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Cambridge Bay
Ikaluktutiak

Gjoa Haven
Okhoktok

Taloyoak

Kugaaruk

Richard Dwyer

Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, Nunavut
X0B 1J0

September 27th, 2019

Re: KIA response to TMAC's response on TMAC's Hope Bay Project 2018 NWB Annual Report.

Dear Richard Dwyer, the KIA has reviewed TMAC's responses to our comments and recommendations to their Hope Bay Project 2018 NWB Annual Report for Project.

Enclosed are our final comments on TMAC's responses for the Hope Bay Project 2018 NWB Annual Report from our consultants. KIA finds that nineteen responses are satisfactory, while seven are only partially satisfactory to the KIA.

Thank you

John Roesch

John Roesch, P.Eng.

Senior Hope Bay Project Officer
Kitikmeot Inuit Association, Department of Lands and Environment

Cc Geoff Clark, Director, KIA, Department of Lands and Environment

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Hope Bay Project 2018 NWB Annual Report

Review Comment Number	KIA-NWB-1
Subject/Topic	Corrective actions for spills of flotation tailings.
Recommendation / Request	The KIA requests that TMAC provide an expected timeline for the installation of a leak detection system on the tailings pipeline.
TMAC RESPONSE TO KIA-NWB-1	TMAC anticipates that the installation of a leak detection system on the tailings pipeline will occur in Q3 2019.
KIA Response to TMAC	TMAC's response is satisfactory. A Leak Detection System is expected to be installed on the tailings pipeline in Q3 2019. This is something that the KIA may wish to check on during site inspections and subsequent correspondence, to ensure it is done in a timely manner, as the wording ("anticipate"), does not denote a clear commitment to a timeline.

Review Comment Number	KIA-NWB-2
Subject/Topic	March 2019 revision of Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan.
Recommendation /Request	The KIA requests that the March 2019 revision of the Hope Bay Waste Rock, Ore and Mine Backfill Management Plan be submitted to the NWB, KIA, and other regulatory bodies for review.
TMAC RESPONSE TO KIA-NWB-2	The March 2019 Waste Rock, Ore and Mine Backfill Management Plan was submitted to the NWB for regulatory approval on January 25, 2019. Following this, a notification for comment was sent out on January 25 2019 and a second notification was sent out on March 8, 2019. On February 13 2019 the KIA submitted a confirmation email to the NWB Indicating no comment.
KIA Response to TMAC	Thank you for the clarification. There was ambiguity as to whether TMAC made further revisions to the Waste Rock, Ore and Mine Backfill Management Plan in March 2019. If no additional changes were made since the KIA reviewed

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	the document submitted on January 25, 2019, then TMAC's response is satisfactory.

Spill Contingency Plan

Review Comment Number	KIA-NWB-3
Subject/Topic	Immediately reportable spill volume for miscellaneous products, substances, or organisms.
Recommendation/ Request	The KIA recommends that TMAC confirm spill-reporting thresholds with the GN and GNWT, and to update the information presented in the Immediately Reportable Spills, if needed.
TMAC RESPONSE TO KIA-NWB-3	TMAC will investigate to determine the correct reportable quantity and include in the next update of the Spill Contingency Plan if required.
KIA Response to TMAC	TMAC's response is satisfactory. The correct reportable quantity for miscellaneous products, substances, or organisms will be determined with the GN and GNWT and will be included in the next update of the Spill Contingency Plan, if required.

Review Comment Number	KIA-NWB-4
Subject/Topic	Missing or incorrect contact information for external reporting audiences.
Recommendation/ Request	The KIA requests additional information about spill reporting requirements for Transport Canada, and that contact information be included in the Plan for TC's Marine Safety Inspector. The KIA also recommends that TMAC confirm the correct contact information for the CIRNAC Inspector and update the table of Key Government Contacts, if needed.

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TMAC RESPONSE TO KIA-NWB-4	TMAC will ensure the correct contact information for the CIRNAC inspector is up to date with key Government Contacts in the next annual update of the Spill Contingency Plan.
KIA Response to TMAC	TMAC's response is partially satisfactory. They will confirm and include the correct contact information for the CIRNAC inspector in the next update of the Spill Contingency Plan. However, TMAC did not address the KIA's comment regarding marine spills and reporting requirements to a Transport Canada Marine Safety Inspector. Request to TMAC: Please include contact information for the Marine Safety Inspector in the list of Key Government Contacts and indicate the situation(s) in which the Marine Safety Inspector needs to be notified in the next update of the Spill Contingency Plan.

Review Comment Number	KIA-NWB-5
Subject/Topic	Spill kit locations at Doris and Boston.
Recommendation/ Request	The KIA recommends that updated photos or site diagrams, with appropriate scale indicators, be included in the next version of the Hope Bay Spill Contingency Plan.
TMAC RESPONSE TO KIA-NWB-5	TMAC will ensure updated site diagrams will be included in the next annual update of the Spill Contingency Plan.
KIA Response to TMAC	TMAC's response is satisfactory. Updated site diagrams will be included in the next annual update of the Spill Contingency Plan. The KIA expects that site diagrams will include scale bars to be able to accurately review the location of spill kits.

Review Comment Number	KIA-NWB-6
Subject/Topic	Emergency response for a Jet-A fuel spill to water.
Recommendation/ Request	The KIA requests that additional information regarding spills to water be included in the Jet-A Specific Spill

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	Response Plan, such as the party (ies) responsible for clean-up/treatment.
TMAC RESPONSE TO KIA-NWB-6	TMAC will provide additional information to the Aviation Fuel (Jet-A) Specific Spill Response Plan in the next annual update of the Spill Contingency Plan.
KIA Response to TMAC	TMAC's response is satisfactory. Additional information regarding Jet-A spills will be provided in the next annual update of the Spill Contingency Plan.

Review Comment Number	KIA-NWB-7
Subject/Topic	Proposed hierarchy for spill response prioritization and environmental resource maps.
Recommendation/ Request	The KIA requests that the proposed prioritization hierarchy in Section 2.2.16 of the Spill Contingency Plan be revised to a level of detail that is compatible with the Environmental Sensitivity Mapping for this project. The KIA also requests that Environmental Sensitivity Maps be provided to Project personnel in a larger format and at higher resolution, such that they are useful for emergency spill response.
TMAC RESPONSE TO KIA-NWB-7	TMAC would like to take the opportunity to re-visit the response hierarchy to reflect operational experience. TMAC's first priority in any spill incident is to stop the source of the spill (if not already accomplished at the time discovered), then to prevent the spread and contain the spill and then to assess the best method to remove as much of the spilled substance as possible taking into consideration numerous factors including but not limited to land, water, topography, substrate depth, location and season. Safety of personnel is the paramount consideration in all efforts and work plans. Based on the review of Appendix 3 and experience to date, TMAC will re-visit the Environmental Sensitivity Mapping to account for the abiotic and biotic factors that practically guide spill response at Hope Bay. KIA

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	will be engaged on this matter and the potential timing of the next update in the plan.
KIA Response to TMAC	TMAC's response is satisfactory. We appreciate that the proponent is open to revisiting the response hierarchy and Environmental Sensitivity Mapping, and the KIA looks forward to further engagement about this issue.

Review Comment Number	KIA-NWB-8
Subject/Topic	Stronger wording needed for spill-related monitoring.
Recommendation/ Request	The KIA recommends that TMAC use stronger wording within Section 3.4 of the Spill Contingency Plan, i.e. "monitoring will be triggered" rather than "monitoring may be triggered" for various spill response scenarios.
TMAC RESPONSE TO KIA-NWB-8	TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.
KIA Response to TMAC	TMAC's response is partially satisfactory. Please see detailed KIA review comments for KIA-NWB-9 below.

Review Comment Number	KIA-NWB-9
Subject/Topic	Triggered Monitoring of spills to water.
Recommendation/ Request	Please remove the discretionary language in Section 3.4 to so that monitoring is required for (i) all spills to water of substances that dissolve or sink which are unlikely to be recovered and (ii) all

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	externally reportable spills to land of substances unlikely to be fully recovered. Please specify under what conditions monitoring will be triggered for spills (i) and (ii) (e.g., type of spill, volume, mobility, proximity to sensitive environmental features), what parameters will be collected, and how soon after a spill triggered monitoring will be implemented.
TMAC RESPONSE TO KIA-NWB-9	TMAC is committed to the application of the appropriate spill prevention, response, monitoring and restoration activities outlined in the Spill Contingency Plan. TMAC believes that it is not practical to establish specific thresholds for various spill response scenarios as there are many and monitoring and restoration activities would need to be determined on a case-by-case basis. Where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA.
KIA Response to TMAC	TMAC's response is the same as for KIA-NWB-8, which is partially satisfactory. The proponent states that "where deemed appropriate, monitoring and restoration programs would be developed in consultation with the CIRNAC Inspector and the KIA." As evidenced by comments KIA-NWB-8 and -9, the KIA believes that monitoring and restoration programs should be developed prior to spill events as part of spill response planning and preparedness and to show an understanding of the potential effects of spills on land and in water. These programs can then be adapted, in a timely manner, to each spill response scenario on a case-by-case basis. We appreciate that TMAC's monitoring and restoration programs will be developed in consultation with the KIA; however, we recommend that consultation about spill response and triggered monitoring occur as soon as possible. KIA acknowledges that spill response varies depending on numerous factors (including type of substance, location of spill, volume, proximity to sensitive environmental features etc.), all spills need to be monitored to help determine what response is appropriate. Furthermore, in the case of spills to water and land that are unlikely to be recovered, it is paramount that monitoring be conducted to track whether these spills cause any adverse environmental effects, so that effective mitigation measures can be implemented.

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	Consequently, the discretionary language in the guidelines for monitoring spills under Section 3.4 should be removed and replaced with wording stating that monitoring is required for all spills described under (i) and (ii) in our prior recommendation. The KIA also requests clarification about situations in which TMAC would deem it appropriate to develop appropriate monitoring and restoration programs in consultation with the CIRNAC Inspector and the KIA (e.g., compared to when it would be inappropriate to do so).

Review Comment Number	KIA-NWB-10
Subject/Topic	Spill kit location at Patch Laydown Facility.
Recommendation/ Request	Please clarify whether any fuel storage and spill kit locations exist at the Patch Laydown Facility.
TMAC RESPONSE TO KIA-NWB-10	Fuel and chemical storage facilities have been removed from the Patch Laydown Facility. Plate B.2 will be removed in the next annual update of the Spill Contingency Plan.
KIA Response to TMAC	TMAC's response is satisfactory. The Patch Laydown Facility no longer has fuel/chemical storage and thus no spill kits are needed. Plate B.2 will be removed in the next annual update of the Spill Contingency Plan.

Review Comment Number	KIA-NWB-11
Subject/Topic	Mitigation measures for settlement of tanks.
Recommendation/ Request	Please explain what management action is taken if settlement of the fuel tanks at the Boston site is detected during routine monitoring.
TMAC RESPONSE TO KIA-NWB-11	If settlement of the fuel tanks at the Boston site are detected beyond an acceptable limit, TMAC will discontinue the use of the tank(s) that are effected by settlement and engage the Engineer of Record (SRK Consulting) for guidance and

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	recommendations for correcting the settlement issue. TMAC will continue to monitor permafrost and physical stability of site infrastructure on an ongoing basis and will take a proactive approach to risks identified
KIA Response to TMAC	TMAC's response is satisfactory. Mitigation measures for settlement of tanks at Boston include discontinued use of the fuel tanks and consultation with the Engineer of Record (SRK Consulting) for guidance and recommendations.

Aquatic Effects Monitoring Program (AEMP)

Review Comment Number	KIA-NWB-12
Subject/Topic	Comparison to all previous years' data for exposure areas to baseline data.
Recommendation/ Request	Please include a comparison to all previous years' results including 2017 to provide the reviewer with greater context to help establish if trends noted are due to the mine or natural variability.
TMAC RESPONSE TO KIA-NWB-12	For the purposes of the AEMP, true baseline data are considered to be data collected prior to 2010, as Doris Mine construction began in 2010. However, all available historical data from 1995 to 2018 were included in the trend analysis (including data from 2017). Table B.1-1 in Appendix B summarizes all the data used in the analysis, and provides a rationale for any data that were excluded from the analysis. Figures 3.2-1 to 3.4-1 in the main body of the 2018 AEMP report show all the years of data used in the evaluation of each parameter.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-13
Subject/Topic	Measurement of water conductivity under ice.

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Recommendation/ Request	Please add specific conductivity to the physical limnology parameter list specifically for under-ice conditions or provide a rationale as to why this parameter was not included.
TMAC RESPONSE TO KIA-NWB-13	Although field measurements of conductivity were not always collected due to the type of profiling Sonde used, conductivity was consistently included in the suite of water quality parameters analyzed by the laboratory (ALS). Therefore, conductivity data are available for any future assessment of mine-related effects or cryo-concentration.
KIA Response to TMAC	TMAC has indicated that conductivity is consistently measured under ice and update their monitoring plan accordingly. TMAC should further commit to reporting these data in future annual reports. This response is only partially satisfactory.

Review Comment Number	KIA-NWB-14
Subject/Topic	Handling of QA/QC data that fails to meet RPD threshold of 50%.
Recommendation/ Request	Please describe how QA/QC data that failed to meet the RPD threshold of 50% were handled including: 1) if they those samples were considered contaminated, and 2) whether they were included in the effects analysis. If these samples were included in the analysis, please provide rationale was to why they were deemed appropriate to evaluate conditions in the aquatic environment what the implications their inclusion may have on when characterizing the aquatic environment.
TMAC RESPONSE TO KIA-NWB-14	For each of the three parameters for which the RPD was greater than 50% total manganese in Doris Lake North in April (RPD of 54.9%), dissolved orthophosphate in Doris

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	Lake North in July (RPD of 118%), and total nickel in Doris Lake North in August (RPD of 69.0%), the questionable data were examined to determine whether any of the conclusions of the effects analysis could have been impacted by these potentially contaminated samples. In all three cases, there was determined to be no need to exclude these samples, as the questionable results had no impact on final conclusions. Total manganese and dissolved orthophosphate are not evaluated parameters in the AEMP, so the raw data results are included only the appendices and are not discussed in the main report. Total nickel is an evaluated parameter; however, the August data were within the range of historical concentrations, and the statistical and graphical analyses did not find any evidence of a change in nickel concentrations over time. Therefore, potential contamination issues in August of 2018 did not lead to unusually elevated concentrations and did not influence the results of the effects analysis. As the potentially contaminated samples did not affect the conclusions of the AEMP, the samples were not excluded, but simply flagged in the QA/QC section.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-15
Subject/Topic	Contamination of water samples.
Recommendation/ Request	Please update the aquatic effects monitoring program to include protocols to prevent future contamination from the GO-FLO sampler. These protocols should be adopted for the remainder of the 2019 monitoring season and the updated AEMP should be included with the 2019 annual report.
TMAC RESPONSE TO KIA-NWB-15	A thorough rinsing protocol for the GO-FLO is already in place and documented in the AEMP (e.g., see sections A.1.5 and A1.5.1 of the 2018 AEMP). The same protocol will be in place during the 2019 AEMP; therefore, no change to the AEMP is warranted. The protocol is as follows: prior to

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	initiation of the sampling program, the GO-FLO is sent to ALS for acid washing to remove potential contaminants from handling, storage, and/or previous sampling programs. Once at site, the GO-FLO is again rinsed 3 times with lab-provided deionized water prior to the collection of an equipment blank. To collect an equipment blank the GO-FLO is again filled with lab-provided deionized water and subsamples are decanted from the GO-FLO using the same manner as for field collected samples. During sampling, the GO-FLO sampler is lowered into the water column in an open configuration, allowing lake water to pass through the sampler. This process thoroughly rinses the GO-FLO with site-specific water prior to sample collection. Therefore, even if some contamination is occasionally present in the sampler prior to sample collection (which would be detected in the equipment blank), it is unlikely that contamination would be introduced to the water quality sample because of this thorough rinse with site-specific water.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-16
Subject/Topic	Exclusion of earlier water quality data.
Recommendation/ Request	Please provide rationale for excluding any data, which has been collected but not brought forward for additional analysis as part of the assessment of aquatic effects in the annual report.
TMAC RESPONSE TO KIA-NWB-16	The rationale for exclusion of April 1998 data was accidentally omitted from Table B.1-1. The 1998 sampling site location is the same as the 1997 location (see Figure 2.2-3 of the 2018 AEMP report), and the rationale for exclusion of 1998 data is the same rationale given for the exclusion of 1997 data “samples were collected from a sampling location further south than current AEMP site”.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

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Review Comment Number	KIA-NWB-17
Subject/Topic	Triggers for low action level.
Recommendation/ Request	Please, provide an alternate method of triggering a low action level when concentrations of a parameter at Reference B are below detection for more than 60% of samples and statistical comparison between Doris North and Reference B cannot be performed.
TMAC RESPONSE TO KIA-NWB-17	In a situation where the analysis cannot proceed for the reference lake because of the high proportion of censored data, a trend analysis would still proceed for Doris Lake North provided that less than 60% of the dataset was censored for this exposure lake; however, it would not be possible to compare the trend in Doris Lake North to the reference lake trend. If the trend analysis shows that there is an observed increase in a parameter concentration in Doris Lake North and it is not possible to compare this trend to the reference lake because of the high proportion of non-detects, the conservative approach of not ruling out a mine effect is taken. In this case, condition 3 of the low action level trigger would me met (the absence of a similar change at the reference location) simply because the analysis could not be undertaken for the reference station. This was the case for total molybdenum concentrations in the 2018 AEMP (see Section 3.3-19). There was evidence of an increase in total molybdenum concentration in Doris Lake North (so condition 1 was met), more than 60% of the reference lake concentrations were below detection so it could not be confirmed that a similar change occurred at the reference location and a mine-effect could not be ruled out (so condition 3 was met); however, since total molybdenum concentrations remained far below 75% of the CCME guideline, condition 2 was not met, and the low action level was not exceeded. This example demonstrates that the conditions for triggering a low action level are robust to situations where

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	concentrations are mostly below detection limits in the reference lake, but are potentially increasing at the exposure lake. A low action level can still be exceeded if the reference site data are highly censored and cannot be included in the analysis.
KIA Response to TMAC	TMAC has demonstrated that conditions for triggering low action levels are maintained when parameter concentrations are mostly below detection limits in the reference lake. TMAC should include these explanation in future annual reports. This response is partially satisfactory.

Review Comment Number	KIA-NWB-18
Subject/Topic	Water quality trends over seasons.
Recommendation/ Request	Please provide text describing how TMAC will react if all three triggers for a low action level occur for one season (either under-ice or open-water), but not the other to provide the reviewer with confidence that changes in water quality and possible adverse effects to biota are being properly managed.
TMAC RESPONSE TO KIA-NWB-18	The analysis of effects is undertaken separately for each season to increase the likelihood of detecting an effect where an effect is present. If data for all seasons were pooled into a single analysis, variability would be increased and the ability to detect an effect where an effect is present would be reduced. The low action level is triggered if the trends and concentrations in either of the two seasons meet the conditions outlined in the Doris AEMP response framework. As written, the conditions apply to each individual analysis, (or parameter-season combination) undertaken as part of the evaluation of effects. This is a conservative approach that is most protective of the environment.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

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Review Comment Number	KIA-NWB-19
Subject/Topic	Variation in under ice nitrate concentrations in Doris North Lake.
Recommendation/ Request	Please provide text describing the possible source of nitrate at the mine in the context of increased under-ice nitrate concentration at Doris North and mitigation measures that may be implemented if concentrations continue to increase.
TMAC RESPONSE TO KIA-NWB-19	We disagree that the graphical evidence suggests that nitrate concentrations are increasing at the exposure site. Although the concentration of nitrate in the deep sample from Doris Lake North in April 2018 was the highest recorded nitrate concentration to date (0.201 mg/L), this concentration was only slightly higher than the deep water concentration in Doris Lake North in May 2007 (0.187 mg/L). Furthermore, the average water column nitrate concentration in April 2018 (0.115 mg/L) was nearly identical to the average for May 2007 (0.117 mg/L). Looking only at the data form the last three years, deep water nitrate concentrations appear to be increasing, but looking more broadly at the trend from 2006 to 2018, concentrations seem to oscillate and are highly variable among years and between depths. Recent data from April 2019 (top: 0.0230 mg/L; bottom: 0.0266 mg/L; unpublished) show that deep-water concentrations have dropped by nearly an order of magnitude between April 2018 and April 2019, further supporting the observation that concentrations are variable and there is no increasing trend.
KIA Response to TMAC	TMAC has demonstrated that under-ice nitrate concentrations are highly variable in Doris Lake North, and that maximum and average values in 2018 are similar to baseline maximum and average values from 2007. However, given that the reference lake under-ice nitrate concentrations show far less variation, we still request that TMAC discuss possible reasons for the fluctuating trend at Doris North in comparison to the reference sites, and to identify mitigation measures to be implemented should concentrations continue to rise. This issue is partially resolved.

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Review Comment Number	KIA-NWB-20
Subject/Topic	Aquatic monitoring program – water quality
Recommendation/ Request	If applicable, please provide information about how/why the water quality monitoring that occurred is different from what was set out in the Plan.
TMAC RESPONSE TO KIA-NWB-20	We were not able to find any mention in the AEMP Plan on page 6 or elsewhere that monitoring samples collected under the SNP program would be used to evaluate effects to Doris Lake (TMAC 2016). Could the reviewer please double-check where they might have found this statement? It was stated in the AEMP Plan that data collected in 2015 and prior will be used as before data; however, the categorization of data into "before" and "after" groups was only relevant when the statistical method being used was a BACI (before-after control impact) analysis. Starting in the 2017 assessment year, it was concluded that sufficient data had been collected at the reference and exposure sites to estimate long-term temporal trends, so a trend analysis approach was used instead of a BACI approach, which tends to obscure inter-annual trends. With the trend analysis, there is no need to categorize data into "before" and "after" groups.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-21
Subject/Topic	Water quality
Recommendation/ Request	Please incorporate the above suggestions where applicable.
TMAC RESPONSE TO KIA-NWB-21	TMAC will take these recommendations into consideration for future monitoring reports.

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KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-22
Subject/Topic	Water quality
Recommendation/ Request	Please incorporate the above suggestion in future reports.
TMAC RESPONSE TO KIA-NWB-22	Noted. This change will be incorporated for future AEMP reports.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-23
Subject/Topic	Water quality
Importance	Moderate
References	TMAC Resources Doris Project 2018 Aquatic Effects Monitoring Program Report (Version: B.1, March 2019)
Summary	The methodology for dealing with non-detect water quality data is not clear.
TMAC RESPONSE TO KIA-NWB-23	The treatment of non-detects is detailed in Appendix B, Section B.2.1.1 of the 2018 AEMP. The text from this section is reproduced here: "If all data in the current assessment year (2018) were below the detection limit, no regression analysis was performed for that variable. If a large amount of data (> 60%) from a lake were below the detection limit, the lake was removed from the analyses and inference was based on plots of the observed data. In cases where the reference lake was removed, it was not possible to make comparisons with the monitored lake and

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	inference was based on plots of the observed data. Linear mixed effects (LME) regression or Tobit regression analysis was used to test whether or not there was evidence of time trend at each monitored lake. Tobit regression was used when a moderate amount of data (between 10 and 60%) from a given lake were below the detection limit. For LME models, observations below the analytical detection limit were substituted by half the detection limit. Then, the lake, year (as well as depth and season, if applicable) average was calculated. For Tobit models, the fact that each censored measurement falls between 0 and the detection limit was used to obtain the estimated range for the average in a given lake and year (as well as depth and season, if applicable). This interval was used in the Tobit regression analysis."
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-24
Subject/Topic	Water quality
Recommendation/ Request	Please note the additional parameters for future reporting.
TMAC RESPONSE TO KIA-NWB-24	All evaluated water quality parameters including those noted above (turbidity, boron, iron, chromium) are being watched closely and will continue to be watched closely through the AEMP. The evaluation of effects methodology is based on both statistical analysis and graphical of trends over time, and trends between the reference and exposure sites. For turbidity and boron, based on a visual examination of the trends (graphical analysis), the discussion provided in the 2018 AEMP does state that concentrations of these parameters appear to have increased slightly over time in Doris Lake (at least over certain years), but the statistical analysis reveals in both cases that these potentially increasing trends are not significantly different from the

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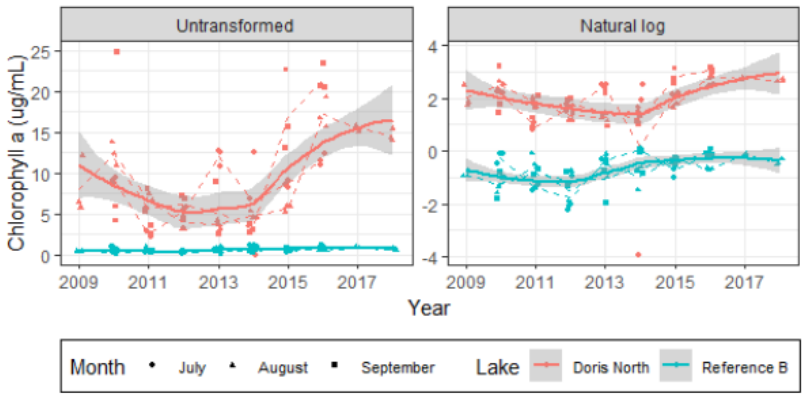
trends observed in Reference lake B, so a Project related increased is ruled out.

For iron, both the graphical and statistical analyses show that trends in Doris Lake have been generally consistent over time. Iron will continue to be closely monitored for signs of an increase.

Only 2 out of 12 samples collected in Doris Lake in 2018 contained detectable concentrations of total chromium, and due to the high proportion of data below detection limits in the historical dataset, trends could not be evaluated statistically. Although there is no apparent increase over time, there were 2 exceedances of the CCME guideline since 2017. However, sporadic increases above the CCME guideline have also been observed in samples from Reference Lake B, and are not necessarily indicative of a Project effect.

Regarding chlorophyll, although the trend in Doris Lake appears to increase over time, the evidence suggests that a similar change was evident in Reference lake B, as there is no statistical evidence of a differential trend in chlorophyll over time in these lakes. Therefore, the increase was concluded to be unrelated to the Project. It is difficult to see the trend in Ref B in the graph presented in the main report (see left panel below), but Appendix B of the 2018 AEMP Report shows the untransformed data alongside the log transformed data (see right panel below), and the similarity in trends is much more evident in the log-transformed graph.



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	Regarding the suggestion to increase the p-value for determination of significance from 0.05 to 0.1, it is difficult to justify using a different p-value for the chlorophyll analysis than the p-value used for all other analyses. The use of 0.05 is already considered conservative given the large number of analyses that are run, as this would result in a false positive rate of 5% (i.e., 5% of statistical analyses would produce a p-value of less than 0.05 by chance alone where an effect is not actually present). Adjusting this to 10% would result is twice the number of false positives if this were applied to all analyses. Here is the justification provided in the 2018 AEMP for the use of a p-value of 0.05 for the determination of significance: "Any statistical analysis can result in a type I error (finding a significant where an effect is not present, i.e., false positive) or a type II error (failing to find a significant effect where an effect is present, i.e., false negative). In the monitoring context, a false positive is more tolerable than a false negative. There is a direct trade-off between the two error rates, as reducing one type of statistical error generally increases the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. Therefore, there may be false positives in the analyses that were conducted, which is a conservative and environmentally protective approach. For this AEMP, the unadjusted type I error rate (or significance level) was set to 0.05, indicating that approximately 5% of the time, statistical results will show a significant effect (i.e., p value of < 0.05) by random chance alone where an effect is not actually present."
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-25
Subject/Topic	Water quality
Recommendation/ Request	Please provide additional rationale about why Linear Mixed Effects model is the appropriate statistical test for water quality changes.

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TMAC RESPONSE TO KIA-NWB-25	A linear mixed effects (LME) model is an extension of the linear regression model with the addition of random effects. A LME model was used to account for potential sources of random variation, such as those that affects all measurements in all lakes in a given year. As mentioned in the methods section on random variation: "Random sources of variation can affect variable measurements. Potential sources of variability include environmental factors affecting all lakes equally in a given year, sampling variation that affects samples taken from a lake in a single year, and true measurement errors from laboratory analysis. The main sources of variation can be broken down into two components: yearly effects that affect the measurements in all lakes and effects that affect each lake individually. Random effects are included in the LME model to account for these sources of variation." A linear model is "linear" in its model parameters, and not in the trend that it fits. For example, a simple linear model can be expressed as: Y = B0 + B1X1, Where Y is the response, B0 is the intercept, B1 is often called the slope term, and X1 is the explanatory variable (for example, time). In this model, the trend is linear and monotonic. However, higher order terms (for example, squared or cubed) can be included to describe non-linear trends. For example, if time was also included as a squared term in the form: Y = B0 + B1X1 + B2(X1^2). This model produces the fit shown below:

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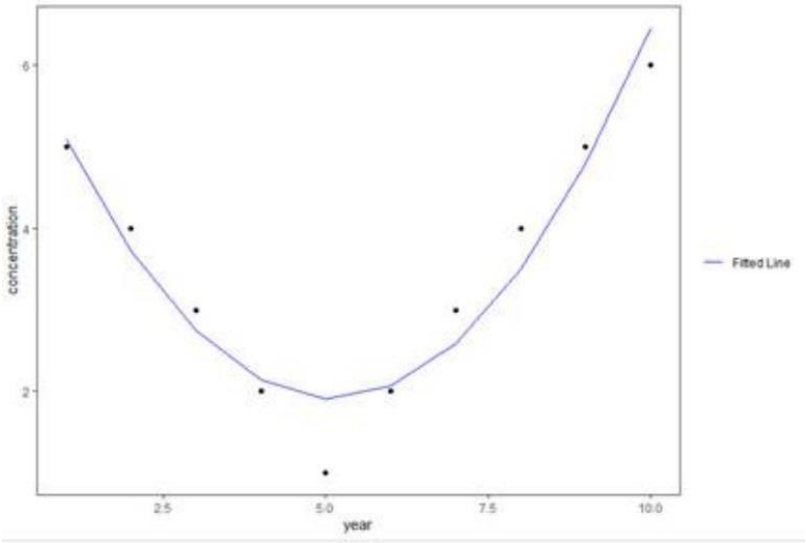

Therefore, a linear model is not constrained to capture monotonic linear trends.

Depending on the model setup, step-wise trends and curvi-linear trends may also be characterized.

The LME model used in the 2018 AEMP utilizes splines to capture trends over time. Splines do not constrain the trends to straight lines or monotonicity. For non-linear trends, spline fits provide a better characterization of the trends over time and capture more of the fluctuation shown in the data. If the data were suggesting step-wise or non-linear trends, the splines would show indication of such patterns.

Treating the data by phase or before vs. after is preferred if the number of years of data is limited. In the 2018 AEMP, up to 14 years of data were available for analysis. If the data were treated by phase or before vs. after, the actual resolution of the data would be lost, as in, an overall average would be assigned to each phase or period and the variation or change between years cannot be assessed. A simple average may mask the true patterns in the data.

Fitting time trends to the data using LME allows for the graphical and statistical assessment of long-term trends. Comparison of trends to reference sites give indication whether trends may be 'natural'. Seasonality (open-water vs. under-ice) was accounted for in the LME as separate time

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	trends and overall averages (intercepts) were estimated for each lake-season group.
KIA Response to TMAC	KIA is satisfied with TMAC's response.

Review Comment Number	KIA-NWB-26
Subject/Topic	Water quality
Recommendation/ Request	Going forward, it is requested that impacts of the morphological differences between Reference Lake B and Doris Lake North be discussed in more detail in the results.
TMAC RESPONSE TO KIA-NWB-26	Where relevant to the discussion of observed differences between lakes, morphological characteristics could be discussed in the AEMP to explain these differences. In the 2018 report, molybdenum was the only variable for which a possible mine effect was identified. In this case, molybdenum concentrations in the Reference Lake B could not be assessed or compared to the concentrations in Doris Lake due to the high proportion of concentrations below detection limits in the reference lake; therefore, a discussion of morphological differences between these lakes was irrelevant.
KIA Response to TMAC	KIA is satisfied with TMAC's response.