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AQUATIC EFFECTS MONITORING PROGRAM ANNUAL 2017 REPORT – PLAIN LANGUAGE BRIEFING AND TECHNICAL REVIEW COMMENTS

Technical Memorandum # 367-18-04

Prepared for:

Environmental Monitoring Advisory Board (EMAB)
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1.0 BACKGROUND AND SCOPE OF WORK

Diavik Diamond Mines (2012) Inc. (DDMI) submitted the 2017 Aquatic Effects Monitoring Program (AEMP) Annual Report on April 13, 2018 in accordance with Part J, Condition 8 and Schedule 8, Condition 4 of Water Licence W2015L2-0001 (Golder 2018).

The Wek'eezhii Land and Water Board (WLWB) noted the following for the review of the 2017 AEMP (the Report):

"The AEMP represents an extensive monitoring program, which includes the monitoring of water, sediment, and several types of living organisms around the Diavik site. In the cover letter with the Report, DDMI states that "sampling was carried out according to the requirements specified in the AEMP Study Design Version 4.1 for an interim monitoring year, which included sampling in the [near-field] NF and [mid-field] MF areas of the lake".

DDMI also indicated in the cover letter that the Report includes revisions as required under the Board's decisions on the 2014, 2015 and 2016 (Version 1 and Version 1.1) AEMP Annual Reports and that Action Level exceedance reporting was required as per Part J, Condition 6 of the Licence."

North/South Consultants Inc. (NSC) conducted a technical review of the 2017 AEMP Annual Report for the Environmental Monitoring Advisory Board (EMAB). The following aquatic environment components were reviewed by NSC personnel with technical knowledge and expertise in each of the areas: dust; effluent and water chemistry; plankton; and eutrophication indicators. As directed by EMAB in their Scope of Work for the review, the following points were considered:

- Diavik responses to previous North/South recommendations, if applicable;
- Appropriateness of sampling timing and frequency;
- Quality of data collected;
- Methods used to analyze data;
- Adequacy of discussion of results;
- Implications of results;
- Defensibility of conclusions and recommendations;
- Emerging issues that may indicate environmental change over time;
- Unanticipated project-related effects;

- Action levels reached and adequacy of proposed follow-up;
- Adaptive management responses; and
- Include recommendations on improvements to monitoring/management actions for EMAB's consideration.

Section 2 provides a plain language briefing of the key review comments, along with recommendations for consideration by EMAB. Detailed technical review comments and recommendations are provided in Table 1, and in the Excel comments template as required for submission to the WLWB.

2.0 PLAIN LANGUAGE BRIEFING

The following sections present a plain language briefing of NSC's comments in relation to the points identified by EMAB for evaluation during the review of the 2017 AEMP Annual Report, and any additional review comments and recommendations borne from this review. The following sections present key comments for discussion by EMAB members and refer to:

- presentation and discussion of pH monitoring results;
- discussion of temporal patterns for several metals in the mixing zone;
- dissolved oxygen (DO) results and discussion;
- effluent and water quality assurance/quality control (QA/QC) sample results;
- phytoplankton QA/QC results and discussion;
- spatial extent of effects for eutrophication indicators discussion;
- inclusion of results for LDS-4;
- increasing Trend for total nitrogen (TN) along transect MF2-FF2
- discussion of anthropogenic loading of total phosphorus (TP);
- methods for estimating the spatial extent of effects on nutrients; and
- review of QA/QC duplicate sample results for nutrients.

To aid in this discussion, useful figures (and corresponding numbering and captions) are included from the 2017 AEMP Annual Report.

The technical review comments (Table 1) include additional detailed comments that recommend various revisions to clarify either the presentation of results and/or their interpretation to improve the overall quality of the report; these comments are excluded from the discussion below.

2.1 EFFLUENT AND WATER QUALITY

2.1.1 Discussion of pH Results

Section 3.3.1 (Results and Discussion, Effluent and Mixing Zone Water Quality) of the Main Report (page 22) indicates: "Field pH values measured at the mixing zone boundary in 2017, particularly during the ice-cover season, were below the Effects Benchmark value of 6.5; however, pH throughout Lac de Gras was often measured below this Effects Benchmark, in both ice-cover and open-water seasons, at various depths, and over time (i.e., 2002 to 2016)."

It is understood that pH is not considered within the Substance of Interest (SOI) identification process. However, it would be beneficial to include some discussion of pH in the effluent for comparison to the lake monitoring results within this section of the report. This would assist with an overall presentation of potential mine-related effects on pH.

It would also be beneficial to provide baseline information on pH in Lac de Gras (i.e., prior to 2002) in the discussion as normal ranges have not been derived for this metric.

Recommendation 1: Include results for pH in effluent and incorporate into the discussion of pH monitoring results for Lac de Gras.

Recommendation 2: Include baseline pH results for Lac de Gras to facilitate an evaluation of potential changes to this metric over time.

2.1.2 Temporal Patterns in Antimony, Molybdenum, and Uranium in the Mixing Zone

Appendix II, Effluent and Water Chemistry Report, Section 3.2.3 (Results, Trends in Effluent and at the Mixing Zone Boundary, Total Metals; page 36) indicates: "For most total metal SOIs, concentrations in the effluent were greater than the concentrations measured at the mixing zone boundary in 2017, indicating that the Mine effluent is a source of these variables to Lac de Gras. One exception was copper, where concentrations in the effluent were generally similar to or less than those recorded at the mixing zone boundary (Figure 3-13B/C). Lead and tin also had concentrations in the effluent that were generally similar to those at the mixing zone boundary (i.e., often below the DL), although sporadic elevated concentrations of these two variables occurred in the effluent which were greater than the measured concentrations at the mixing zone boundary (Figures 3-14B/C and 3-18B/C)."

The temporal pattern of effluent concentration and loading for several metals including antimony (Figure 3-11; page 38), molybdenum (Figure 3-15; page 42), and uranium (Figure 3-19; page 46) was not reflected in the mixing zone water quality results. Specifically, concentrations in the mixing zone decreased, and were notably lower than the effluent concentrations, in the open-water season despite increased concentrations in, and loading from, effluent.

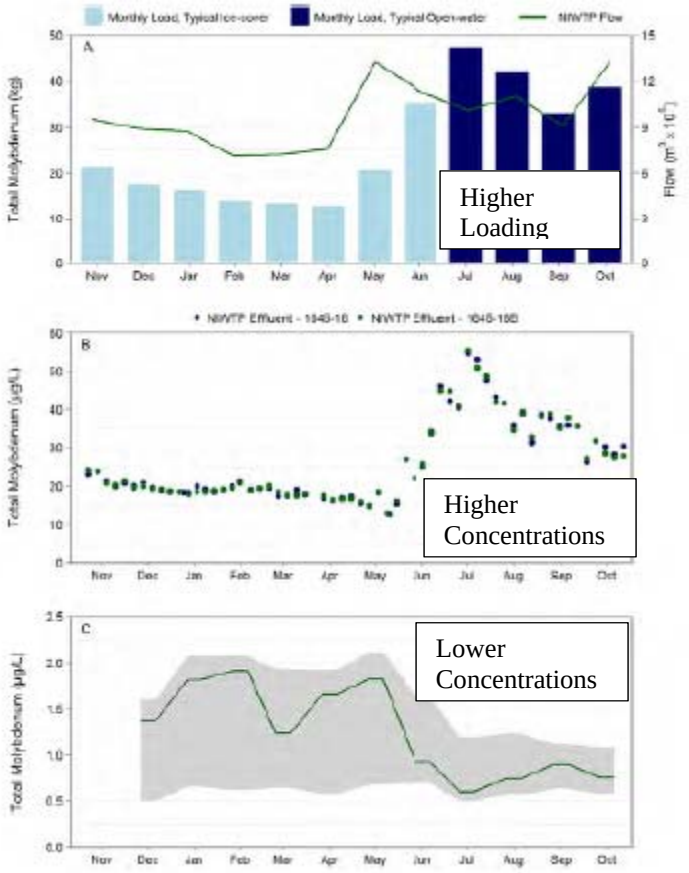


Figure 3-15. Molybdenum: A) Monthly Loading Rate from the North Inlet Water Treatment Plant and Concentration in B) Effluent and at C) the Mixing Zone Boundary (after Golder 2018).

Recommendation: Include a discussion of these observations in the report, including where feasible, potential or conceptual explanations.

2.1.3 Dissolved Oxygen Results and Discussion

Section 3.3 (page 53) only compares DO monitoring results to the 6.5 mg/L Canadian Council of Ministers of the Environment (CCME) protection of aquatic life (PAL) guideline (CCME 1999; updated to 2018). NSC had commented (NSC 2018) previously that DO results should be compared to both the 6.5 mg/L (early life stages absent) and the 9.5 mg/L (early life stages present) CCME PAL guidelines (CCME 1999; updated to 2018) where applicable.

The CCME 9.5 mg/L benchmark for early life stages would be more appropriate for fall spawning species such as Lake Trout. Indications of these guidelines on the depth profile figures would also greatly improve the ability to readily assess where exceedances occurred (Note: this would also apply for pH).

Recommendation 1: Include a comparison of DO monitoring results to the appropriate benchmarks (i.e., 6.5 and 9.5 mg/L).

Recommendation 2: Add 6.5 and 9.5 mg/L benchmarks for DO and pH benchmarks to depth profile figures.

2.1.4 Quality Assurance/Quality Control Sample Results

The Effluent and Water Chemistry Report Appendix B (QA/QC Methods and Results; page B-3) indicates that duplicate sample results were considered "notable" where the Relative Percent Difference (RPD) was greater than 40%. This criterion is higher than used in previous reports. For example, in the 2017 AEMP Annual Report (Golder 2017), the criterion was 20% for evaluating duplicate sample results (Appendix II, Appendix C, page C-3). The same criterion (40%) is also identified in Appendix XIII, Eutrophication Indicators Report, Appendix C (Quality Assurance and Quality Control; page C-3).

Recommendation: Review the text and revise (if the value was reported in error) or provide a rationale for the change in the RPD criterion for evaluating duplicate sample results.

2.2 PLANKTON

2.2.1 Phytoplankton QA/QC Results and Discussion

The QA/QC review of phytoplankton data considers results for counts (i.e., abundance) and not biomass (Appendix XI, Plankton Report, Appendix A, Quality Assurance and Quality Control, page A-4, Table A-1, and Appendix B - Raw Plankton Data). However, the plankton component of the AEMP is focussed on results for phytoplankton biomass and not abundance. It is recommended that an analysis and discussion of QA/QC results for biomass, in addition to abundance, be provided. Phytoplankton biomass is derived from two estimates: (1) counts of algal cells; and (2) measures/estimates of cell biovolume. Phytoplankton biomass results are therefore affected by an additional source of variability (i.e., biovolume measurements) beyond measures of algal abundance.

A similar comment was submitted in the review of the 2016 Annual AEMP Report (NSC 2017): "Comparison of duplicate phytoplankton samples should be done both for abundance (i.e., cell counts) as well as biomass. The latter is typically more variable than the former as it is derived from two measurements (cell counts and algal cell size). As biomass is the metric of concern for the AEMP QA/QC should focus on this metric."

Recommendation: Provide an analysis and discussion of phytoplankton biomass QA/QC results.

2.3 EUTROPHICATION INDICATORS

2.3.1 Spatial Extent of Effects Discussion

Section 4.3.3 reads: "The boundary of effects on concentrations of TN to the northwest extended to at least Station MF1-5; however, the extent of effects along the MF1-FF1 transect could not be assessed further, because sampling in the FF1 area was not completed in 2017 as part of the interim program. The extent of effects to the northeast of the Mine extended to the end of the MF2-FF2 transect (Station FF2-5). The boundary of effects south of the Mine extended to between stations MF3-6 and MF3-7. The resulting affected area of the lake based on concentrations of TN was estimated as greater than or equal to 240 km^2, or greater than or equal to 41.9% of lake area, which is less than reported in 2016, but comparable to the affected areas calculated for this variable in previous years."

The last sentence should be modified to clearly state that direct comparisons to 2016 results are not possible due to the lack of sampling in far-field (FF) areas in 2017.

As noted in previous comments (e.g., Section 2.4.3, NSC 2018 and row 35 in associated excel submission), comparisons of spatial extent of effects between years for eutrophication indicators should be done with caution and should include explanatory text identifying the limitations of inter-annual comparisons in light of the lack of sampling in the FF areas in interim years.

Note that although this comment and the recommendation below refer specifically to TN, both are intended to apply to all discussions of eutrophication indicators. It is noted that a similar issue occurs in the discussion of chlorophyll *a* results.

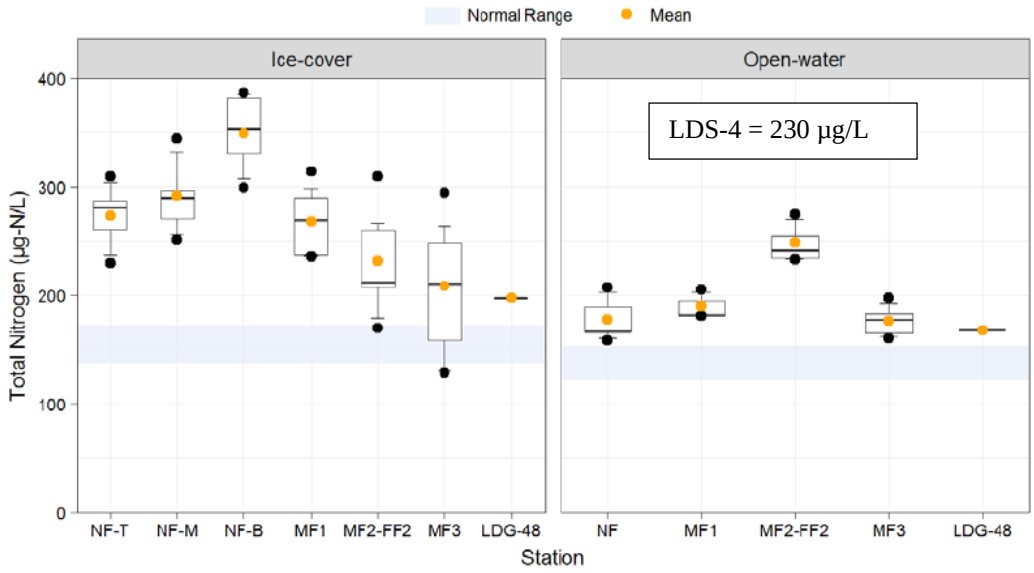
Recommendation: Include a qualifying statement indicating that due to the lack of FF data for 2017 and the implications regarding limitations on defining the spatial extent of effects in those years, comparison to 2016 or other years is associated with uncertainty.

2.3.2 Inclusion of Results for LDS-4

The discussion and graphical plots of results for nutrients in Lac de Gras within the eutrophication indicators section (Main Document, Section 4.3.2, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, pages 34-35) does not include results for the inflow to Lac de Gras (i.e., Site LDS-4), though it is noted that some discussion of results for this site are provided in Appendix XIII (e.g., pages 34-43).

Inclusion of monitoring results for site LDS-4 within the Main Report would assist with interpretation of results. For example, TN concentrations were notably higher in the MF2-FF2 transect in the open-water season (Main Document, Figure 4-4, page 25); it would be of interest to compare these results to the upstream site at the lake inflow to evaluate the potential influence of upstream conditions on this transect. Qualitative review of the raw data files suggest that the

inflow of Lac de Gras contained a higher concentration of TN than the MF1, MF3, and NF areas and may have contributed to the relatively higher concentrations of TN observed along transect MF2-FF2 in the open-water season (the report notes that no sample was collected from LDS-4 in winter).



NF = near-field; MF = mid-field; FF = far-field; LDG-48 = Lac de Gras outlet; T = top depth; M = middle depth; B = bottom depth.

Figure 4-4. Concentrations of Total Nitrogen in Lac de Gras during the Ice-Cover and Open-Water Seasons, 2017 (after Golder 2018).

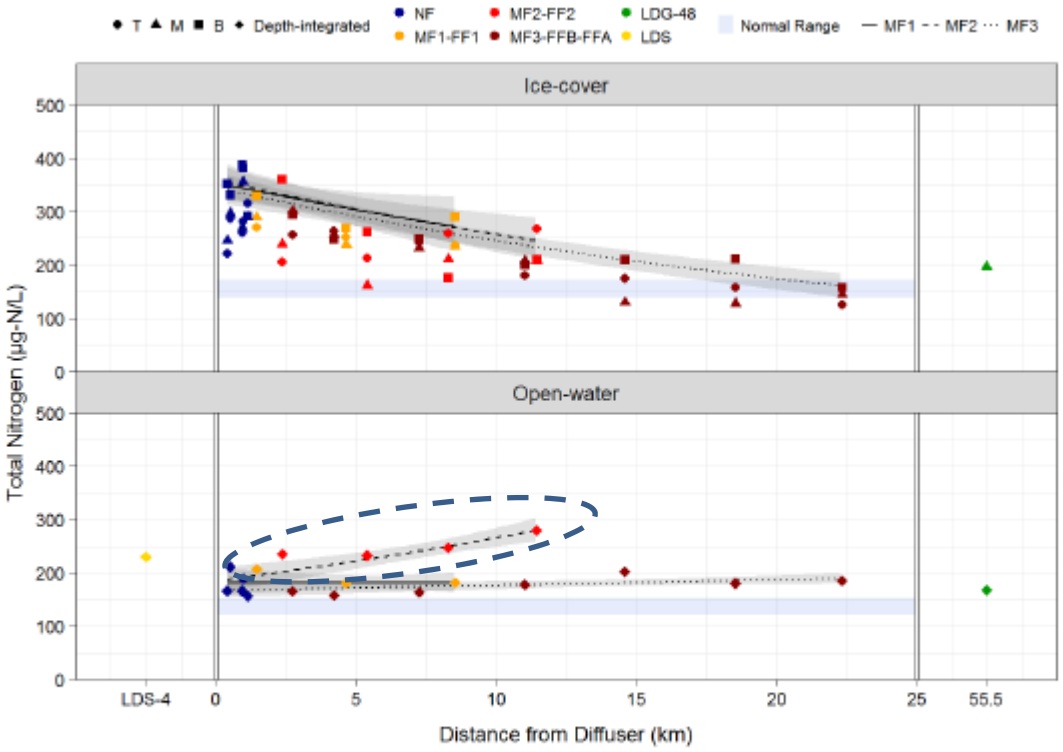
Recommendation: Add results for LDS-4 to figures and include discussion of results for LDS-4 within the discussion of nutrients in Lac de Gras in the main document (Section 4.3.2) and Appendix XIII (Section 3.4).

2.3.3 Increasing Trend for TN along Transect MF2-FF2

Appendix XIII, Eutrophication Indicators Report, Section 3.6.2 indicates: "Concentrations of TN were generally greater than the normal range during both ice-cover and open-water seasons (Figure 3-20). **Strong decreasing trends in TN concentrations were observed along all transects during both seasons**, with the exception of the MF1 transect during the open-water season (Table 3-2). Concentrations of TN at LDG-48 were similar to concentrations observed in the MF2-FF2 area during the open-water season. The concentration of TN at LDS-4 was slightly greater than those measured in the NF area during the open-water season." (page 38).[1]

[1] Text underlined and bolded for emphasis.

Figure 3-20 (page 39) indicates a trendline for the MF2 transect for TN that increases with distance from the effluent diffuser (see blue circle in figure below). As noted above in Section 2.3.2, the concentration of TN measured at LDS-4 may have contributed to the higher TN concentrations observed along transect MF2-FF2.



Note: Samples collected from Lac du Sauvage are presented to the left of the y-axis in a separate panel and LGD-48 in presented to the right of the y-axis. Shaded bands around fitted prediction lines are 95% confidence intervals (back-transformed to original scale of the variable).

µg-N/L = micrograms nitrogen per litre; NF = near-field; MF = mid-field; FF = far-field; LDG-48 = Lac de Gras outlet; LDS = Lac du Sauvage.

Figure 3-20. Concentrations of Total Nitrogen According to Distance from the Effluent Discharge, 2017 (after Golder 2018).

Recommendation 1: Correct the text to reflect positive trend in TN at transect MF2-FF2 in the open-water season.

Recommendation 2: Provide additional discussion of potential effects of water quality at the Lac du Sauvage outflow on nutrients in Lac de Gras, notably at transect MF2-FF2.

2.3.4 Discussion of Anthropogenic Loading of TP

Section 4.3 of the main document (Eutrophication Indicators, Summary and Discussion, pages 31-44) and Section 4.1 of Appendix XIII (Summary and Discussion, Nutrients in Effluent and the Mixing Zone; page 51) only present annual loading of total phosphorus (TP) to Lac de Gras for effluent. This underrepresents the total loading of TP to Lac de Gras associated with the mine.

Estimates of loading from dust, presented in Appendix XIII Appendix D (Assessment of Total Phosphorus Deposition to Lac De Gras), should be presented and discussed within the main body of the report and the summary section of Appendix XIII.

Recommendation: Incorporate discussion of all anthropogenic sources of TP to Lac de Gras within the main document and Appendix XIII.

2.3.5 Methods for Estimating Spatial Extent of Effects

Although concentrations of TN were generally higher in Lac de Gras in winter, use of the 2017 open-water season monitoring data for delineation of the spatial extent of effects (i.e., the area of Lac de Gras above the normal range) would result in a larger calculated affected area. Specifically, results for the most western site (MF3-7) along transect MF3 exceeded the normal range in the summer but not the winter (see Figure 4-2 reproduced below). Use of the open-water season data would result in an affected area that extended to the full extent of the monitoring site boundaries. The TN concentration for site MF3-7 in winter is 0.159 mg/L (mean of bottom samples; raw data presented in Appendix XIII - E), which is within the normal range for this season (0.138 - 0.173 mg/L), whereas the concentration for the open-water season is 0.186 mg/L (mean of raw data presented in Appendix XIII - E), which is above the upper boundary of the normal range (0.153 mg/L).

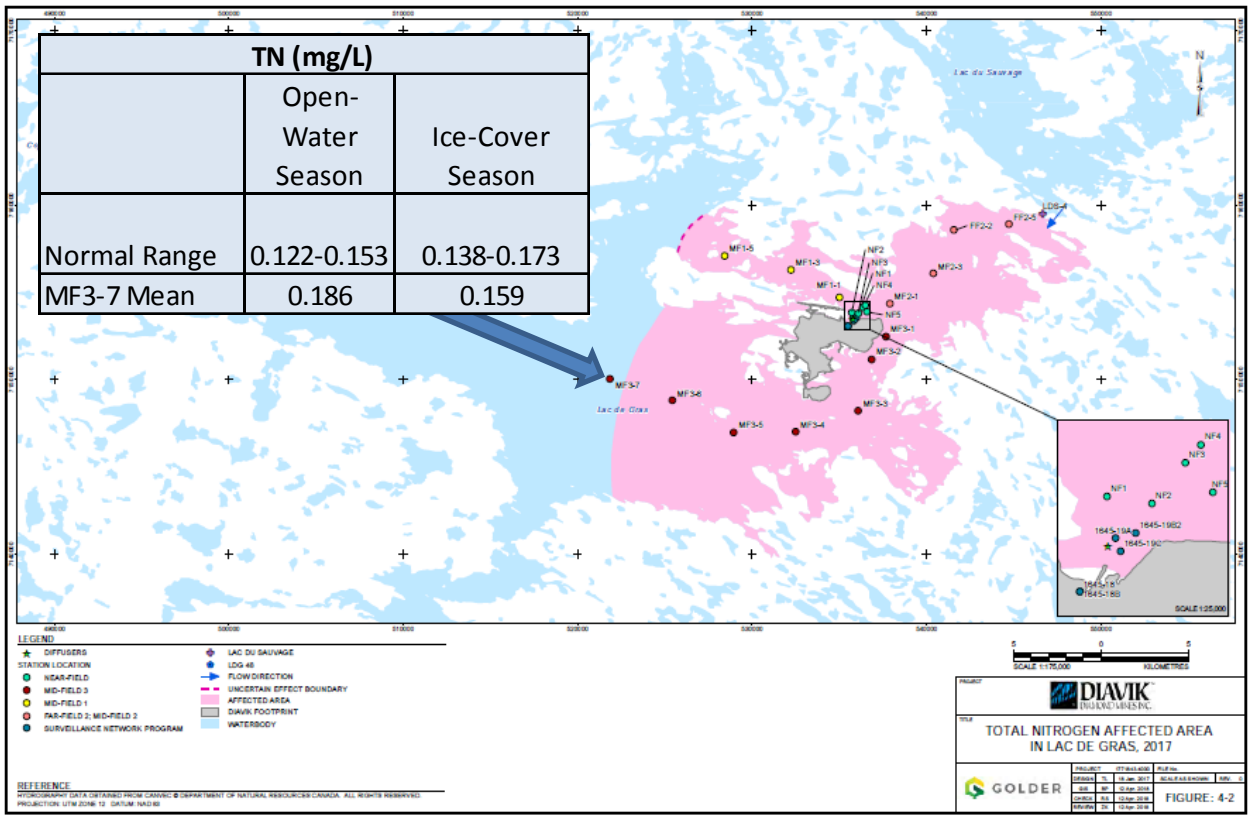


Figure 4-2. Total Nitrogen Affected Area in Lac de Gras, 2017 (after Golder 2018).

Recommendation: Recommend presenting spatial extent of effects for either the worst case (i.e., the largest spatial extent of effects) or present both the ice-cover and open-water season results in two figures. The latter would also provide for direct comparison of chlorophyll *a* and nutrient results for the same time period.

2.3.6 Review of QA/QC Duplicate Sample Results

In Appendix XIII (Eutrophication Indicators Report, Appendix C, Quality Assurance and Quality Control; page C-3), the percent of flagged duplicate nutrient samples for 2017 was expressed based on the total number of duplicate samples for the year (e.g., total of 190 duplicate sample pairs for the open-water season). However, of the total 190 duplicate pairs, RPDs (measure of precision of duplicate results) for many samples could not be reliably assessed due to data values being less than five times the analytical detection limit. It would be more appropriate to evaluate the overall percent of flagged samples based on the total number of duplicate pair results where the RPD could be reliably calculated (i.e., for those total number of paired samples that exceeded five times the detection limit). This approach also does not consider QA/QC results on a parameter by parameter basis and thus may not adequately assess potential issues with specific analytes.

Recommendation 1: Recommend expressing the percent of flagged duplicate RPDs based on the total number of paired samples where one or more values exceeded 5 times the analytical detection limit (i.e., those data pairs that could be reliably assessed for RPDs).

Recommendation 2: Recommend expressing percentages of flagged values by water quality parameter in order to evaluate issues that may be present with specific analytes.

2.4 DETAILED TECHNICAL REVIEW COMMENTS

Detailed technical review comments and recommendations are provided in the following Table 1; these are also provided in the Excel comments template as required for submission to the WLWB.

Table 1. Technical review comments and recommendations on the 2017 AEMP Annual Report.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX I, Dust Deposition, Section 2.3, Methodology, Snow Water Chemistry, page 2-7 and Table 3.4-2, page 3-20	The methods description indicates: "For quality assurance and control purposes, duplicate samples were collected at stations SS3-5 and SS5-5, and an equipment blank sample was collected at station SS3-6. Snow water chemistry sampling methodology is detailed in SOP ENVR-512-0213 (see Appendix F)." Table 3.4-2 (page 3-20) presents results for a "Control 1 Blank Sample". It is unclear if this represents the results of the equipment blank referred to earlier.	Clarify what type of blank sample is presented in Table 3.4-2.
MAIN DOCUMENT, Effluent and Water Chemistry, Section 3.3.1, Results and Discussion, Effluent and Mixing Zone Water Quality, page 22	The Report indicates: "Field pH values measured at the mixing zone boundary in 2017, particularly during the ice-cover season, were below the Effects Benchmark value of 6.5; however, pH throughout Lac de Gras was often measured below this Effects Benchmark, in both ice-cover and open-water seasons, at various depths, and over time (i.e., 2002 to 2016)." It is understood that pH is not considered within the Substance of Interest (SOI) identification process. However, it would be beneficial to include some discussion of pH in the effluent for comparison to the lake monitoring results within the report. This would assist with an overall presentation of potential mine-related effects on pH. It would also be beneficial to provide baseline information on pH in Lac de Gras (i.e., prior to 2002) in the discussion as normal ranges have not been derived for this metric.	Include results for pH in effluent and incorporate into the discussion of pH monitoring results for Lac de Gras. Include baseline pH results for Lac de Gras to facilitate an evaluation of potential changes to this metric over time.
APPENDIX II, Effluent and Water Chemistry Report, Section 2.4.2, Methods, Quality Assurance/Quality Control, Abnormal Results for Turbidity, page 23	The report indicates: "Similarly, elevated values of field-measured turbidity were recorded using a YSI water quality meter at the mixing zone boundary in January 2017 (Appendix B). January 2017 was the only month of the sampling year when data were recorded with the YSI at the mixing zone." However, page 2 indicates that "The in situ water column profile measurements were taken at AEMP stations using a multi-parameter water quality meter (YSI) following the methods described in DDMI's Standard Operating Procedure (SOP) ENVR-684-0317 "SOP YSI ProDSS"." It is unclear what in situ meters were used for the 2017 water quality monitoring program.	Provide clarification of the in situ field instruments used over the 2017 monitoring program.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX II, Effluent and Water Chemistry Report, Section 3.2.3, Results, Trends in Effluent and at the Mixing Zone Boundary, Total Metals, page 36 and figures 3-10 to 3-19	The report indicates: "For most total metal SOIs, concentrations in the effluent were greater than the concentrations measured at the mixing zone boundary in 2017, indicating that the Mine effluent is a source of these variables to Lac de Gras. One exception was copper, where concentrations in the effluent were generally similar to or less than those recorded at the mixing zone boundary (Figure 3-13B/C). Lead and tin also had concentrations in the effluent that were generally similar to those at the mixing zone boundary (i.e., often below the DL), although sporadic elevated concentrations of these two variables occurred in the effluent which were greater than the measured concentrations at the mixing zone boundary (Figures 3-14B/C and 3-18B/C)." The temporal pattern of effluent concentration and loading for several metals including antimony (Figure 3-11), molybdenum (Figure 3-15), and uranium (Figure 3-19) was not reflected in the mixing zone water quality results. Specifically, concentrations in the mixing zone decreased, and were notably lower than the effluent concentrations, in the open-water season despite increased concentrations in, and loading from, effluent.	Include a discussion of these observations in the report, including, where feasible potential or conceptual explanations.
APPENDIX II, Effluent and Water Chemistry Report, Section 3.3, Results, Depth Profiles, page 53	Section 3.3 (page 53) only compares dissolved oxygen (DO) monitoring results to the 6.5 mg/L Canadian Council of Ministers of the Environment (CCME) protection of aquatic life (PAL) guideline (CCME 1999; updated to 2018). NSC had commented (NSC 2018) previously that DO results should be compared to both the 6.5 mg/L (early life stages absent) and the 9.5 mg/L (early life stages present) CCME PAL guidelines (CCME 1999; updated to 2018) where applicable. The CCME 9.5 mg/L benchmark for early life stages would be more appropriate for fall spawning species such as Lake Trout. Indications of these guidelines on the depth profile figures would also greatly improve the ability to readily assess where exceedances occurred (Note: this would also apply for pH).	Include a comparison of DO monitoring results to the appropriate benchmarks (i.e., 6.5 and 9.5 mg/L). Add 6.5 and 9.5 mg/L benchmarks for DO and pH benchmarks to depth profile figures.
APPENDIX II, Effluent and Water Chemistry Report, Section 3.4.3, Results, Action Level Evaluation, Action Level 3, page 70, Figure 3-29	The Action Level 3 for dissolved sodium indicated on Figure 3-29 (51 mg/L; page 70) differs from what is presented in Table 3-8 (13.8 mg/L; page 64).	Review and revise table/figure for Action Level 3 values for dissolved sodium.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX II, Effluent and Water Chemistry Report, Section 3.4.3, Results, Action Level Evaluation, Action Level 3, pages 65-83. Figures 3-24 to 3-42	Action Level 3 values are not presented on all water quality Figures 3-24 to 3-42. See for example Figure 3-30 sulphate (page 71).	Add Action Level 3 values where missing to the figures.
APPENDIX II, Effluent and Water Chemistry Report, Section 3.7, Results, Comparison of AEMP Data to Effects Benchmarks, page 124	The report indicates: "Concentrations in all other samples collected during the 2017 AEMP were below the relevant Effects Benchmarks for the protection of aquatic life and drinking water. This includes the sample collected at Station LDG-48, which is located at the Lac de Gras outflow to the Coppermine River (Appendix D)." As noted in Section 3.3 (page 53) some DO measurements were below the CCME PAL guidelines. These occurrences should be included within this discussion.	Include discussion of DO monitoring results that were below CCME PAL benchmarks.
APPENDIX II, Effluent and Water Chemistry Report, Appendix B, Quality Assurance and Quality Control Methods and Results, page B-3	The QA/QC Appendix B (page B-3) indicates that duplicate sample results were considered "notable" where the Relative Percent Difference (RPD) was greater than 40%. This criterion is higher than used in previous reports. For example, in the 2017 AEMP Annual Report (Golder 2017), the criterion was 20% for evaluating duplicate sample results (Appendix II, Appendix C, page C-3).	Review the text and revise (if the value was reported in error) or provide a rationale for the change in the RPD criterion for evaluating duplicate sample results.
APPENDIX II, Effluent and Water Chemistry Report, Appendix C, Initial Effluent and Water Quality Data Screening, page C-9, Figure C-6	A footnote to Figure C-6 (page C-9) indicates: "Note: Anomalous data were recorded at the bottom depth of the MF3-6 profile during the ice-cover season of 2017 and were not included in the data presented in Section 3.3. It is likely that the measuring device encountered the bottom sediments and caused the anomalous measurements." The figure presents results of in situ depth profile measurements for a single site and sampling time. It is unclear what are the anomalous data referred to and what data were omitted from data presented in Section 3.3.	Provide a description of the anomalous data removed for this data set.
APPENDIX XI, Plankton Report, Appendix A, Quality Assurance and Quality Control, page A-4, Table A-1, and Appendix B - Raw Plankton Data	Appendix B indicates three samples were collected at Site MF3-5. Footnotes in the table indicate sample MF3-5-QC(a) is a "Field QC (duplicate) sample" and sample MF-3-5-QC(b) is a "Field QC (split) sample." The third sample (MF-3-5) is presumably the "original" sample (i.e., the other duplicate field sample). Table A-1 presents RPDs for duplicate phytoplankton samples and Table A-3 presents RPDs for the split sample. The results for these two comparisons appear to be reversed (based on the raw data provided in Appendix B).	Verify that duplicate and split sample QC results are presented in the correct tables and/or that the footnotes included in Appendix B are accurate.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX XI, Plankton Report, Appendix A, Quality Assurance and Quality Control, page A-4, Table A-1, and Appendix B - Raw Plankton Data	The QA/QC review of phytoplankton data considers results for counts (i.e., abundance) and not biomass. However, the plankton component of the AEMP is focussed on results for phytoplankton biomass and not abundance. It is recommended that an analysis and discussion of QA/QC results for biomass, in addition to abundance, be provided. Phytoplankton biomass is derived from two estimates: (1) counts of algal cells; and (2) measures/estimates of cell biovolume. Phytoplankton biomass results are therefore affected by an additional source of variability (i.e., biovolume measurements) beyond measures of algal abundance. A similar comment was submitted in the review of the 2016 Annual AEMP Report (NSC 2017): "Comparison of duplicate phytoplankton samples should be done both for abundance (i.e., cell counts) as well as biomass. The latter is typically more variable than the former as it is derived from two measurements (cell counts and algal cell size). As biomass is the metric of concern for the AEMP QA/QC should focus on this metric."	Provide an analysis and discussion of phytoplankton biomass QA/QC results.
MAIN DOCUMENT, Section 4.3.3, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, page 38	As noted in previous comments (e.g., Section 2.4.3, NSC 2018 and row 35 in associated excel submission), comparisons of spatial extent of effects between years for eutrophication indicators should be done with caution and should include explanatory text identifying the limitations of inter-annual comparisons in light of the lack of sampling in the FF areas in interim years Section 4.3.3 reads: "The boundary of effects on concentrations of TN to the northwest extended to at least Station MF1-5; however, the extent of effects along the MF1-FF1 transect could not be assessed further, because sampling in the FF1 area was not completed in 2017 as part of the interim program. The extent of effects to the northeast of the Mine extended to the end of the MF2-FF2 transect (Station FF2-5). The boundary of effects south of the Mine extended to between stations MF3-6 and MF3-7. The resulting affected area of the lake based on concentrations of TN was estimated as greater than or equal to 240 km2, or greater than or equal to 41.9% of lake area, which is less than reported in 2016, but comparable to the affected areas calculated for this variable in previous years." The last sentence should be modified to clearly state that direct comparisons to 2016 results are not possible due to the lack of sampling in FF areas in 2017.	Include a qualifying statement indicating that due to the lack of FF data for 2017 and the implications regarding limitations on defining the spatial extent of effects in those years, comparison to 2016 or other years is associated with uncertainty.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Section 4.3.3, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, page 41	Similar to the comment above, comparisons of spatial extent of effects for chlorophyll a between years should be done with caution and should include explanatory text identifying the limitations of inter-annual comparisons in light of the lack of sampling in the FF areas in interim years. Section 4.3.3 reads: "Effects on chlorophyll a were observed in the NF area and along all three transects. The boundary of effects on concentrations of chlorophyll a to the northwest of the Mine extended to Station MF1-5 (Figure 4-10). The extent of effects to the northeast of the Mine extended to the end of the MF2-FF2 transect (Station FF2-5). The boundary of effects south of the Mine extended to Station MF3-4. The extent of effects on concentrations of chlorophyll a, based on the affected stations, was calculated to be 149.8 km2. Compared to the total surface area of the lake (573 km2), the area demonstrating effects on chlorophyll a concentration represents 26.2% of the lake area, similar to the extent of effects observed in 2013 (Golder 2014)." The last sentence should be modified to clearly state that direct comparisons to 2013 results are not possible due to the lack of sampling in FF areas in 2017. As the boundary of the extent of effects along the northwest transect could not be accurately defined, the affected area may have been larger in 2017 than 2013.	Include a qualifying statement indicating that due to the lack of FF data for 2017 and the implications regarding limitations on defining the spatial extent of effects in those years, comparison to 2013 or other years is associated with uncertainty.
APPENDIX XIII, Eutrophication Indicators Report, Section 3.2, Results, Effects of Dust Deposition, page 23	The report indicates: "The estimated total anthropogenic TP loading from the Mine in 2017 was 1.4 tonnes per year (t/yr), with 0.42 t/yr from effluent, 0.63 t/yr from direct dust deposited to the lake surface, and 0.34 t/yr from runoff from the surrounding watershed (excluding the Mine footprint). The anthropogenic TP loading (including both effluent and fugitive dust) presented a 7.3% increase relative to the natural background TP loading of the watershed." (page 23) It is unclear what the "natural background TP loading of the watershed" is that is referenced or how that value (not indicated) was estimated.	Indicate the estimated "natural background TP loading of the watershed" and provide an explanation of how the estimate was derived. Clarify the method for estimating "anthropogenic loading" to Lac de Gras.

TOPIC	COMMENT	RECOMMENDATION
MAIN DOCUMENT, Section 4.3.2, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, pages 34-35 and APPENDIX XIII, Eutrophication Indicators Report, Section 3.4, Results, Nutrients in Lac de Gras, pages 25-29	The discussion and graphical plots of results for nutrients in Lac de Gras within the Eutrophication Indicators section (Main Document, Section 4.3.2, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, pages 34-35) does not include results for the inflow to Lac de Gras (i.e., Site LDS-4), though it is noted that some discussion of results for this site are provided in Appendix XIII (e.g., pages 34-43). Inclusion of monitoring results for site LDS-4 within the Main Report would assist with interpretation of results. For example, TN concentrations were notably higher in the MF2-FF2 transect in the open-water season (Main Document, Figure 4-4, page 25); it would be of interest to compare these results to the upstream site at the lake inflow to evaluate the potential influence of upstream conditions on this transect. Qualitative review of the raw data files suggest that the inflow of Lac de Gras contained a higher concentration of TN than the MF1, MF3, and NF areas and may have contributed to the relatively higher concentrations of TN observed along transect MF2-FF2 in the open-water season (the report notes that no sample was collected from LDS-4 in winter).	Add results for LDS-4 to figures and include discussion of results for LDS-4 within the discussion of nutrients in Lac de Gras in the main document (Section 4.3.2) and Appendix XIII (Section 3.4).
APPENDIX XIII, Eutrophication Indicators Report, Section 3.5, Results, Chlorophyll a, and Phytoplankton and Zooplankton Biomass, pages 30-31 and MAIN DOCUMENT, Section 4.3.2, Eutrophication Indicators, Results and Discussion, Nutrients and Water Chemistry in Lac de Gras, page 36	As noted for nutrients, it would be of benefit to include the LDS-4 results for chlorophyll a within the discussion and Figure 3-13 presented in Section 3.5 of Appendix XIII (page 31) and Figure 4-5, Section 4.3.2 in the main document (page 36).	Add results for LDS-4 to Figure 3-13 and include discussion of results for LDS-4 within the discussion of chlorophyll a in Lac de Gras.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX XIII, Eutrophication Indicators Report, Section 3.6.2, Results, Spatial Analysis in Lac de Gras, Nutrients, page 38	The report indicates: "Concentrations of TN were generally greater than the normal range during both ice-cover and open-water seasons (Figure 3-20). Strong decreasing trends in TN concentrations were observed along all transects during both seasons, with the exception of the MF1 transect during the open-water season (Table 3-2). Concentrations of TN at LDG-48 were similar to concentrations observed in the MF2-FF2 area during the open-water season. The concentration of TN at LDS-4 was slightly greater than those measured in the NF area during the open-water season." (page 38). Figure 3-20 (page 39) indicates a trendline for MF2 for TN that increases with distance from the effluent diffuser. As noted above, the concentration of TN measured at LDS-4 may have contributed to the higher TN concentrations observed along transect MF2-FF2.	Correct the text to reflect positive trend in TN at transect MF2-FF2 in the open-water season. Provide additional discussion of potential effects of water quality at the Lac du Sauvage outflow on nutrients in Lac de Gras, notably at transect MF2-FF2.
APPENDIX XIII, Eutrophication Indicators Report, Section 3.7, Results, Action Level Evaluation, page 48	The demarcation of Action Level 3 (i.e., Normal Range plus 25% Benchmark (AL3)) is not legible in Figure 3-28.	Revise figure.
APPENDIX XIII, Eutrophication Indicators Report, Section 3.7, Results, Action Level Evaluation, page 48	There appears to be an erroneous figure reference or the referenced figure is not provided in relation to the following text: "In 2017, 26.2% of the lake area had chlorophyll a concentrations above the upper limit of the normal range (i.e., 0.82 µg/L) (Figures 3-28, 3-29 and 4-2; Table 3-3)." Figure 3-29 presents the area of the lake that exceeds the Action Level 3 criterion.	Review text and figures and revise where required.
MAIN DOCUMENT, Section 4.3, Eutrophication Indicators, Summary and Discussion, pages 31-44, and APPENDIX XIII, Eutrophication Indicators Report, Section 4.1, Summary and Discussion, Nutrients in Effluent and the Mixing Zone, page 51	Section 4.3 of the main document (pages 31-44) and Section 4.1 of Appendix XIII (page 51) only present annual loading of total phosphorus (TP) to Lac de Gras for effluent. This underrepresents the total loading of TP to Lac de Gras associated with the mine. Estimates of loading from dust, presented in Appendix XIII Appendix D (Assessment of Total Phosphorus Deposition to Lac De Gras), should be presented and discussed within the main body of the report and the summary section of Appendix XIII.	Incorporate discussion of all anthropogenic sources of TP to Lac de Gras within the main document and Appendix XIII.

TOPIC	COMMENT	RECOMMENDATION
APPENDIX XIII, Eutrophication Indicators Report, Section 4.3, Summary and Discussion, Extent of Effects, pages 53-59, Figure 4-2 and Appendix XIII - E, Eutrophication Indicators Raw Data	Although concentrations of TN were generally higher in Lac de Gras in winter, use of the 2017 open-water season monitoring data for delineation of the spatial extent of effects (i.e., the area of Lac de Gras above the normal range) would result in a larger calculated affected area. Specifically, results for the most western site (MF3-7) along transect MF3 exceeded the normal range in the summer but not the winter. Use of the open-water season data would result in an affected area that extended to the full extent of the monitoring site boundaries. The TN concentration for site MF3-7 in winter is 0.159 mg/L (mean of bottom samples; raw data presented in Appendix XIII - E), which is within the normal range for this season (0.138 - 0.173 mg/L), whereas the concentration for the open-water season is 0.186 mg/L (mean of raw data presented in Appendix XIII - E), which is above the upper boundary of the normal range (0.153 mg/L).	Recommend presenting spatial extent of effects for either the worst case (i.e., the largest spatial extent of effects) or present both the ice-cover and open-water season results in two figures. The latter would also provide for direct comparison of chlorophyll a and nutrient results for the same time period.
APPENDIX XIII, Eutrophication Indicators Report, Appendix C, Quality Assurance and Quality Control, page C-3	Similar to a previous comment, the QA/QC appendix C (page C-3) indicates that duplicate sample results were considered notable where the Relative Percent Difference (RPD) was greater than 40%. This criterion is higher than used in previous reports. For example, in the 2017 AEMP Annual Report (Golder 2017), the criterion was 20% for evaluating duplicate sample results (Appendix XIII, Appendix B, page B-3).	Review the text and revise (if the value was reported in error) or provide a rationale for the change in the RPD criterion for evaluating duplicate sample results.
APPENDIX XIII, Eutrophication Indicators Report, Appendix C, Quality Assurance and Quality Control, page C-3	For review of QA/QC results, the percent of flagged duplicate nutrient samples (i.e., those failing data quality objectives) was expressed based on the total number of duplicate sample pairs collected (e.g., total of 190 duplicate sample pairs for the open-water season). However, of the total 190 duplicate pairs, RPDs for many samples could not be reliably assessed due to data values being less than 5 times the analytical detection limit. It would be more appropriate to evaluate the overall percent of flagged samples based on the total number of duplicate pair results where the RPD could be reliably calculated (i.e., for those total number of paired samples that exceeded 5 times the detection limit). This approach also does not consider QA/QC results on a parameter by parameter basis and thus may not adequately assess potential issues with specific analytes.	Recommend expressing the percent of flagged duplicate RPDs based on the total number of paired samples where one or more values exceeded 5 times the analytical detection limit. Also recommend expressing percentages of flagged values by water quality parameter in order to evaluate issues that may be present with specific analytes.

3.0 SUPPORTING MATERIALS FOR REVIEW

Golder. 2017. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program 2016 Annual Report. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2017.

Golder. 2018a. Diavik Diamond Mines (2012) Inc. 2014 to 2016 Aquatic Effects Re-evaluation Report Version 1.0. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2018.

Golder. 2018b. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program Study Design Version 5.0. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2018.

Golder. 2018c. Diavik Diamond Mines (2012) Inc. Aquatic Effects Monitoring Program 2017 Annual Report. Submitted to Diavik Diamond Mines (2012) Inc. Yellowknife, NT, March 2018.

NSC. 2016. Aquatic Effects Monitoring Program 2015 Annual Report – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-16-05.

NSC. 2017. Aquatic Effects Monitoring Program 2016 Annual Report – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-17-01.

NSC. 2018. 2014 to 2016 Aquatic Effects Re-Evaluation Report – Plain language briefing and technical review comments. Prepared for the Environmental Monitoring Advisory Board. Technical Memorandum # 367-18-01.