	0.044	2.2 x	0.058	0.14	2.5 x	0.023	0.028	1.2 x	0.062	0.095	1.5 x
Dissolved Mercury	mg/L	0.000016	0.0000015	0.0000019	1.2 x	0.0000057	0.0000067	1.2 x	0.0000029	0.0000041	1.4 x	0.0000099	0.000014	1.4 x
Dissolved Molybdenum	mg/L	0.01	0.000063	0.000067	1.1 x	0.00018	0.00021	1.2 x	0.000076	0.00014	1.8 x	0.00021	0.00042	1.9 x
Dissolved Nickel	mg/L	0.025	0.00055	0.00056	1 x	0.0016	0.0017	1 x	0.00066	0.00076	1.1 x	0.0019	0.0022	1.2 x
Dissolved Selenium	mg/L	0.001	0.00026	0.00033	1.3 x	0.00077	0.00092	1.2 x	0.00032	0.00032	1 x	0.0009	0.00089	1 x
Dissolved Silver	mg/L	0.00025	0.0000032	0.0000033	1 x	0.000009	0.0000096	1.1 x	0.0000035	0.0000046	1.3 x	0.0000095	0.000013	1.4 x
Dissolved Sodium	mg/L	-	6.3	6.9	1.1 x	18	20	1.1 x	7.6	7.7	1 x	21	21	1 x
Dissolved Thallium	mg/L	0.0008	0.0000057	0.0000058	1 x	0.000017	0.000018	1 x	0.0000072	0.000008	1.1 x	0.000021	0.000023	1.1 x
Dissolved Uranium	mg/L	0.01	0.000027	0.000029	1.1 x	0.000081	0.000091	1.1 x	0.000034	0.000054	1.6 x	0.000095	0.00016	1.7 x
Dissolved Vanadium	mg/L	0.1	0.00024	0.00025	1 x	0.00069	0.00075	1.1 x	0.00028	0.00039	1.4 x	0.00077	0.0012	1.5 x
Dissolved Zinc	mg/L	0.03	0.0029	0.0033	1.1 x	0.0083	0.009	1.1 x	0.0033	0.0034	1 x	0.0089	0.0092	1 x
Dissolved Phosphorous	mg/L	Variable	0.016	0.016	1 x	0.046	0.047	1 x	0.019	0.019	1 x	0.052	0.052	1 x
Total Aluminum	mg/L	0.1	0.061	0.061	1 x	***0.18***	***0.18***	1 x	0.077	0.075	1 x	***0.22***	***0.21***	1 x
Total Antimony	mg/L	-	0.000014	0.000015	1.1 x	0.000048	0.000053	1.1 x	0.000021	0.000033	1.6 x	0.000061	0.0001	1.7 x
Total Arsenic	mg/L	0.005	0.00021	0.00025	1.2 x	0.00063	0.00073	1.2 x	0.00026	0.00035	1.3 x	0.00074	0.001	1.4 x
Total Barium	mg/L	-	0.0028	0.0039	1.4 x	0.0084	0.011	1.3 x	0.0034	0.0041	1.2 x	0.0097	0.012	1.2 x
Total Beryllium	mg/L	0.1	0.0000066	0.0000074	1.1 x	0.000019	0.000025	1.3 x	0.0000081	0.000021	2.6 x	0.000023	0.000067	3 x
Total Boron	mg/L	0.5	0.0066	0.0088	1.3 x	0.02	0.025	1.3 x	0.008	0.013	1.6 x	0.023	0.037	1.6 x
Total Cadmium	mg/L	0.00012	0.0000091	0.0000092	1 x	0.000025	0.000026	1 x	0.0000098	0.00001	1.1 x	0.000026	0.000028	1.1 x
Total Calcium	mg/L	-	3.4	6.5	1.9 x	10	19	1.9 x	4.1	7.6	1.8 x	12	22	1.9 x
Total Chromium	mg/L	0.001	0.00031	0.00031	1 x	0.00095	0.00096	1 x	0.0004	0.0004	1 x	***0.0012***	***0.0012***	1 x
Total Cobalt	mg/L	0.05	0.000076	0.0001	1.3 x	0.00021	0.00028	1.3 x	0.000085	0.00011	1.3 x	0.00023	0.0003	1.3 x
Total Copper	mg/L	0.002	0.0012	0.0013	1.1 x	***0.0036***	***0.0041***	1.1 x	0.0015	***0.0025***	1.7 x	***0.0042***	***0.0077***	1.8 x
Total Iron	mg/L	0.3	0.14	0.14	1 x	***0.41***	***0.42***	1 x	0.16	0.16	1 x	***0.45***	***0.43***	0.9 x
Total Lead	mg/L	0.001	0.000044	0.00005	1.1 x	0.00013	0.00014	1.1 x	0.000055	0.000058	1.1 x	0.00016	0.00016	1.1 x
Total Lithium	mg/L	2.5	0.0096	0.0096	1 x	0.028	0.028	1 x	0.011	0.011	0.9 x	0.032	0.029	0.9 x
Total Magnesium	mg/L	-	2.1	2.7	1.3 x	6.2	7.4	1.2 x	2.5	3.1	1.2 x	7.2	8.8	1.2 x
Total Manganese	mg/L	0.2	0.02	0.044	2.2 x	0.058	0.14	2.5 x	0.023	0.028	1.2 x	0.062	0.095	1.5 x
Total Mercury	mg/L	0.000016	0.0000015	0.0000019	1.2 x	0.0000057	0.0000067	1.2 x	0.0000029	0.0000041	1.4 x	0.0000099	0.000014	1.4 x
Total Molybdenum	mg/L	0.01	0.000063	0.000067	1.1 x	0.00018	0.00021	1.2 x	0.000076	0.00014	1.8 x	0.00021	0.00042	1.9 x
Total Nickel	mg/L	0.025	0.00055	0.00056	1 x	0.0016	0.0017	1 x	0.00066	0.00076	1.1 x	0.0019	0.0022	1.2 x
Total Selenium	mg/L	0.001	0.00026	0.00033	1.3 x	0.00077	0.00092	1.2 x	0.00032	0.00032	1 x	0.0009	0.00089	1 x
Total Silver	mg/L	0.00025	0.0000032	0.0000033	1 x	0.000009	0.0000096	1.1 x	0.0000035	0.0000046	1.3 x	0.0000095	0.000013	1.4 x
Total Sodium	mg/L	-	6.3	6.9	1.1 x	18	20	1.1 x	7.6	7.7	1 x	21	21	1 x
Total Thallium	mg/L	0.0008	0.0000057	0.0000058	1 x	0.000017	0.000018	1 x	0.0000072	0.000008	1.1 x	0.000021	0.000023	1.1 x
Total Uranium	mg/L	0.01	0.000027	0.000029	1.1 x	0.000081	0.000091	1.1 x	0.000034	0.000054	1.6 x	0.000095	0.00016	1.7 x
Total Vanadium	mg/L	0.1	0.00024	0.00025	1 x	0.00069	0.00075	1.1 x	0.00028	0.00039	1.4 x	0.00077	0.0012	1.5 x
Total Zinc	mg/L	0.03	0.0029	0.0033	1.1 x	0.0083	0.009	1.1 x	0.0033	0.0034	1 x	0.0089	0.0092	1 x
Total Phosphorous	mg/L	Variable	0.016	0.016	1 x	0.046	0.047	1 x	0.019	0.019	1 x	0.052	0.052	1 x

[1] CCME Exceedance shown in bold italics

Stickleback Lake Average and Maximum Concentrations During Operations and Post-Closure - Upper Case														
Parameter	Units	Min CCME[1]	Operations						Post -Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	2.9	2.9	n/a	9.2	9.3	1 x	4.1	4.1	n/a	13	13	n/a
TDS	mg/L	-	29	51	1.8 x	87	150	1.7 x	36	45	1.3 x	100	120	1.2 x
Fluoride	mg/L	0.12	0.077	0.078	1 x	***0.22***	***0.22***	n/a	0.085	0.086	1 x	***0.23***	***0.23***	n/a
Chloride	mg/L	120	12	30	2.5 x	36	99	2.8 x	15	17	1.1 x	42	63	1.5 x
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.0013	0.0013	n/a	0.0039	0.0039	n/a	0.0016	0.0016	n/a	0.0045	0.0045	n/a
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.02	0.023	1.2 x	0.058	0.062	1.1 x	0.023	0.023	n/a	0.061	0.062	1 x
Nitrate	mg/L as N	3	0.025	0.026	1 x	0.07	0.071	1 x	0.027	0.027	n/a	0.073	0.073	n/a
Nitrite	mg/L as N	10	0.0046	0.0046	n/a	0.012	0.013	1.1 x	0.0048	0.0048	n/a	0.013	0.013	n/a
Sulphate	mg/L	1000	4.2	4.4	1 x	13	14	1.1 x	5.4	8.7	1.6 x	16	27	1.7 x
Alkalinity	mg/L	-	13	18	1.4 x	39	51	1.3 x	16	27	1.7 x	45	81	1.8 x
Hardness	mg/L	-	17	26	1.5 x	51	75	1.5 x	21	22	1 x	59	65	1.1 x
Dissolved Aluminum	mg/L	0.1	0.099	0.1	1 x	***0.29***	***0.29***	n/a	***0.12***	***0.11***	0.9 x	***0.32***	***0.32***	n/a
Dissolved Antimony	mg/L	-	0.000065	0.000066	1 x	0.00018	0.00019	1.1 x	0.000072	0.000084	1.2 x	0.00019	0.00023	1.2 x
Dissolved Arsenic	mg/L	0.005	0.00022	0.00027	1.2 x	0.00066	0.00082	1.2 x	0.00027	0.00053	2 x	0.00077	0.0016	2.1 x
Dissolved Barium	mg/L	-	0.0038	0.0043	1.1 x	0.011	0.012	1.1 x	0.0045	0.0052	1.2 x	0.012	0.015	1.3 x
Dissolved Beryllium	mg/L	0.1	0.00012	0.00012	n/a	0.00033	0.00033	n/a	0.00013	0.00013	n/a	0.00034	0.00035	1 x
Dissolved Boron	mg/L	0.5	0.01	0.011	1.1 x	0.03	0.033	1.1 x	0.012	0.018	1.5 x	0.034	0.052	1.5 x
Dissolved Cadmium	mg/L	0.00012	0.000011	0.000011	n/a	0.000032	0.000033	1 x	0.000013	0.000014	1.1 x	0.000034	0.000039	1.1 x
Dissolved Calcium	mg/L	-	3.7	6.6	1.8 x	11	19	1.7 x	4.4	8.9	2 x	12	26	2.2 x
Dissolved Chromium	mg/L	0.001	0.00057	0.00057	n/a	***0.0017***	***0.0017***	n/a	0.00069	0.00068	1 x	***0.0019***	***0.0019***	n/a
Dissolved Cobalt	mg/L	0.05	0.00016	0.00016	n/a	0.00044	0.00046	1 x	0.00017	0.00019	1.1 x	0.00047	0.00053	1.1 x
Dissolved Copper	mg/L	0.002	0.0014	0.0015	1.1 x	***0.0041***	***0.0049***	1.2 x	0.0017	***0.0034***	2 x	***0.0046***	***0.011***	2.4 x
Dissolved Iron	mg/L	0.3	0.23	0.23	n/a	***0.64***	***0.65***	1 x	0.25	0.25	n/a	***0.68***	***0.67***	1 x
Dissolved Lead	mg/L	0.001	0.000072	0.000073	1 x	0.00021	0.00022	1 x	0.000083	0.000094	1.1 x	0.00023	0.00027	1.2 x
Dissolved Lithium	mg/L	2.5	0.011	0.011	n/a	0.034	0.034	n/a	0.014	0.013	0.9 x	0.04	0.037	0.9 x
Dissolved Magnesium	mg/L	-	2.2	2.7	1.2 x	6.4	7.6	1.2 x	2.7	3.4	1.3 x	7.5	9.8	1.3 x
Dissolved Manganese	mg/L	0.2	0.022	0.045	2 x	0.062	0.14	2.3 x	0.024	0.035	1.5 x	0.066	0.1	1.5 x
Dissolved Mercury	mg/L	0.000016	0.0000077	0.0000078	1 x	***0.000024***	***0.000024***	n/a	0.00001	0.000011	1.1 x	***0.000031***	***0.000032***	1 x
Dissolved Molybdenum	mg/L	0.01	0.000063	0.000072	1.1 x	0.00019	0.00025	1.3 x	0.000077	0.00021	2.7 x	0.00022	0.00066	3 x
Dissolved Nickel	mg/L	0.025	0.00061	0.00063	1 x	0.0018	0.0019	1.1 x	0.00073	0.001	1.4 x	0.0021	0.003	1.4 x
Dissolved Selenium	mg/L	0.001	0.00029	0.00035	1.2 x	0.00085	0.00096	1.1 x	0.00035	0.00037	1.1 x	0.001	0.001	n/a
Dissolved Silver	mg/L	0.00025	0.0000077	0.0000078	1 x	0.000022	0.000023	1 x	0.0000088	0.0000094	1.1 x	0.000024	0.000026	1.1 x
Dissolved Sodium	mg/L	-	6.5	7.1	1.1 x	19	20	1.1 x	7.9	8	1 x	22	22	n/a
Dissolved Thallium	mg/L	0.0008	0.0000092	0.0000092	n/a	0.000029	0.000029	n/a	0.000012	0.000013	1.1 x	0.000035	0.000036	1 x
Dissolved Uranium	mg/L	0.01	0.000028	0.000031	1.1 x	0.000084	0.0001	1.2 x	0.000035	0.000077	2.2 x	0.000099	0.00024	2.4 x
Dissolved Vanadium	mg/L	0.1	0.00032	0.00033	1 x	0.00095	0.001	1.1 x	0.00039	0.00051	1.3 x	0.0011	0.0015	1.4 x
Dissolved Zinc	mg/L	0.03	0.0065	0.0065	n/a	0.018	0.019	1.1 x	0.0071	0.0072	1 x	0.019	0.019	n/a
Dissolved Phosphorous	mg/L	Variable	0.017	0.017	n/a	0.051	0.052	1 x	0.021	0.021	n/a	0.06	0.06	n/a
Total Aluminum	mg/L	0.1	0.099	0.1	1 x	***0.29***	***0.29***	n/a	***0.12***	***0.11***	0.9 x	***0.32***	***0.32***	n/a
Total Antimony	mg/L	-	0.000065	0.000066	1 x	0.00018	0.00019	1.1 x	0.000072	0.000084	1.2 x	0.00019	0.00023	1.2 x
Total Arsenic	mg/L	0.005	0.00022	0.00027	1.2 x	0.00066	0.00082	1.2 x	0.00027	0.00053	2 x	0.00077	0.0016	2.1 x
Total Barium	mg/L	-	0.0038	0.0043	1.1 x	0.011	0.012	1.1 x	0.0045	0.0052	1.2 x	0.012	0.015	1.3 x
Total Beryllium	mg/L	0.1	0.00012	0.00012	n/a	0.00033	0.00033	n/a	0.00013	0.00013	n/a	0.00034	0.00035	1 x
Total Boron	mg/L	0.5	0.01	0.011	1.1 x	0.03	0.033	1.1 x	0.012	0.018	1.5 x	0.034	0.052	1.5 x
Total Cadmium	mg/L	0.00012	0.000011	0.000011	n/a	0.000032	0.000033	1 x	0.000013	0.000014	1.1 x	0.000034	0.000039	1.1 x
Total Calcium	mg/L	-	3.7	6.6	1.8 x	11	19	1.7 x	4.4	8.9	2 x	12	26	2.2 x
Total Chromium	mg/L	0.001	0.00057	0.00057	n/a	***0.0017***	***0.0017***	n/a	0.00069	0.00068	1 x	***0.0019***	***0.0019***	n/a
Total Cobalt	mg/L	0.05	0.00016	0.00016	n/a	0.00044	0.00046	1 x	0.00017	0.00019	1.1 x	0.00047	0.00053	1.1 x
Total Copper	mg/L	0.002	0.0014	0.0015	1.1 x	***0.0041***	***0.0049***	1.2 x	0.0017	***0.0034***	2 x	***0.0046***	***0.011***	2.4 x
Total Iron	mg/L	0.3	0.23	0.23	n/a	***0.64***	***0.65***	1 x	0.25	0.25	n/a	***0.68***	***0.67***	1 x
Total Lead	mg/L	0.001	0.000072	0.000073	1 x	0.00021	0.00022	1 x	0.000083	0.000094	1.1 x	0.00023	0.00027	1.2 x
Total Lithium	mg/L	2.5	0.011	0.011	n/a	0.034	0.034	n/a	0.014	0.013	0.9 x	0.04	0.037	0.9 x
Total Magnesium	mg/L	-	2.2	2.7	1.2 x	6.4	7.6	1.2 x	2.7	3.4	1.3 x	7.5	9.8	1.3 x
Total Manganese	mg/L	0.2	0.022	0.045	2 x	0.062	0.14	2.3 x	0.024	0.035	1.5 x	0.066	0.1	1.5 x
Total Mercury	mg/L	0.000016	0.0000077	0.0000078	1 x	***0.000024***	***0.000024***	n/a	0.00001	0.000011	1.1 x	***0.000031***	***0.000032***	1 x
Total Molybdenum	mg/L	0.01	0.000063	0.000072	1.1 x	0.00019	0.00025	1.3 x	0.000077	0.00021	2.7 x	0.00022	0.00066	3 x
Total Nickel	mg/L	0.025	0.00061	0.00063	1 x	0.0018	0.0019	1.1 x	0.00073	0.001	1.4 x	0.0021	0.003	1.4 x
Total Selenium	mg/L	0.001	0.00029	0.00035	1.2 x	0.00085	0.00096	1.1 x	0.00035	0.00037	1.1 x	0.001	0.001	n/a
Total Silver	mg/L	0.00025	0.0000077	0.0000078	1 x	0.000022	0.000023	1 x	0.0000088	0.0000094	1.1 x	0.000024	0.000026	1.1 x
Total Sodium	mg/L	-	6.5	7.1	1.1 x	19	20	1.1 x	7.9	8	1 x	22	22	n/a
Total Thallium	mg/L	0.0008	0.0000092	0.0000092	n/a	0.000029	0.000029	n/a	0.000012	0.000013	1.1 x	0.000035	0.000036	1 x
Total Uranium	mg/L	0.01	0.000028	0.000031	1.1 x	0.000084	0.0001	1.2 x	0.000035	0.000077	2.2 x	0.000099	0.00024	2.4 x
Total Vanadium	mg/L	0.1	0.00032	0.00033	1 x	0.00095	0.001	1.1 x	0.00039	0.00051	1.3 x	0.0011	0.0015	1.4 x
Total Zinc	mg/L	0.03	0.0065	0.0065	n/a	0.018	0.019	1.1 x	0.0071	0.0072	1 x	0.019	0.019	n/a
Total Phosphorous	mg/L	Variable	0.017	0.017	n/a	0.051	0.052	1 x	0.021	0.021	n/a	0.06	0.06	n/a

[1] ***CCME Exceedance shown in bold italics***

Boston TMA Average and Maximum Concentrations During Post-Closure							
Parameter	Units	MMER		Post-Closure			
				Average		Maximum	
		Current[1]	Proposed[2]	Base Case	Upper Case	Base Case	Upper Case
TSS	mg/L	15	15	1.8	2.8	2	6
TDS	mg/L	-	-	78	120	110	160
Fluoride	mg/L	-	-	0.046	0.059	0.051	0.064
Chloride	mg/L	-	-	8.1	8.4	8.4	9.7
Free Cyanide	mg/L	-	-	-	-	-	-
Total Cyanide	mg/L	1	0.5	0.00099	0.00099	0.001	0.001
WAD Cyanide	mg/L	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-
Ammonia	mg/L as N	-	Variable	0.0068	0.011	0.013	0.017
Nitrate	mg/L as N	-	-	0.0059	0.01	0.015	0.022
Nitrite	mg/L as N	-	-	0.00099	0.0018	0.001	0.004
Sulphate	mg/L	-	-	45	74	77	120
Alkalinity	mg/L	-	-	75	86	75	86
Hardness	mg/L	-	-	21	23	31	32
Dissolved Aluminum	mg/L	-	-	0.038	0.06	0.038	0.061
Dissolved Antimony	mg/L	-	-	0.0047	0.0051	0.0095	0.0095
Dissolved Arsenic	mg/L	0.5	0.1	0.04	0.044	0.08	0.081
Dissolved Barium	mg/L	-	-	0.0089	0.011	0.012	0.014
Dissolved Beryllium	mg/L	-	-	0.00074	0.00078	0.0014	0.0014
Dissolved Boron	mg/L	-	-	0.65	0.91	1.3	1.7
Dissolved Cadmium	mg/L	-	-	0.00017	0.00019	0.00034	0.00035
Dissolved Calcium	mg/L	-	-	27	35	29	36
Dissolved Chromium	mg/L	-	-	0.00042	0.00059	0.00063	0.00079
Dissolved Cobalt	mg/L	-	-	0.0019	0.0021	0.0037	0.0038
Dissolved Copper	mg/L	0.3	0.1	0.0085	0.014	0.0086	0.014
Dissolved Iron	mg/L	-	-	0.053	0.14	0.055	0.14
Dissolved Lead	mg/L	0.2	0.08	0.000081	0.00016	0.00011	0.00019
Dissolved Lithium	mg/L	-	-	0.0058	0.0073	0.01	0.011
Dissolved Magnesium	mg/L	-	-	6.1	7.5	7.1	8.4
Dissolved Manganese	mg/L	-	-	0.035	0.071	0.041	0.076
Dissolved Mercury	mg/L	-	-	0.00001	0.00001	0.000011	0.000011
Dissolved Molybdenum	mg/L	-	-	0.00078	0.0013	0.0011	0.0016
Dissolved Nickel	mg/L	0.5	0.25	0.0042	0.0057	0.0073	0.0086
Dissolved Selenium	mg/L	-	-	0.0003	0.00045	0.00045	0.00059
Dissolved Silver	mg/L	-	-	0.000014	0.000014	0.000018	0.000018
Dissolved Sodium	mg/L	-	-	4.6	4.7	4.9	5
Dissolved Thallium	mg/L	-	-	0.00002	0.000021	0.000031	0.000031
Dissolved Uranium	mg/L	-	-	0.00019	0.00035	0.0002	0.00036
Dissolved Vanadium	mg/L	-	-	0.0013	0.0014	0.0016	0.0017
Dissolved Zinc	mg/L	0.5	0.4	0.0041	0.0067	0.0057	0.0081
Dissolved Phosphorous	mg/L	-	-	0.011	0.013	0.012	0.013
Total Aluminum	mg/L	-	-	0.038	0.061	0.039	0.062
Total Antimony	mg/L	-	-	0.0047	0.0051	0.0095	0.0095
Total Arsenic	mg/L	0.5	0.1	0.04	0.044	0.08	0.081
Total Barium	mg/L	-	-	0.0089	0.011	0.012	0.014
Total Beryllium	mg/L	-	-	0.00074	0.00078	0.0014	0.0014
Total Boron	mg/L	-	-	0.65	0.91	1.3	1.7
Total Cadmium	mg/L	-	-	0.00017	0.00019	0.00034	0.00035
Total Calcium	mg/L	-	-	27	35	29	36
Total Chromium	mg/L	-	-	0.00042	0.0006	0.00064	0.0008
Total Cobalt	mg/L	-	-	0.0019	0.0021	0.0037	0.0038
Total Copper	mg/L	0.3	0.1	0.0085	0.014	0.0086	0.014
Total Iron	mg/L	-	-	0.053	0.14	0.056	0.15
Total Lead	mg/L	0.2	0.08	0.000081	0.00016	0.00011	0.00019
Total Lithium	mg/L	-	-	0.0058	0.0073	0.01	0.011
Total Magnesium	mg/L	-	-	6.1	7.5	7.1	8.4
Total Manganese	mg/L	-	-	0.035	0.071	0.041	0.076
Total Mercury	mg/L	-	-	0.000011	0.000011	0.000011	0.000011
Total Molybdenum	mg/L	-	-	0.00078	0.0013	0.0011	0.0016
Total Nickel	mg/L	0.5	0.25	0.0042	0.0057	0.0073	0.0086
Total Selenium	mg/L	-	-	0.0003	0.00045	0.00045	0.00059
Total Silver	mg/L	-	-	0.000014	0.000014	0.000018	0.000018
Total Sodium	mg/L	-	-	4.6	4.7	4.9	5
Total Thallium	mg/L	-	-	0.00002	0.000021	0.000031	0.000031
Total Uranium	mg/L	-	-	0.00019	0.00035	0.0002	0.00036
Total Vanadium	mg/L	-	-	0.0013	0.0014	0.0016	0.0017
Total Zinc	mg/L	0.5	0.4	0.0041	0.0067	0.0057	0.0081
Total Phosphorous	mg/L	-	-	0.011	0.013	0.012	0.013

[1] ***Current MMER Exceedance Shown in bold italics***

[2] Proposed MMER Exceedance shown in grey highlight

Boston Combined Average and Maximum Concentrations During Operations and Post-Closure - Base Case											
Parameter	Units	MMER		Operations							
				Combined Effluent		Sewage Treatment Plant Effluent		Contact Water Treatment Plant Effluent		Process Plant Treatment Plant Effluent	
		Current[1]	Proposed[2]	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
TSS	mg/L	15	15	8.5	14	1.7	2	2	11	11	15
TDS	mg/L	-	-	530	1800	11	21	73	900	760	2200
Fluoride	mg/L	-	-	0.053	0.28	0.014	0.03	0.026	0.28	0.053	0.15
Chloride	mg/L	-	-	180	670	4.4	8.5	6.7	210	280	820
Free Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	1	0.5	0.069	0.25	0.00053	0.001	0.000067	0.00067	0.11	0.31
WAD Cyanide	mg/L	-	-	0.069	0.25	-	-	-	-	0.11	0.31
Cyanate	mg/L	-	-	5.6	20	-	-	-	-	8.9	25
Thiocyanate	mg/L	-	-	3.7	13	-	-	-	-	5.9	17
Ammonia	mg/L as N	-	Variable	3.4	13	5.3	10	0.22	7.3	3.5	10
Nitrate	mg/L as N	-	-	0.66	15	0.5	1.0	0.53	18	0.35	1.0
Nitrite	mg/L as N	-	-	9.7	30	16	30	0.00087	0.027	11	30
Sulphate	mg/L	-	-	79	310	1.6	3.0	22	270	100	670
Alkalinity	mg/L	-	-	85	280	5	9.9	8.7	88	120	350
Hardness	mg/L	-	-	530	1600	6.5	13	110	1100	720	2000
Dissolved Aluminum	mg/L	-	-	0.033	0.095	0.03	0.064	0.0074	0.073	0.035	0.1
Dissolved Antimony	mg/L	-	-	0.011	0.037	0.0000061	0.000073	0.0022	0.027	0.015	0.043
Dissolved Arsenic	mg/L	0.5	0.1	0.0028	0.0091	0.000088	0.00017	0.00074	0.0073	0.0035	0.01
Dissolved Barium	mg/L	-	-	0.011	0.11	0.0011	0.0022	0.0098	0.11	0.0071	0.02
Dissolved Beryllium	mg/L	-	-	0.0046	0.016	0.0000026	0.0000055	0.00029	0.0038	0.0071	0.02
Dissolved Boron	mg/L	-	-	0.23	3.6	0.0027	0.0053	0.29	3.6	0.063	0.18
Dissolved Cadmium	mg/L	-	-	0.000028	0.000091	0.0000017	0.0000079	0.0000074	0.000073	0.000035	0.0001
Dissolved Calcium	mg/L	-	-	160	500	1.3	2.7	38	380	220	620
Dissolved Chromium	mg/L	-	-	0.0031	0.01	0.0013	0.0025	0.00077	0.0088	0.0037	0.011
Dissolved Cobalt	mg/L	-	-	0.0029	0.015	0.00002	0.000062	0.0012	0.015	0.0034	0.0096
Dissolved Copper	mg/L	0.3	0.1	0.00048	0.0018	0.0011	0.002	0.000074	0.00073	0.00035	0.001
Dissolved Iron	mg/L	-	-	0.14	0.45	0.013	0.025	0.037	0.37	0.18	0.5
Dissolved Lead	mg/L	0.2	0.08	0.00052	0.0017	0.000027	0.00005	0.00011	0.0013	0.00071	0.002
Dissolved Lithium	mg/L	-	-	0.0084	0.076	0.0031	0.0075	0.0075	0.083	0.0046	0.013
Dissolved Magnesium	mg/L	-	-	30	99	0.82	1.6	4.4	47	43	120
Dissolved Manganese	mg/L	-	-	0.036	0.29	0.0049	0.017	0.027	0.31	0.026	0.075
Dissolved Mercury	mg/L	-	-	0.0000045	0.000028	0.0000029	0.000008	0.0000027	0.000029	0.0000032	0.000009
Dissolved Molybdenum	mg/L	-	-	0.0027	0.009	0.000027	0.00005	0.00074	0.0073	0.0035	0.01
Dissolved Nickel	mg/L	0.5	0.25	0.0014	0.0046	0.00027	0.0005	0.00037	0.0037	0.0018	0.005
Dissolved Selenium	mg/L	-	-	0.00057	0.0018	0.00011	0.00022	0.00015	0.0015	0.00071	0.002
Dissolved Silver	mg/L	-	-	0.00022	0.00075	0.00000078	0.0000028	0.000016	0.00018	0.00033	0.00094
Dissolved Sodium	mg/L	-	-	55	200	2.5	4.9	0.31	3.2	86	240
Dissolved Thallium	mg/L	-	-	0.00012	0.00047	0.0000026	0.0000057	0.000038	0.00044	0.00015	0.00043
Dissolved Uranium	mg/L	-	-	0.00052	0.0017	0.00011	0.0002	0.000082	0.00089	0.00071	0.002
Dissolved Vanadium	mg/L	-	-	0.0061	0.02	0.000083	0.0002	0.0012	0.014	0.0085	0.024
Dissolved Zinc	mg/L	0.5	0.4	0.0057	0.018	0.0011	0.002	0.0015	0.015	0.0071	0.02
Dissolved Phosphorous	mg/L	-	-	0.1	0.76	0.5	1.0	0.00075	0.008		
Total Aluminum	mg/L	-	-	0.078	0.24	0.03	0.064	0.02	0.19	0.094	0.27
Total Antimony	mg/L	-	-	0.011	0.037	0.0000061	0.000073	0.0022	0.027	0.015	0.043
Total Arsenic	mg/L	0.5	0.1	0.0041	0.013	0.000088	0.00017	0.0011	0.011	0.0052	0.015
Total Barium	mg/L	-	-	0.011	0.11	0.0011	0.0022	0.0098	0.11	0.0072	0.02
Total Beryllium	mg/L	-	-	0.0046	0.016	0.0000026	0.0000055	0.00029	0.0038	0.0071	0.02
Total Boron	mg/L	-	-	0.23	3.6	0.0027	0.0053	0.29	3.6	0.063	0.18
Total Cadmium	mg/L	-	-	0.000028	0.000092	0.0000017	0.0000079	0.0000075	0.000074	0.000036	0.0001
Total Calcium	mg/L	-	-	160	500	1.3	2.7	38	380	220	620
Total Chromium	mg/L	-	-	0.0041	0.014	0.0013	0.0025	0.00099	0.011	0.005	0.014
Total Cobalt	mg/L	-	-	0.0031	0.016	0.00002	0.000062	0.0012	0.015	0.0036	0.01
Total Copper	mg/L	0.3	0.1	0.00061	0.0019	0.0011	0.002	0.00011	0.0011	0.00052	0.0015
Total Iron	mg/L	-	-	0.39	1.3	0.013	0.025	0.1	1	0.5	1.4
Total Lead	mg/L	0.2	0.08	0.00054	0.0018	0.000027	0.00005	0.00012	0.0014	0.00072	0.0021
Total Lithium	mg/L	-	-	0.0084	0.076	0.0031	0.0075	0.0075	0.083	0.0046	0.013
Total Magnesium	mg/L	-	-	30	100	0.82	1.6	4.4	47	43	120
Total Manganese	mg/L	-	-	0.045	0.31	0.0049	0.017	0.029	0.33	0.039	0.11
Total Mercury	mg/L	-	-	0.000059	0.0002	0.0000029	0.000008	0.000015	0.00015	0.000076	0.00021
Total Molybdenum	mg/L	-	-	0.0027	0.0091	0.000027	0.00005	0.00074	0.0073	0.0035	0.01
Total Nickel	mg/L	0.5	0.25	0.0026	0.0085	0.00027	0.0005	0.00069	0.0069	0.0033	0.0094
Total Selenium	mg/L	-	-	0.00057	0.0018	0.00011	0.00022	0.00015	0.0015	0.00071	0.002
Total Silver	mg/L	-	-	0.00022	0.00075	0.00000078	0.0000028	0.000016	0.00018	0.00033	0.00094
Total Sodium	mg/L	-	-	55	200	2.5	4.9	0.31	3.2	86	240
Total Thallium	mg/L	-	-	0.00012	0.00047	0.0000026	0.0000057	0.000038	0.00044	0.00015	0.00043
Total Uranium	mg/L	-	-	0.00052	0.0017	0.00011	0.0002	0.000082	0.00089	0.00071	0.002
Total Vanadium	mg/L	-	-	0.0064	0.021	0.000083	0.0002	0.0013	0.014	0.0089	0.025
Total Zinc	mg/L	0.5	0.4	0.0058	0.019	0.0011	0.002	0.0015	0.015	0.0073	0.021
Total Phosphorous	mg/L	-	-	0.11	0.76	0.5	1.0	0.0013	0.013	0.0033	0.0094

[1] ***Current MMER Exceedance Shown in bold italics***

[2] Proposed MMER Exceedance shown in grey highlight

Boston Combined Average and Maximum Concentrations During Operations and Post-Closure - Upper Case

Parameter	Units	MMER		Operations							
				Combined Effluent		Sewage Treatment Plant Effluent		Contact Water Treatment Plant Effluent		Process Plant Treatment Plant Effluent	
		Current[1]	Proposed[2]	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
TSS	mg/L	15	15	9.1	14	4.6	6	2	11	11	15
TDS	mg/L	-	-	540	1800	22	23	86	1100	760	2200
Fluoride	mg/L	-	-	0.055	0.3	0.036	0.065	0.028	0.3	0.053	0.15
Chloride	mg/L	-	-	180	670	8.6	9.8	6.7	210	280	820
Free Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	1	0.5	0.069	0.25	0.001	0.001	0.000067	0.00067	0.11	0.31
WAD Cyanide	mg/L	-	-	0.069	0.25	-	-	-	-	0.11	0.31
Cyanate	mg/L	-	-	5.6	20	-	-	-	-	8.9	25
Thiocyanate	mg/L	-	-	3.7	13	-	-	-	-	5.9	17
Ammonia	mg/L as N	-	Variable	3.4	13	10	10	0.22	7.3	3.5	10
Nitrate	mg/L as N	-	-	0.66	15	1.0	1.0	0.53	18	0.35	1.0
Nitrite	mg/L as N	-	-	9.7	30	30	30	0.00094	0.029	11	30
Sulphate	mg/L	-	-	88	450	4.4	5.0	35	460	100	670
Alkalinity	mg/L	-	-	85	280	9.9	10	9.5	96	120	350
Hardness	mg/L	-	-	530	1600	13	13	110	1100	720	2000
Dissolved Aluminum	mg/L	-	-	0.034	0.098	0.067	0.081	0.0074	0.073	0.035	0.1
Dissolved Antimony	mg/L	-	-	0.011	0.037	0.000021	0.000087	0.0023	0.027	0.015	0.043
Dissolved Arsenic	mg/L	0.5	0.1	0.0028	0.0091	0.00018	0.00018	0.00074	0.0073	0.0035	0.01
Dissolved Barium	mg/L	-	-	0.013	0.13	0.0023	0.0031	0.012	0.13	0.0071	0.02
Dissolved Beryllium	mg/L	-	-	0.0046	0.016	0.00003	0.0001	0.00029	0.0038	0.0071	0.02
Dissolved Boron	mg/L	-	-	0.3	4.8	0.0065	0.0083	0.38	4.8	0.063	0.18
Dissolved Cadmium	mg/L	-	-	0.000028	0.000091	0.0000045	0.000009	0.0000074	0.000073	0.000035	0.0001
Dissolved Calcium	mg/L	-	-	160	500	2.5	2.9	38	380	220	620
Dissolved Chromium	mg/L	-	-	0.0031	0.011	0.0025	0.0025	0.00078	0.0089	0.0037	0.011
Dissolved Cobalt	mg/L	-	-	0.003	0.016	0.000068	0.00013	0.0013	0.016	0.0034	0.0096
Dissolved Copper	mg/L	0.3	0.1	0.00048	0.0018	0.002	0.002	0.000074	0.00073	0.00035	0.001
Dissolved Iron	mg/L	-	-	0.14	0.45	0.025	0.025	0.037	0.37	0.18	0.5
Dissolved Lead	mg/L	0.2	0.08	0.00053	0.0017	0.00005	0.00005	0.00012	0.0014	0.00071	0.002
Dissolved Lithium	mg/L	-	-	0.0095	0.088	0.0088	0.0088	0.0086	0.094	0.0046	0.013
Dissolved Magnesium	mg/L	-	-	30	100	1.7	1.7	4.6	50	43	120
Dissolved Manganese	mg/L	-	-	0.038	0.31	0.0099	0.018	0.031	0.34	0.026	0.075
Dissolved Mercury	mg/L	-	-	0.0000049	0.000028	0.00001	0.000013	0.0000027	0.000029	0.0000032	0.000009
Dissolved Molybdenum	mg/L	-	-	0.0027	0.009	0.00005	0.00005	0.00074	0.0073	0.0035	0.01
Dissolved Nickel	mg/L	0.5	0.25	0.0014	0.0046	0.0005	0.0005	0.00037	0.0037	0.0018	0.005
Dissolved Selenium	mg/L	-	-	0.00057	0.0018	0.00024	0.00026	0.00015	0.0015	0.00071	0.002
Dissolved Silver	mg/L	-	-	0.00022	0.00075	0.0000042	0.0000064	0.000017	0.00019	0.00033	0.00094
Dissolved Sodium	mg/L	-	-	55	200	4.9	5	0.32	3.3	86	240
Dissolved Thallium	mg/L	-	-	0.00012	0.00047	0.0000086	0.000015	0.000038	0.00044	0.00015	0.00043
Dissolved Uranium	mg/L	-	-	0.00053	0.0017	0.0002	0.0002	0.000093	0.00099	0.00071	0.002
Dissolved Vanadium	mg/L	-	-	0.0061	0.021	0.00021	0.00057	0.0012	0.014	0.0085	0.024
Dissolved Zinc	mg/L	0.5	0.4	0.0057	0.018	0.002	0.002	0.0015	0.015	0.0071	0.02
Dissolved Phosphorous	mg/L	-	-	0.1	0.76	1.0	1.0	0.00089	0.0088		
Total Aluminum	mg/L	-	-	0.08	0.25	0.067	0.081	0.02	0.19	0.094	0.27
Total Antimony	mg/L	-	-	0.011	0.037	0.000021	0.000087	0.0023	0.027	0.015	0.043
Total Arsenic	mg/L	0.5	0.1	0.0041	0.013	0.00018	0.00018	0.0011	0.011	0.0052	0.015
Total Barium	mg/L	-	-	0.013	0.13	0.0023	0.0031	0.012	0.13	0.0072	0.02
Total Beryllium	mg/L	-	-	0.0046	0.016	0.00003	0.0001	0.00029	0.0038	0.0071	0.02
Total Boron	mg/L	-	-	0.3	4.8	0.0065	0.0083	0.38	4.8	0.063	0.18
Total Cadmium	mg/L	-	-	0.000028	0.000093	0.0000045	0.000009	0.0000075	0.000074	0.000036	0.0001
Total Calcium	mg/L	-	-	160	500	2.5	2.9	38	380	220	620
Total Chromium	mg/L	-	-	0.0041	0.014	0.0025	0.0025	0.001	0.011	0.005	0.014
Total Cobalt	mg/L	-	-	0.0032	0.016	0.000068	0.00013	0.0013	0.016	0.0036	0.01
Total Copper	mg/L	0.3	0.1	0.00061	0.0019	0.002	0.002	0.00011	0.0011	0.00052	0.0015
Total Iron	mg/L	-	-	0.39	1.3	0.025	0.025	0.1	1	0.5	1.4
Total Lead	mg/L	0.2	0.08	0.00054	0.0018	0.00005	0.00005	0.00012	0.0014	0.00072	0.0021
Total Lithium	mg/L	-	-	0.0095	0.088	0.0088	0.0088	0.0086	0.094	0.0046	0.013
Total Magnesium	mg/L	-	-	30	100	1.7	1.7	4.7	50	43	120
Total Manganese	mg/L	-	-	0.047	0.34	0.0099	0.018	0.033	0.37	0.039	0.11
Total Mercury	mg/L	-	-	0.00006	0.00021	0.00001	0.000013	0.000017	0.00017	0.000076	0.00021
Total Molybdenum	mg/L	-	-	0.0027	0.0091	0.00005	0.00005	0.00074	0.0073	0.0035	0.01
Total Nickel	mg/L	0.5	0.25	0.0026	0.0085	0.0005	0.0005	0.00069	0.0069	0.0033	0.0094
Total Selenium	mg/L	-	-	0.00057	0.0018	0.00024	0.00026	0.00015	0.0015	0.00071	0.002
Total Silver	mg/L	-	-	0.00022	0.00075	0.0000042	0.0000064	0.000017	0.00019	0.00033	0.00094
Total Sodium	mg/L	-	-	55	200	4.9	5	0.32	3.4	86	240
Total Thallium	mg/L	-	-	0.00012	0.00047	0.0000086	0.000015	0.000038	0.00044	0.00015	0.00043
Total Uranium	mg/L	-	-	0.00053	0.0017	0.0002	0.0002	0.000093	0.001	0.00071	0.002
Total Vanadium	mg/L	-	-	0.0065	0.022	0.00021	0.00057	0.0013	0.014	0.0089	0.025
Total Zinc	mg/L	0.5	0.4	0.0058	0.019	0.002	0.002	0.0015	0.015	0.0073	0.021
Total Phosphorous	mg/L	-	-	0.11	0.76	1.0	1.0	0.0015	0.014	0.0033	0.0094

[1] ***Current MMER Exceedance Shown in bold italics***

[2] Proposed MMER Exceedance shown in grey highlight

Aimaolokatalok Lake - Section 2b Average and Maximum Concentrations During Operations and Post-Closure - Base Case														
			Operations						Post -Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
Parameter	Units	Min CCME[1]	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	1.7	1.7	1 x	2.6	2.6	1 x	1.8	1.8	1 x	2.6	2.6	1 x
TDS	mg/L	-	20	20	1 x	30	34	1.1 x	21	21	1 x	30	30	1 x
Fluoride	mg/L	0.12	0.027	0.028	1 x	0.041	0.041	1 x	0.029	0.029	1 x	0.041	0.041	1 x
Chloride	mg/L	120	8	8.2	1 x	12	13	1.1 x	8.4	8.4	1 x	12	12	1 x
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.00097	0.001	1.1 x	0.0015	0.002	1.3 x	0.001	0.001	1 x	0.0015	0.0015	1 x
WAD Cyanide	mg/L	-	-	0.000073	-	-	0.00051	-	-	0.00000018	-	-	0.00002	-
Cyanate	mg/L	-	-	0.0059	-	-	0.042	-	-	0.000014	-	-	0.0016	-
Thiocyanate	mg/L	-	-	0.0039	-	-	0.028	-	-	0.0000095	-	-	0.0011	-
Ammonia	mg/L as N	1.54	0.011	0.015	1.4 x	0.015	0.038	2.5 x	0.011	0.011	1 x	0.015	0.017	1.2 x
Nitrate	mg/L as N	3	0.011	0.013	1.2 x	0.015	0.03	2 x	0.011	0.011	1 x	0.015	0.015	1 x
Nitrite	mg/L as N	10	0.00097	0.011	12 x	0.0015	0.064	43 x	0.001	0.0011	1.1 x	0.0015	0.0079	5.4 x
Sulphate	mg/L	1000	2.9	3	1 x	4.4	5.1	1.2 x	3.1	3.1	1 x	4.4	4.5	1 x
Alkalinity	mg/L	-	9.2	9.4	1 x	14	15	1.1 x	9.8	9.8	1 x	14	14	1 x
Hardness	mg/L	-	12	13	1.1 x	18	22	1.2 x	13	13	1 x	18	19	1 x
Dissolved Aluminum	mg/L	0.1	0.045	0.045	1 x	0.071	0.071	1 x	0.048	0.048	1 x	0.074	0.073	1 x
Dissolved Antimony	mg/L	-	0.000013	0.000029	2.2 x	0.000023	0.00011	4.9 x	0.000014	0.000015	1 x	0.000023	0.000034	1.5 x
Dissolved Arsenic	mg/L	0.005	0.00016	0.00016	1 x	0.00024	0.00026	1.1 x	0.00017	0.00017	1 x	0.00024	0.00025	1 x
Dissolved Barium	mg/L	-	0.0021	0.0021	1 x	0.0031	0.0033	1 x	0.0022	0.0022	1 x	0.0031	0.0032	1 x
Dissolved Beryllium	mg/L	0.1	0.0000048	0.00001	2.1 x	0.0000074	0.000043	5.8 x	0.0000051	0.0000053	1 x	0.0000074	0.0000098	1.3 x
Dissolved Boron	mg/L	0.5	0.0048	0.0055	1.2 x	0.0073	0.01	1.4 x	0.0051	0.0051	1 x	0.0073	0.0084	1.1 x
Dissolved Cadmium	mg/L	0.00012	0.0000057	0.0000058	1 x	0.0000079	0.000008	1 x	0.000006	0.000006	1 x	0.0000078	0.0000079	1 x
Dissolved Calcium	mg/L	-	2.5	2.7	1.1 x	3.7	5	1.4 x	2.6	2.6	1 x	3.7	3.9	1.1 x
Dissolved Chromium	mg/L	0.001	0.00024	0.00025	1 x	0.00039	0.00041	1.1 x	0.00026	0.00026	1 x	0.0004	0.0004	1 x
Dissolved Cobalt	mg/L	0.05	0.000051	0.000056	1.1 x	0.000072	0.0001	1.4 x	0.000053	0.000053	1 x	0.000072	0.000076	1.1 x
Dissolved Copper	mg/L	0.002	0.00089	0.0009	1 x	0.0014	0.0014	1 x	0.00095	0.00095	1 x	0.0014	0.0014	1 x
Dissolved Iron	mg/L	0.3	0.098	0.098	1 x	0.14	0.14	1 x	0.1	0.1	1 x	0.14	0.14	1 x
Dissolved Lead	mg/L	0.001	0.000033	0.000034	1 x	0.000051	0.000055	1.1 x	0.000035	0.000035	1 x	0.000051	0.000052	1 x
Dissolved Lithium	mg/L	2.5	0.0069	0.007	1 x	0.011	0.011	1 x	0.0073	0.0072	1 x	0.01	0.01	n/a
Dissolved Magnesium	mg/L	-	1.5	1.6	1 x	2.3	2.5	1.1 x	1.6	1.6	1 x	2.3	2.3	1 x
Dissolved Manganese	mg/L	0.2	0.014	0.014	1 x	0.019	0.019	1 x	0.014	0.014	1 x	0.019	0.019	1 x
Dissolved Mercury	mg/L	0.000016	0.0000015	0.0000016	1 x	0.0000035	0.0000035	1 x	0.0000019	0.0000019	1 x	0.0000046	0.0000046	1 x
Dissolved Molybdenum	mg/L	0.01	0.000044	0.000049	1.1 x	0.000069	0.000091	1.3 x	0.000047	0.000048	1 x	0.000069	0.000072	1 x
Dissolved Nickel	mg/L	0.025	0.00039	0.0004	1 x	0.0006	0.00061	1 x	0.00042	0.00042	1 x	0.0006	0.0006	1 x
Dissolved Selenium	mg/L	0.001	0.00019	0.00019	1 x	0.00029	0.00029	1 x	0.0002	0.0002	1 x	0.00029	0.00029	1 x
Dissolved Silver	mg/L	0.00025	0.000002	0.0000023	1.1 x	0.0000029	0.0000046	1.6 x	0.0000022	0.0000022	1 x	0.0000029	0.000003	1 x
Dissolved Sodium	mg/L	-	4.5	4.6	1 x	6.9	7.3	1.1 x	4.8	4.8	1 x	6.9	6.9	1 x
Dissolved Thallium	mg/L	0.0008	0.0000043	0.0000045	1 x	0.0000067	0.0000078	1.2 x	0.0000046	0.0000046	1 x	0.0000068	0.0000069	1 x
Dissolved Uranium	mg/L	0.01	0.00002	0.000021	1 x	0.000031	0.000035	1.1 x	0.000021	0.000021	1 x	0.000031	0.000031	1 x
Dissolved Vanadium	mg/L	0.1	0.00016	0.00017	1.1 x	0.00024	0.00029	1.2 x	0.00017	0.00017	1 x	0.00024	0.00025	1 x
Dissolved Zinc	mg/L	0.03	0.002	0.002	1 x	0.0029	0.0029	1 x	0.0021	0.0021	1 x	0.0028	0.0028	1 x
Dissolved Phosphorous	mg/L	Variable	0.011	0.011	1 x	0.017	0.017	1 x	0.012	0.012	1 x	0.017	0.017	1 x
Total Aluminum	mg/L	0.1	0.045	0.045	1 x	0.071	0.072	1 x	0.048	0.048	1 x	0.074	0.073	1 x
Total Antimony	mg/L	-	0.000013	0.000029	2.2 x	0.000023	0.00011	4.9 x	0.000014	0.000015	1 x	0.000023	0.000034	1.5 x
Total Arsenic	mg/L	0.005	0.00016	0.00016	1 x	0.00024	0.00027	1.1 x	0.00017	0.00017	1 x	0.00024	0.00025	1 x
Total Barium	mg/L	-	0.0021	0.0021	1 x	0.0031	0.0033	1 x	0.0022	0.0022	1 x	0.0031	0.0032	1 x
Total Beryllium	mg/L	0.1	0.0000048	0.00001	2.1 x	0.0000074	0.000043	5.8 x	0.0000051	0.0000053	1 x	0.0000074	0.0000098	1.3 x
Total Boron	mg/L	0.5	0.0048	0.0055	1.2 x	0.0073	0.01	1.4 x	0.0051	0.0051	1 x	0.0073	0.0084	1.1 x
Total Cadmium	mg/L	0.00012	0.0000057	0.0000058	1 x	0.0000079	0.000008	1 x	0.000006	0.000006	1 x	0.0000078	0.0000079	1 x
Total Calcium	mg/L	-	2.5	2.7	1.1 x	3.7	5	1.4 x	2.6	2.6	1 x	3.7	3.9	1.1 x
Total Chromium	mg/L	0.001	0.00024	0.00025	1 x	0.00039	0.00042	1.1 x	0.00026	0.00026	1 x	0.0004	0.0004	1 x
Total Cobalt	mg/L	0.05	0.000051	0.000056	1.1 x	0.000072	0.0001	1.4 x	0.000053	0.000053	1 x	0.000072	0.000076	1.1 x
Total Copper	mg/L	0.002	0.00089	0.0009	1 x	0.0014	0.0014	1 x	0.00095	0.00095	1 x	0.0014	0.0014	1 x
Total Iron	mg/L	0.3	0.098	0.099	1 x	0.14	0.14	1 x	0.1	0.1	1 x	0.14	0.14	1 x
Total Lead	mg/L	0.001	0.000033	0.000034	1 x	0.000051	0.000055	1.1 x	0.000035	0.000035	1 x	0.000051	0.000052	1 x
Total Lithium	mg/L	2.5	0.0069	0.007	1 x	0.011	0.011	1 x	0.0073	0.0072	1 x	0.01	0.01	n/a
Total Magnesium	mg/L	-	1.5	1.6	1 x	2.3	2.5	1.1 x	1.6	1.6	1 x	2.3	2.3	1 x
Total Manganese	mg/L	0.2	0.014	0.014	1 x	0.019	0.019	1 x	0.014	0.014	1 x	0.019	0.019	1 x
Total Mercury	mg/L	0.000016	0.0000015	0.0000016	1.1 x	0.0000035	0.000004	1.1 x	0.0000019	0.0000019	1 x	0.0000046	0.0000046	1 x
Total Molybdenum	mg/L	0.01	0.000044	0.000049	1.1 x	0.000069	0.000091	1.3 x	0.000047	0.000048	1 x	0.000069	0.000072	1 x
Total Nickel	mg/L	0.025	0.00039	0.0004	1 x	0.0006	0.00062	1 x	0.00042	0.00042	1 x	0.0006	0.0006	1 x
Total Selenium	mg/L	0.001	0.00019	0.00019	1 x	0.00029	0.00029	1 x	0.0002	0.0002	1 x	0.00029	0.00029	1 x
Total Silver	mg/L	0.00025	0.000002	0.0000023	1.1 x	0.0000029	0.0000046	1.6 x	0.0000022	0.0000022	1 x	0.0000029	0.000003	1 x
Total Sodium	mg/L	-	4.5	4.6	1 x	6.9	7.3	1.1 x	4.8	4.8	1 x	6.9	6.9	1 x
Total Thallium	mg/L	0.0008	0.0000043	0.0000045	1 x	0.0000067	0.0000078	1.2 x	0.0000046	0.0000046	1 x	0.0000068	0.0000069	1 x
Total Uranium	mg/L	0.01	0.00002	0.000021	1 x	0.000031	0.000035	1.1 x	0.000021	0.000021	1 x	0.000031	0.000031	1 x
Total Vanadium	mg/L	0.1	0.00016	0.00017	1.1 x	0.00024	0.00029	1.2 x	0.00017	0.00017	1 x	0.00024	0.00025	1 x
Total Zinc	mg/L	0.03	0.002	0.002	1 x	0.0029	0.0029	1 x	0.0021	0.0021	1 x	0.0028	0.0028	1 x
Total Phosphorous	mg/L	Variable	0.011	0.011	1 x	0.017	0.017	1 x	0.012	0.012	1 x	0.017	0.017	1 x

[1] ***CCME Exceedance shown in bold italics***

Aimaolokatalok Lake - Section 2b Average and Maximum Concentrations During Operations and Post-Closure - Upper Case

Parameter	Units	Min CCME[1]	Operations						Post -Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	2.3	2.3	n/a	4.2	4.2	n/a	2.6	2.6	n/a	4.8	4.8	n/a
TDS	mg/L	-	21	22	1 x	33	37	1.1 x	23	23	n/a	33	33	n/a
Fluoride	mg/L	0.12	0.05	0.05	n/a	0.071	0.071	n/a	0.053	0.053	n/a	0.071	0.071	n/a
Chloride	mg/L	120	8.9	9.1	1 x	13	15	1.2 x	9.4	9.3	1 x	13	13	n/a
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.00097	0.001	1 x	0.0015	0.002	1.3 x	0.001	0.001	n/a	0.0015	0.0015	n/a
WAD Cyanide	mg/L	-	-	0.000073	-	-	0.00051	-	-	0.00000018	-	-	0.00002	-
Cyanate	mg/L	-	-	0.0059	-	-	0.042	-	-	0.000014	-	-	0.0016	-
Thiocyanate	mg/L	-	-	0.0039	-	-	0.028	-	-	0.0000095	-	-	0.0011	-
Ammonia	mg/L as N	1.54	0.013	0.018	1.4 x	0.019	0.042	2.2 x	0.014	0.014	n/a	0.019	0.021	1.1 x
Nitrate	mg/L as N	3	0.016	0.018	1.1 x	0.022	0.037	1.7 x	0.017	0.016	0.9 x	0.022	0.022	n/a
Nitrite	mg/L as N	10	0.0028	0.013	4.6 x	0.0038	0.066	17.4 x	0.0029	0.003	1 x	0.0038	0.01	2.6 x
Sulphate	mg/L	1000	3.2	3.4	1.1 x	5.3	6.1	1.2 x	3.5	3.5	n/a	5.5	5.5	n/a
Alkalinity	mg/L	-	9.7	9.8	1 x	15	15	n/a	10	10	n/a	15	15	n/a
Hardness	mg/L	-	13	13	n/a	19	23	1.2 x	13	13	n/a	19	20	1.1 x
Dissolved Aluminum	mg/L	0.1	0.067	0.067	n/a	0.1	0.1	n/a	0.071	0.071	n/a	0.1	0.1	n/a
Dissolved Antimony	mg/L	-	0.000043	0.000059	1.4 x	0.000061	0.00015	2.5 x	0.000045	0.000045	n/a	0.000061	0.000072	1.2 x
Dissolved Arsenic	mg/L	0.005	0.00016	0.00017	1.1 x	0.00025	0.00027	1.1 x	0.00017	0.00018	1.1 x	0.00025	0.00026	1 x
Dissolved Barium	mg/L	-	0.0026	0.0027	1 x	0.0039	0.004	1 x	0.0028	0.0028	n/a	0.0039	0.0039	n/a
Dissolved Beryllium	mg/L	0.1	0.000074	0.000079	1.1 x	0.0001	0.00014	1.4 x	0.000077	0.000077	n/a	0.0001	0.0001	n/a
Dissolved Boron	mg/L	0.5	0.0072	0.0082	1.1 x	0.011	0.014	1.3 x	0.0076	0.0077	1 x	0.011	0.012	1.1 x
Dissolved Cadmium	mg/L	0.00012	0.0000077	0.0000077	n/a	0.000012	0.000012	n/a	0.0000079	0.0000079	n/a	0.000011	0.000011	n/a
Dissolved Calcium	mg/L	-	2.6	2.8	1.1 x	3.9	5.2	1.3 x	2.7	2.8	1 x	3.9	4.1	1.1 x
Dissolved Chromium	mg/L	0.001	0.0004	0.00041	1 x	0.00062	0.00064	1 x	0.00043	0.00043	n/a	0.00062	0.00062	n/a
Dissolved Cobalt	mg/L	0.05	0.0001	0.00011	1.1 x	0.00014	0.00017	1.2 x	0.00011	0.00011	n/a	0.00014	0.00015	1.1 x
Dissolved Copper	mg/L	0.002	0.00099	0.00099	n/a	0.0015	0.0015	n/a	0.001	0.0011	1.1 x	0.0015	0.0015	n/a
Dissolved Iron	mg/L	0.3	0.15	0.15	n/a	0.21	0.21	n/a	0.15	0.15	n/a	0.21	0.21	n/a
Dissolved Lead	mg/L	0.001	0.000049	0.00005	1 x	0.000072	0.000076	1.1 x	0.000052	0.000052	n/a	0.000071	0.000072	1 x
Dissolved Lithium	mg/L	2.5	0.0085	0.0085	n/a	0.013	0.013	n/a	0.0089	0.0089	n/a	0.013	0.013	n/a
Dissolved Magnesium	mg/L	-	1.6	1.6	n/a	2.4	2.7	1.1 x	1.7	1.7	n/a	2.4	2.5	1 x
Dissolved Manganese	mg/L	0.2	0.015	0.015	n/a	0.021	0.021	n/a	0.015	0.015	n/a	0.02	0.021	1.1 x
Dissolved Mercury	mg/L	0.000016	0.0000057	0.0000057	n/a	0.00001	0.00001	n/a	0.0000064	0.0000064	n/a	0.000011	0.000011	n/a
Dissolved Molybdenum	mg/L	0.01	0.000045	0.00005	1.1 x	0.000071	0.000093	1.3 x	0.000049	0.000049	n/a	0.000071	0.000074	1 x
Dissolved Nickel	mg/L	0.025	0.00044	0.00044	n/a	0.00066	0.00067	1 x	0.00046	0.00046	n/a	0.00066	0.00066	n/a
Dissolved Selenium	mg/L	0.001	0.00021	0.00021	n/a	0.00033	0.00033	n/a	0.00022	0.00022	n/a	0.00033	0.00033	n/a
Dissolved Silver	mg/L	0.00025	0.0000051	0.0000053	1 x	0.0000075	0.0000092	1.2 x	0.0000054	0.0000054	n/a	0.0000075	0.0000076	1 x
Dissolved Sodium	mg/L	-	4.7	4.8	1 x	7.2	7.6	1.1 x	5	5	n/a	7.2	7.2	n/a
Dissolved Thallium	mg/L	0.0008	0.0000078	0.000008	1 x	0.000014	0.000014	n/a	0.0000081	0.0000081	n/a	0.000012	0.000012	n/a
Dissolved Uranium	mg/L	0.01	0.000021	0.000022	1 x	0.000032	0.000036	1.1 x	0.000022	0.000022	n/a	0.000032	0.000033	1 x
Dissolved Vanadium	mg/L	0.1	0.00024	0.00024	n/a	0.00037	0.00042	1.1 x	0.00025	0.00025	n/a	0.00037	0.00037	n/a
Dissolved Zinc	mg/L	0.03	0.0042	0.0042	n/a	0.0058	0.0058	n/a	0.0044	0.0044	n/a	0.0058	0.0058	n/a
Dissolved Phosphorous	mg/L	Variable	0.013	0.013	n/a	0.02	0.02	n/a	0.014	0.013	0.9 x	0.02	0.02	n/a
Total Aluminum	mg/L	0.1	0.067	0.067	n/a	0.1	0.1	n/a	0.071	0.071	n/a	0.1	0.1	n/a
Total Antimony	mg/L	-	0.000043	0.000059	1.4 x	0.000061	0.00015	2.5 x	0.000045	0.000045	n/a	0.000061	0.000072	1.2 x
Total Arsenic	mg/L	0.005	0.00016	0.00017	1.1 x	0.00025	0.00028	1.1 x	0.00017	0.00018	1.1 x	0.00025	0.00026	1 x
Total Barium	mg/L	-	0.0026	0.0027	1 x	0.0039	0.004	1 x	0.0028	0.0028	n/a	0.0039	0.0039	n/a
Total Beryllium	mg/L	0.1	0.000074	0.000079	1.1 x	0.0001	0.00014	1.4 x	0.000077	0.000077	n/a	0.0001	0.0001	n/a
Total Boron	mg/L	0.5	0.0072	0.0082	1.1 x	0.011	0.014	1.3 x	0.0076	0.0077	1 x	0.011	0.012	1.1 x
Total Cadmium	mg/L	0.00012	0.0000077	0.0000077	n/a	0.000012	0.000012	n/a	0.0000079	0.0000079	n/a	0.000011	0.000011	n/a
Total Calcium	mg/L	-	2.6	2.8	1.1 x	3.9	5.2	1.3 x	2.7	2.8	1 x	3.9	4.1	1.1 x
Total Chromium	mg/L	0.001	0.0004	0.00041	1 x	0.00062	0.00065	1 x	0.00043	0.00043	n/a	0.00062	0.00062	n/a
Total Cobalt	mg/L	0.05	0.0001	0.00011	1.1 x	0.00014	0.00017	1.2 x	0.00011	0.00011	n/a	0.00014	0.00015	1.1 x
Total Copper	mg/L	0.002	0.00099	0.00099	n/a	0.0015	0.0015	n/a	0.001	0.0011	1.1 x	0.0015	0.0015	n/a
Total Iron	mg/L	0.3	0.15	0.15	n/a	0.21	0.21	n/a	0.15	0.15	n/a	0.21	0.21	n/a
Total Lead	mg/L	0.001	0.000049	0.00005	1 x	0.000072	0.000076	1.1 x	0.000052	0.000052	n/a	0.000071	0.000072	1 x
Total Lithium	mg/L	2.5	0.0085	0.0085	n/a	0.013	0.013	n/a	0.0089	0.0089	n/a	0.013	0.013	n/a
Total Magnesium	mg/L	-	1.6	1.6	n/a	2.4	2.7	1.1 x	1.7	1.7	n/a	2.4	2.5	1 x
Total Manganese	mg/L	0.2	0.015	0.015	n/a	0.021	0.021	n/a	0.015	0.015	n/a	0.02	0.021	1.1 x
Total Mercury	mg/L	0.000016	0.0000057	0.0000058	1 x	0.00001	0.00001	n/a	0.0000064	0.0000064	n/a	0.000011	0.000011	n/a
Total Molybdenum	mg/L	0.01	0.000045	0.00005	1.1 x	0.000071	0.000093	1.3 x	0.000049	0.000049	n/a	0.000071	0.000074	1 x
Total Nickel	mg/L	0.025	0.00044	0.00044	n/a	0.00066	0.00068	1 x	0.00046	0.00046	n/a	0.00066	0.00066	n/a
Total Selenium	mg/L	0.001	0.00021	0.00021	n/a	0.00033	0.00033	n/a	0.00022	0.00022	n/a	0.00033	0.00033	n/a
Total Silver	mg/L	0.00025	0.0000051	0.0000054	1.1 x	0.0000075	0.0000092	1.2 x	0.0000054	0.0000054	n/a	0.0000075	0.0000076	1 x
Total Sodium	mg/L	-	4.7	4.8	1 x	7.2	7.6	1.1 x	5	5	n/a	7.2	7.2	n/a
Total Thallium	mg/L	0.0008	0.0000078	0.000008	1 x	0.000014	0.000014	n/a	0.0000081	0.0000081	n/a	0.000012	0.000012	n/a
Total Uranium	mg/L	0.01	0.000021	0.000022	1 x	0.000032	0.000036	1.1 x	0.000022	0.000022	n/a	0.000032	0.000033	1 x
Total Vanadium	mg/L	0.1	0.00024	0.00024	n/a	0.00037	0.00042	1.1 x	0.00025	0.00025	n/a	0.00037	0.00037	n/a
Total Zinc	mg/L	0.03	0.0042	0.0042	n/a	0.0058	0.0058	n/a	0.0044	0.0044	n/a	0.0058	0.0058	n/a
Total Phosphorous	mg/L	Variable	0.013	0.013	n/a	0.02	0.02	n/a	0.014	0.013	0.9 x	0.02	0.02	n/a

[1] ***CCME Exceedance shown in bold italics***

Aimaolokatalok Lake - Section 2a Average and Maximum Concentrations During Operations and Post-Closure - Base Case

Parameter	Units	Min CCME[1]	Operations						Post -Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline	Base Case Baseline	Base Case	Increase from Baseline
TSS	mg/L	Variable	2.1	2.1	1 x	5.4	5.4	1 x	2.2	2.2	1 x	4.4	4.4	1 x
TDS	mg/L	-	24	25	1 x	63	63	1 x	24	25	1 x	53	55	1 x
Fluoride	mg/L	0.12	0.035	0.035	1 x	0.089	0.089	1 x	0.035	0.035	1 x	0.071	0.072	1 x
Chloride	mg/L	120	9.9	9.9	1 x	26	26	n/a	9.9	9.9	1 x	22	22	1 x
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.0012	0.0012	1 x	0.0032	0.0032	n/a	0.0012	0.0012	1 x	0.0027	0.0027	1 x
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.014	0.014	1 x	0.035	0.035	1 x	0.014	0.014	1 x	0.024	0.025	1 x
Nitrate	mg/L as N	3	0.015	0.015	1 x	0.035	0.036	1 x	0.015	0.015	1 x	0.024	0.024	1 x
Nitrite	mg/L as N	10	0.0012	0.0012	1 x	0.0032	0.0032	n/a	0.0012	0.0012	1 x	0.0027	0.0027	1 x
Sulphate	mg/L	1000	3.6	3.7	1 x	9.5	9.5	1 x	3.6	4.1	1.2 x	7.9	9.2	1.2 x
Alkalinity	mg/L	-	11	12	1.1 x	30	30	1 x	12	14	1.2 x	25	30	1.2 x
Hardness	mg/L	-	15	15	1 x	38	38	n/a	15	15	1 x	32	32	1 x
Dissolved Aluminum	mg/L	0.1	0.054	0.054	1 x	***0.15***	***0.14***	1 x	0.054	0.054	0.99 x	***0.13***	***0.13***	0.98 x
Dissolved Antimony	mg/L	-	0.000039	0.000039	1 x	0.00014	0.00014	1 x	0.00004	0.000075	1.9 x	0.000061	0.00017	2.7 x
Dissolved Arsenic	mg/L	0.005	0.00022	0.00022	1 x	0.00054	0.00054	1 x	0.00022	0.00051	2.3 x	0.00044	0.0014	3.1 x
Dissolved Barium	mg/L	-	0.0026	0.0026	1 x	0.0067	0.0067	1 x	0.0026	0.0027	1.1 x	0.0056	0.0059	1.1 x
Dissolved Beryllium	mg/L	0.1	0.000031	0.000031	1 x	0.000097	0.000097	1 x	0.000031	0.00004	1.3 x	0.000045	0.000053	1.2 x
Dissolved Boron	mg/L	0.5	0.0059	0.0063	1.1 x	0.015	0.015	1 x	0.006	0.011	1.9 x	0.013	0.029	2.2 x
Dissolved Cadmium	mg/L	0.00012	0.000032	0.000031	0.98 x	0.000092	0.000092	1 x	0.000033	0.000035	1.1 x	0.000047	0.000049	1.1 x
Dissolved Calcium	mg/L	-	3.1	3.3	1.1 x	8	8	1 x	3.1	3.9	1.3 x	6.5	8.2	1.3 x
Dissolved Chromium	mg/L	0.001	0.00031	0.00031	1 x	0.00089	0.00089	1 x	0.00031	0.00031	1 x	0.00073	0.00072	0.99 x
Dissolved Cobalt	mg/L	0.05	0.00009	0.000091	1 x	0.00021	0.00021	1 x	0.000092	0.00011	1.2 x	0.00013	0.00018	1.3 x
Dissolved Copper	mg/L	0.002	0.0011	0.0012	1.1 x	***0.0029***	***0.0029***	1 x	0.0011	0.0014	1.2 x	***0.0024***	***0.003***	1.2 x
Dissolved Iron	mg/L	0.3	0.13	0.13	1 x	***0.32***	***0.32***	n/a	0.13	0.13	0.99 x	0.24	0.24	1 x
Dissolved Lead	mg/L	0.001	0.000065	0.000064	0.99 x	0.00018	0.00018	1 x	0.000066	0.000067	1 x	0.00011	0.00011	1 x
Dissolved Lithium	mg/L	2.5	0.0088	0.0087	0.99 x	0.023	0.023	1 x	0.0088	0.0086	0.98 x	0.018	0.018	1 x
Dissolved Magnesium	mg/L	-	1.9	1.9	1 x	4.9	4.9	1 x	1.9	2	1.1 x	4.1	4.3	1.1 x
Dissolved Manganese	mg/L	0.2	0.018	0.018	1 x	0.045	0.045	1 x	0.018	0.019	1 x	0.031	0.033	1.1 x
Dissolved Mercury	mg/L	0.000016	***0.000026***	***0.000025***	0.97 x	***0.000085***	***0.000085***	1 x	***0.000027***	***0.000028***	1 x	***0.000041***	***0.000041***	1 x
Dissolved Molybdenum	mg/L	0.01	0.000079	0.000084	1.1 x	0.00019	0.00019	1 x	0.000081	0.000098	1.2 x	0.00013	0.00017	1.3 x
Dissolved Nickel	mg/L	0.025	0.00051	0.00052	1 x	0.0013	0.0013	1 x	0.00052	0.00056	1.1 x	0.0011	0.0012	1.1 x
Dissolved Selenium	mg/L	0.001	0.00026	0.00025	1 x	0.00064	0.00064	n/a	0.00026	0.00026	1 x	0.00053	0.00053	1 x
Dissolved Silver	mg/L	0.00025	0.000027	0.000026	0.97 x	0.000085	0.000085	1 x	0.000028	0.000029	1 x	0.000042	0.000043	1 x
Dissolved Sodium	mg/L	-	5.6	5.6	1 x	15	15	n/a	5.7	5.6	1 x	12	12	1 x
Dissolved Thallium	mg/L	0.0008	0.00003	0.000029	0.97 x	0.000094	0.000094	1 x	0.00003	0.000032	1 x	0.000044	0.000045	1 x
Dissolved Uranium	mg/L	0.01	0.000049	0.00005	1 x	0.00014	0.00014	1 x	0.00005	0.000056	1.1 x	0.000068	0.000079	1.2 x
Dissolved Vanadium	mg/L	0.1	0.00023	0.00024	1 x	0.00056	0.00056	1 x	0.00023	0.00027	1.1 x	0.00042	0.00049	1.2 x
Dissolved Zinc	mg/L	0.03	0.0026	0.0026	1 x	0.0066	0.0066	1 x	0.0027	0.0027	1 x	0.0046	0.0049	1.1 x
Dissolved Phosphorous	mg/L	Variable	0.014	0.014	1 x	0.036	0.036	1 x	0.014	0.014	1 x	0.03	0.03	1 x
Total Aluminum	mg/L	0.1	0.054	0.054	1 x	***0.15***	***0.14***	1 x	0.054	0.054	0.99 x	***0.13***	***0.13***	0.98 x
Total Antimony	mg/L	-	0.000039	0.000039	1 x	0.00014	0.00014	1 x	0.00004	0.000075	1.9 x	0.000061	0.00017	2.7 x
Total Arsenic	mg/L	0.005	0.00022	0.00022	1 x	0.00054	0.00054	1 x	0.00022	0.00051	2.3 x	0.00044	0.0014	3.1 x
Total Barium	mg/L	-	0.0026	0.0026	1 x	0.0067	0.0067	1 x	0.0026	0.0027	1.1 x	0.0056	0.0059	1.1 x
Total Beryllium	mg/L	0.1	0.000031	0.000031	1 x	0.000097	0.000097	1 x	0.000031	0.00004	1.3 x	0.000045	0.000053	1.2 x
Total Boron	mg/L	0.5	0.0059	0.0063	1.1 x	0.015	0.015	1 x	0.006	0.011	1.9 x	0.013	0.029	2.2 x
Total Cadmium	mg/L	0.00012	0.000032	0.000031	0.98 x	0.000092	0.000092	1 x	0.000033	0.000035	1.1 x	0.000047	0.000049	1.1 x
Total Calcium	mg/L	-	3.1	3.3	1.1 x	8	8	1 x	3.1	3.9	1.3 x	6.5	8.2	1.3 x
Total Chromium	mg/L	0.001	0.00031	0.00031	1 x	0.00089	0.00089	1 x	0.00031	0.00031	1 x	0.00073	0.00072	0.99 x
Total Cobalt	mg/L	0.05	0.00009	0.000091	1 x	0.00021	0.00021	1 x	0.000092	0.00011	1.2 x	0.00013	0.00018	1.3 x
Total Copper	mg/L	0.002	0.0011	0.0012	1.1 x	***0.0029***	***0.0029***	1 x	0.0011	0.0014	1.2 x	***0.0024***	***0.003***	1.2 x
Total Iron	mg/L	0.3	0.13	0.13	1 x	***0.32***	***0.32***	n/a	0.13	0.13	0.99 x	0.24	0.24	1 x
Total Lead	mg/L	0.001	0.000065	0.000064	0.99 x	0.00018	0.00018	1 x	0.000066	0.000067	1 x	0.00011	0.00011	1 x
Total Lithium	mg/L	2.5	0.0088	0.0087	0.99 x	0.023	0.023	1 x	0.0088	0.0086	0.98 x	0.018	0.018	1 x
Total Magnesium	mg/L	-	1.9	1.9	1 x	4.9	4.9	1 x	1.9	2	1.1 x	4.1	4.3	1.1 x
Total Manganese	mg/L	0.2	0.018	0.018	1 x	0.045	0.045	1 x	0.018	0.019	1 x	0.031	0.033	1.1 x
Total Mercury	mg/L	0.000016	***0.000026***	***0.000025***	0.97 x	***0.000085***	***0.000085***	1 x	***0.000027***	***0.000028***	1 x	***0.000041***	***0.000041***	1 x
Total Molybdenum	mg/L	0.01	0.000079	0.000084	1.1 x	0.00019	0.00019	1 x	0.000081	0.000098	1.2 x	0.00013	0.00017	1.3 x
Total Nickel	mg/L	0.025	0.00051	0.00052	1 x	0.0013	0.0013	1 x	0.00052	0.00056	1.1 x	0.0011	0.0012	1.1 x
Total Selenium	mg/L	0.001	0.00026	0.00025	1 x	0.00064	0.00064	n/a	0.00026	0.00026	1 x	0.00053	0.00053	1 x
Total Silver	mg/L	0.00025	0.000027	0.000026	0.97 x	0.000085	0.000085	1 x	0.000028	0.000029	1 x	0.000042	0.000043	1 x
Total Sodium	mg/L	-	5.6	5.6	1 x	15	15	n/a	5.7	5.6	1 x	12	12	1 x
Total Thallium	mg/L	0.0008	0.00003	0.000029	0.97 x	0.000094	0.000094	1 x	0.00003	0.000032	1 x	0.000044	0.000045	1 x
Total Uranium	mg/L	0.01	0.000049	0.00005	1 x	0.00014	0.00014	1 x	0.00005	0.000056	1.1 x	0.000068	0.000079	1.2 x
Total Vanadium	mg/L	0.1	0.00023	0.00024	1 x	0.00056	0.00056	1 x	0.00023	0.00027	1.1 x	0.00042	0.00049	1.2 x
Total Zinc	mg/L	0.03	0.0026	0.0026	1 x	0.0066	0.0066	1 x	0.0027	0.0027	1 x	0.0046	0.0049	1.1 x
Total Phosphorous	mg/L	Variable	0.014	0.014	1 x	0.036	0.036	1 x	0.014	0.014	1 x	0.03	0.03	1 x

[1] ***CCME Exceedance shown in bold italics***

Aimaolokatalok Lake - Section 2a Average and Maximum Concentrations During Operations and Post-Closure - Upper Case

Parameter	Units	Min CCME[1]	Operations						Post -Closure					
			Average Open Water			Maximum Under Ice			Average Open Water			Maximum Under Ice		
			Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline	Upper Case Baseline	Upper Case	Increase from Baseline
TSS	mg/L	Variable	2.6	2.6	n/a	8.8	8.8	n/a	2.6	2.6	n/a	8.2	8	1 x
TDS	mg/L	-	26	27	1 x	69	69	n/a	27	28	1 x	58	62	1.1 x
Fluoride	mg/L	0.12	0.066	0.067	1 x	***0.16***	***0.16***	n/a	0.067	0.068	1 x	0.12	0.12	n/a
Chloride	mg/L	120	11	11	n/a	29	29	n/a	11	11	n/a	23	23	n/a
Free Cyanide	mg/L	0.005	-	-	-	-	-	-	-	-	-	-	-	-
Total Cyanide	mg/L	0.005	0.0012	0.0012	n/a	0.0032	0.0032	n/a	0.0012	0.0012	n/a	0.0027	0.0027	n/a
WAD Cyanide	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Thiocyanate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L as N	1.54	0.018	0.018	n/a	0.044	0.044	n/a	0.018	0.018	n/a	0.032	0.032	n/a
Nitrate	mg/L as N	3	0.021	0.021	n/a	0.051	0.051	n/a	0.022	0.022	n/a	0.033	0.034	1 x
Nitrite	mg/L as N	10	0.0038	0.0038	n/a	0.0091	0.0091	n/a	0.0039	0.0039	n/a	0.0058	0.0059	1 x
Sulphate	mg/L	1000	3.8	4.1	1.1 x	12	12	n/a	3.8	4.9	1.3 x	9.7	12	1.2 x
Alkalinity	mg/L	-	12	13	1.1 x	31	32	1 x	12	15	1.3 x	26	32	1.2 x
Hardness	mg/L	-	16	16	n/a	41	41	n/a	16	16	n/a	34	34	n/a
Dissolved Aluminum	mg/L	0.1	0.085	0.085	n/a	***0.21***	***0.21***	n/a	0.086	0.086	n/a	***0.17***	***0.17***	n/a
Dissolved Antimony	mg/L	-	0.00008	0.000081	1 x	0.00018	0.00018	n/a	0.000082	0.00012	1.5 x	0.00012	0.00022	1.8 x
Dissolved Arsenic	mg/L	0.005	0.00023	0.00025	1.1 x	0.00058	0.00058	n/a	0.00023	0.00056	2.4 x	0.00046	0.0015	3.3 x
Dissolved Barium	mg/L	-	0.0034	0.0035	1 x	0.0085	0.0086	1 x	0.0034	0.0036	1.1 x	0.0066	0.0071	1.1 x
Dissolved Beryllium	mg/L	0.1	0.00012	0.00012	n/a	0.00028	0.00028	n/a	0.00013	0.00013	n/a	0.00017	0.0002	1.2 x
Dissolved Boron	mg/L	0.5	0.0091	0.0096	1.1 x	0.023	0.023	n/a	0.0092	0.016	1.7 x	0.019	0.039	2.1 x
Dissolved Cadmium	mg/L	0.00012	0.000035	0.000034	1 x	0.00011	0.00011	n/a	0.000035	0.000038	1.1 x	0.000049	0.000051	1 x
Dissolved Calcium	mg/L	-	3.3	3.6	1.1 x	8.4	8.5	1 x	3.3	4.3	1.3 x	6.8	9	1.3 x
Dissolved Chromium	mg/L	0.001	0.00052	0.00052	n/a	***0.0013***	***0.0013***	n/a	0.00053	0.00053	n/a	***0.0011***	***0.0011***	n/a
Dissolved Cobalt	mg/L	0.05	0.00016	0.00016	n/a	0.00037	0.00037	n/a	0.00016	0.00018	1.1 x	0.00024	0.00029	1.2 x
Dissolved Copper	mg/L	0.002	0.0013	0.0014	1.1 x	***0.0032***	***0.0033***	1 x	0.0013	0.0017	1.3 x	***0.0026***	***0.0036***	1.4 x
Dissolved Iron	mg/L	0.3	0.19	0.2	1.1 x	***0.48***	***0.48***	n/a	0.2	0.2	n/a	***0.33***	***0.34***	1 x
Dissolved Lead	mg/L	0.001	0.000087	0.000088	1 x	0.0002	0.0002	n/a	0.000089	0.000093	1 x	0.00013	0.00014	1.1 x
Dissolved Lithium	mg/L	2.5	0.01	0.01	n/a	0.028	0.028	n/a	0.01	0.01	n/a	0.023	0.023	n/a
Dissolved Magnesium	mg/L	-	2	2	n/a	5.1	5.2	1 x	2	2.1	1.1 x	4.3	4.7	1.1 x
Dissolved Manganese	mg/L	0.2	0.019	0.02	1.1 x	0.048	0.049	1 x	0.02	0.021	1.1 x	0.033	0.038	1.2 x
Dissolved Mercury	mg/L	0.000016	***0.000031***	***0.00003***	1 x	***0.000092***	***0.000092***	n/a	***0.000032***	***0.000033***	1 x	***0.000046***	***0.000046***	n/a
Dissolved Molybdenum	mg/L	0.01	0.00008	0.000091	1.1 x	0.0002	0.0002	n/a	0.000082	0.00012	1.5 x	0.00014	0.00021	1.5 x
Dissolved Nickel	mg/L	0.025	0.00057	0.00059	1 x	0.0014	0.0014	n/a	0.00057	0.00066	1.2 x	0.0012	0.0014	1.2 x
Dissolved Selenium	mg/L	0.001	0.00028	0.00028	n/a	0.00071	0.00071	n/a	0.00028	0.00029	1 x	0.0006	0.0006	n/a
Dissolved Silver	mg/L	0.00025	0.000031	0.00003	1 x	0.000091	0.000091	n/a	0.000032	0.000033	1 x	0.000046	0.000047	1 x
Dissolved Sodium	mg/L	-	5.8	5.9	1 x	15	15	n/a	5.9	5.9	n/a	13	13	n/a
Dissolved Thallium	mg/L	0.0008	0.000034	0.000033	1 x	0.00012	0.00012	n/a	0.000034	0.000035	1 x	0.000047	0.000048	1 x
Dissolved Uranium	mg/L	0.01	0.00005	0.000053	1.1 x	0.00014	0.00014	n/a	0.000051	0.000062	1.2 x	0.00007	0.000092	1.3 x
Dissolved Vanadium	mg/L	0.1	0.00031	0.00032	1 x	0.00081	0.00081	n/a	0.00032	0.00035	1.1 x	0.00069	0.00076	1.1 x
Dissolved Zinc	mg/L	0.03	0.0056	0.0057	1 x	0.014	0.014	n/a	0.0057	0.0058	1 x	0.0094	0.0099	1.1 x
Dissolved Phosphorous	mg/L	Variable	0.016	0.016	n/a	0.042	0.042	n/a	0.016	0.016	n/a	0.035	0.035	n/a
Total Aluminum	mg/L	0.1	0.085	0.085	n/a	***0.21***	***0.21***	n/a	0.086	0.086	n/a	***0.17***	***0.17***	n/a
Total Antimony	mg/L	-	0.00008	0.000081	1 x	0.00018	0.00018	n/a	0.000082	0.00012	1.5 x	0.00012	0.00022	1.8 x
Total Arsenic	mg/L	0.005	0.00023	0.00025	1.1 x	0.00058	0.00058	n/a	0.00023	0.00056	2.4 x	0.00046	0.0015	3.3 x
Total Barium	mg/L	-	0.0034	0.0035	1 x	0.0085	0.0086	1 x	0.0034	0.0036	1.1 x	0.0066	0.0071	1.1 x
Total Beryllium	mg/L	0.1	0.00012	0.00012	n/a	0.00028	0.00028	n/a	0.00013	0.00013	n/a	0.00017	0.0002	1.2 x
Total Boron	mg/L	0.5	0.0091	0.0096	1.1 x	0.023	0.023	n/a	0.0092	0.016	1.7 x	0.019	0.039	2.1 x
Total Cadmium	mg/L	0.00012	0.000035	0.000034	1 x	0.00011	0.00011	n/a	0.000035	0.000038	1.1 x	0.000049	0.000051	1 x
Total Calcium	mg/L	-	3.3	3.6	1.1 x	8.4	8.5	1 x	3.3	4.3	1.3 x	6.8	9	1.3 x
Total Chromium	mg/L	0.001	0.00052	0.00052	n/a	***0.0013***	***0.0013***	n/a	0.00053	0.00053	n/a	***0.0011***	***0.0011***	n/a
Total Cobalt	mg/L	0.05	0.00016	0.00016	n/a	0.00037	0.00037	n/a	0.00016	0.00018	1.1 x	0.00024	0.00029	1.2 x
Total Copper	mg/L	0.002	0.0013	0.0014	1.1 x	***0.0032***	***0.0033***	1 x	0.0013	0.0017	1.3 x	***0.0026***	***0.0036***	1.4 x
Total Iron	mg/L	0.3	0.19	0.2	1.1 x	***0.48***	***0.48***	n/a	0.2	0.2	n/a	***0.33***	***0.34***	1 x
Total Lead	mg/L	0.001	0.000087	0.000088	1 x	0.0002	0.0002	n/a	0.000089	0.000093	1 x	0.00013	0.00014	1.1 x
Total Lithium	mg/L	2.5	0.01	0.01	n/a	0.028	0.028	n/a	0.01	0.01	n/a	0.023	0.023	n/a
Total Magnesium	mg/L	-	2	2	n/a	5.1	5.2	1 x	2	2.1	1.1 x	4.3	4.7	1.1 x
Total Manganese	mg/L	0.2	0.019	0.02	1.1 x	0.048	0.049	1 x	0.02	0.021	1.1 x	0.033	0.038	1.2 x
Total Mercury	mg/L	0.000016	***0.000031***	***0.00003***	1 x	***0.000092***	***0.000092***	n/a	***0.000032***	***0.000033***	1 x	***0.000046***	***0.000046***	n/a
Total Molybdenum	mg/L	0.01	0.00008	0.000091	1.1 x	0.0002	0.0002	n/a	0.000082	0.00012	1.5 x	0.00014	0.00021	1.5 x
Total Nickel	mg/L	0.025	0.00057	0.00059	1 x	0.0014	0.0014	n/a	0.00057	0.00066	1.2 x	0.0012	0.0014	1.2 x
Total Selenium	mg/L	0.001	0.00028	0.00028	n/a	0.00071	0.00071	n/a	0.00028	0.00029	1 x	0.0006	0.0006	n/a
Total Silver	mg/L	0.00025	0.000031	0.00003	1 x	0.000091	0.000091	n/a	0.000032	0.000033	1 x	0.000046	0.000047	1 x
Total Sodium	mg/L	-	5.8	5.9	1 x	15	15	n/a	5.9	5.9	n/a	13	13	n/a
Total Thallium	mg/L	0.0008	0.000034	0.000033	1 x	0.00012	0.00012	n/a	0.000034	0.000035	1 x	0.000047	0.000048	1 x
Total Uranium	mg/L	0.01	0.00005	0.000053	1.1 x	0.00014	0.00014	n/a	0.000051	0.000062	1.2 x	0.00007	0.000092	1.3 x
Total Vanadium	mg/L	0.1	0.00031	0.00032	1 x	0.00081	0.00081	n/a	0.00032	0.00035	1.1 x	0.00069	0.00076	1.1 x
Total Zinc	mg/L	0.03	0.0056	0.0057	1 x	0.014	0.014	n/a	0.0057	0.0058	1 x	0.0094	0.0099	1.1 x
Total Phosphorous	mg/L	Variable	0.016	0.016	n/a	0.042	0.042	n/a	0.016	0.016	n/a	0.035	0.035	n/a

[1] ***CCME Exceedance shown in bold italics***