DE BEERS GROUP

February 2, 2021

Angela Love
Mackenzie Valley Land and Water Board
PO Box 2130
Yellowknife, NT X1A 2P6

Via Email: angela.love@mvlwb.ca

Dear: Ms. Love:

Re: Proposed changes to monitoring under the AEMP Design Plan Update for Care and Maintenance (Golder 2016) at Snap Lake until the AEMP Design Plan for Closure and Post Closure (Golder 2020) is approved.

The 2019 Aquatic Effects Monitoring Program (AEMP) Design Plan for Closure and Post-closure V.0, (2019 AEMP Design Plan) was submitted to the Mackenzie Valley Land and Water Board (MVLWB) in March 2019 as part of the Water Licence renewal and Land Use Permit amendment application package. Following issuance of the water licence (MV2019L2-0004), the document was re-submitted in September 2020, at the request of the MVLWB, as the AEMP Design Plan for Closure V.1. The document was posted for public review and De Beers received information requests associated with both the AEMP Design Plan V.1, and the 2012-2017 Aquatic Effects Re-evaluation Report on 14 December 2020. As part of their review, the MVLWB staff requested that further rationale be provided for proposed design plan changes, that the 2018-2020 AEMP data be included in the re-evaluation and considered in the Design Plan, and that consultation with interested parties be carried out in the form of a Technical Workshop prior to submission of the AEMP Design Plan as V.1.1.

The MVLWB and De Beers met on 17 December 2020 to discuss the information requests and submission of the AEMP Design Plan as V.1.1. At this meeting, it was determined that due to the time required to meet the Board's requests for a workshop and inclusion of additional data, approval of the AEMP Design Plan for closure would not likely occur prior to the 2021 AEMP sampling season. For this reason, the 2021 AEMP will have to continue to follow the existing approved 2013 AEMP Design Plan Update for Care and Maintenance (Golder 2016).

It was also recognized that the Mine discharge volumes have been reduced substantively since approval of the last AEMP. This in turn has resulted in a reduced potential for aquatic effects in Snap Lake and in the downstream aquatic environment. In addition, it was acknowledged by Board staff that certain features of the AEMP Design Plan for Closure V.1 were considered appropriate and desirable to implement during the 2021 AEMP, even before approval of the AEMP Design Plan for Closure and Post-Closure as V.1.1 (anticipated to occur after the 2021 field programs are completed).

Board staff indicated that the MVLWB would be open to considering changes to the AEMP sampling design and data analysis on a temporary basis until such time as the AEMP Design Plan for Closure and Post-Closure V1.1 is approved, submitted in the form of a letter with supporting rationale. The purpose of this letter is to summarize the changes to the AEMP Design Plan Update for Care and Maintenance (Golder 2016) that De Beers is requesting approval for based on discussions at the 17 December 2020 meeting with the MVLWB. De Beers will continue to seek approval for the AEMP Design Plan for Closure and Post-Closure V1.1.

The proposed changes for the 2021 AEMP program are listed in Table 1. The table is organized by the following categories:

- proposed reductions;
- updates to parameters and AEMP benchmarks; and
- other updates.

Should you have any questions or concerns, please feel free to contact me by phone at (867.688.9227) or by email at Sarah.McLean@debeersgroup.com.

Sincerely,

Sarah McLean

Cc: Michelle Peters, DBCI
Jacqueline Ho, MVLWB

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Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Proposed Reductions:			
Water Quality, Sediment Quality, Plankton Community, Benthic Invertebrate Community	Sampling Locations	Discontinue lake-wide, seasonal monitoring in Lake 13. Limited water quality monitoring is proposed in 2021 to support monitoring of fish in Lake 13. This will include collecting water quality samples and field profiles at three locations in Lake 13, and a field profile at the deep location in Lake 13. Water quality field methods in Lake 13 will be the same as approved for Snap Lake AEMP stations.	One reference lake (Northeast Lake) is sufficient for the comparisons for the water quality, sediment quality, plankton, and benthic invertebrate components. The summary of sediment and water quality data collected during the AEMP to date indicate that sediment and water quality in Northeast Lake is more similar to Snap Lake than Lake 13. Lake 13 is not an appropriate reference lake for plankton or benthic invertebrates. The phytoplankton, zooplankton and benthic invertebrate community composition in Lake 13 differs from Snap Lake and Northeast Lake, and is unsuitable for direct comparisons with the Snap Lake main basin. For benthic invertebrate data analysis, Lake 13 was excluded from statistical comparisons and the normal range calculations in the 2015 AEMP data analysis because of differences in the invertebrate community between Snap Lake and Lake 13. If not used as a reference lake for plankton or benthic invertebrates, lake-wide and seasonal water quality monitoring will no longer be needed in Lake 13. Monitoring in Northeast Lake is sufficient for characterizing reference water quality conditions. Historical lake-wide and seasonal water quality data collected in Lake 13 between 2012 and 2018, and additional water quality monitoring completed during the fish health program in 2021 are sufficient to provide background water quality for interpreting fish health results in Lake 13. The MVLWB raised concerns regarding the discontinuation of monitoring in Lake 13; however, the concern raised was in reference to a lack of water quality data in Lake 13 to support the fish health component. The water quality data to support the fish program would continue to be collected in 2021. See information request MVLWB-71 and response from De Beers regarding the discontinuation of water quality monitoring in Lake 13.

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	Sampling Locations	Reduce the number of water quality stations sampled in Northeast Lake in 2021 from five (NEL01 to NEL05) to three (NEL01, NEL02, NEL05). Supporting water quality (i.e., depth-integrated nutrients and field profiles) will be collected at all five Northeast Lake stations to support the plankton component. Field profile measurements at the deep station (NEL06) will continue to assess dissolved oxygen concentrations at a deep location in the reference lake.	Water quality within Northeast Lake has been similar throughout the lake and over time, and sampling completed at three stations were sufficient to characterize reference lake water quality, as described in the most recent annual AEMP Report for Snap Lake (De Beers 2020b). No concerns were raised by reviewers.
Water Quality	Sampling Locations	Discontinue monitoring at the outlet of Downstream Lake 2 (DSL2 outlet) and within Lac Capot Blanc (LCB; LCB-1, LCB-2A, LCB-7 and LCB-8) starting in 2021. Monitoring at the outlets of LCB will continue.	Monitoring at the outlet of DSL2 or within LCB is no longer required because the focus of downstream monitoring is to protect traditional land use in MacKay Lake (i.e., Measure 1(d) *No TDS [total dissolved solids] or its constituent ions from Snap Lake Mine effluent will be detectable, relative to the range of natural variability, at the inlet to MacKay Lake, 44 km downstream of Snap Lake"*). Monitoring TDS and its constituents at DSL2 outlet and locations within LCB was proposed in the Downstream Watercourses Special Study to allow updating the water quality model for LCB in the future (Golder 2017a); however, the current downstream model is based on a mass balance model for each downstream lake and no longer models water quality at locations in LCB, other than the outlets. Monitoring will continue at the outlets of LCB, KING01 (upstream of King Lake) and Node 22 in MacKay Lake. Results from these four locations will be sufficient to answer Key Question 4 for Water Quality (Are spatial and seasonal patterns in water quality in Snap Lake and downstream waterbodies consistent with predictions?) by assessing temporal trends and comparing to predictions, as described in Section 6.4.5.4 in the AEMP Design Plan for Closure V.1 [De Beers 2020]). The proposed monitoring at the outlets of LCB and Node 22 in MacKay Lake will be sufficient to assess Action Levels for protecting traditional land use using comparisons to predictions at LCB outlets and to the range of natural variability at Node 22, as described in Golder (2017a). SLEMA raised concerns regarding the discontinuation of monitoring at DSL2 outlet. See information request SLEMA-14 and response from De Beers for additional rationale regarding discontinuation of monitoring at DSL2 outlet.

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Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	Laboratory Analyses	Reduce analyses of phosphorus in samples collected as part of the AEMP water quality component to two parameters (i.e., total and dissolved phosphorus).	The proposed phosphorus parameters are sufficient to compare to model prediction and the AEMP benchmark and support assessment of potential nutrient enrichment effects. Phosphorus concentrations in Snap Lake have not increased to-date relative to baseline (Section 3.4.4.1 of De Beers 2020). During Closure, phosphorus concentrations are predicted to remain below the AEMP benchmark and whole-lake averages are predicted to remain within the Snap Lake normal range (Section 4.1.1 of Golder 2020). Results for total and dissolved organic and inorganic phosphorus and ortho-phosphate are not required to compare to predictions or the AEMP benchmark. Total and dissolved phosphorus are sufficient to support the evaluation of the predicted biological effects related to nutrient enrichment from phosphorus input. If a Nutrient Enrichment Action Level is triggered, monitoring of additional species of phosphorus can be considered. No concerns were raised by reviewers. SLEMA was in support of reducing phosphorus monitoring to total and dissolved phosphorus (SLEMA-17).
Water Quality	Laboratory Analyses	Discontinue analysis of dissolved metals in Snap and Northeast lakes.	The analyses of dissolved metals in the water quality component is not required because total metal concentrations can be conservatively compared to AEMP benchmarks, even if the benchmarks are based on water quality guidelines for the dissolved metal fraction. The likelihood that concentrations of metals will be above an AEMP benchmark in Snap Lake (i.e., the criteria in the 2013 AEMP Design Plan Updated for Care and Maintenance for analyzing the dissolved metals samples at AEMP stations) during Closure is low based on predicted concentrations (Section 4.1 in the AEMP Re-evaluation Report). If a total metal concentration exceeds an AEMP benchmark that is intended to be compared to the dissolved concentration, additional sampling for dissolved metals could be proposed. The current Water Licence MV2019L2-004 no longer requires that dissolved metals be monitored at the edge of the mixing zone in the SNP (MVLWB 2020). ECCC raised concerns regarding the discontinuation of monitoring of dissolved zinc in Snap and Northeast lakes; see information request ECCC-6 and response from De Beers regarding discontinuation of dissolved zinc monitoring. SLEMA was in support of the discontinuation of dissolved metals monitoring (SLEMA-20).

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	Quality Assurance/ Quality Control Assessment	Discontinue the use of split samples.	In recent years, split samples have provided limited new information regarding the quality of Snap Lake water quality data. Multiple split samples have been sent to separate laboratories annually to assess variability within a sample and between laboratories. The comparisons of results from different laboratories were particularly important when greater uncertainty in concentrations existed in Snap Lake due to issues related to laboratory analyses, such as matrix interference and changes and differences in analytical methods for nutrient and metals. Laboratory issues with split samples have been resolved through the annual QA/QC assessments and Nutrient Special Studies (Section 3.10.1 of Golder 2020); collecting additional split samples during Closure is not expected to provide useful information for assessing the quality of water quality data. No concerns were raised by reviewers.
Water Quality	Quality Assurance/ Quality Control Assessment	Discontinue the use of phosphorus spike samples.	Phosphorus spike samples have been analyzed at different concentrations since 2012, and the uncertainty in phosphorus concentrations has been estimated (average of ±0.002 mg/L) for Snap Lake samples. Results from additional analyses of spiked samples are unlikely to affect this estimate of uncertainty. No concerns were raised by reviewers.
Toxicity	Sampling Frequency	Remove annual under-ice program.	The purpose of toxicity testing is to evaluate if there are Mine-related effects, which are best assessed during periods of discharge or shortly following a period of discharge. Discharge will not occur during ice-covered conditions. During Care and Maintenance and Closure, effluent discharge is not planned or anticipated to occur under-ice (i.e., April or May) or in the fall (i.e., September); therefore, it is recommended that one open-water toxicity sampling program be undertaken following ice-off, during, or as close as possible to, the period of effluent discharge. Under-ice sampling for toxicity after a prolonged period without discharge (i.e., from September through April) is unlikely to provide useful information to evaluate discharge-related toxicity in the receiving environment. No concerns were raised by reviewers.

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Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Sediment Quality	Field Methods	Discontinue sampling of 2-cm depth layer at the diffuser station; continue sampling of 5-cm depth layer at mixing zone stations; collect samples at diffuser and mixing zone stations using the Ekman grab instead of the Tech-ops corer	Concentrations of sediment quality parameters at the diffuser station were similar between the top 2-cm and the top 5-cm depths between 2012 and 2017 (Golder 2020). Future sediment sampling of the top 5-cm depth using an Ekman grab is sufficient to investigate the expected reduction of effects on sediment quality. The top 5-cm sediment sampling depth is consistent with the method used at other stations in Snap Lake and the reference lakes. GNWT/ENR/EAM-4 raised concerns regarding this change, requesting the inclusion of the 2018 to 2019 data in the analysis, which is planned for the updated Aquatic Effects Re-evaluation Report.
Plankton	Parameters	Discontinue Microcystin-LR analysis	Microcystin-LR concentrations have been near or below the detection limit during most years of sampling, which limits its usefulness as a response variable. As per the Water Licence Part G, Item 1, cyanotoxins need only be monitored "in the event that the algal community composition shifts to favour cyanobacteria"; the community in Snap Lake has shifted away from cyanobacteria dominance since baseline. The MVLWB requested clarification of how microcystin sampling can be discontinued while still be used in the action level assessment; see MVLWB-58 and response, which explained that the intent in the AEMP Design Plan for Closure V.1 (De Beers 2020a) was that microcystin monitoring in Snap Lake would be triggered by a Nutrient Enrichment Low Action Level exceedance for water quality, rather than continued monitoring of microcystin.
Plankton	Parameters	Discontinue chlorophyll *c* analysis	Chlorophyll *c* concentrations were generally below the detection limit during most years of sampling, which limits its usefulness as a response variable. No concerns were raised by reviewers.
Plankton	Parameters	Discontinue LI-COR light measurements	Light measurements have indicated that the water column in Snap Lake remains clear and attenuation coefficients are similar to other northern lakes (Kirk 2011). No concerns were raised by reviewers.

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Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Plankton	Data Analysis	Discontinue edibility assessment	The edibility assessment is a coarse-level assessment and classification of phytoplankton taxa as edible or inedible has a high level of uncertainty. There is a great deal of year-to-year variability in the data (i.e., a 100% difference in edible taxa can be observed from one year to the next in both Snap Lake and the reference lakes). There is a lack of a relationship between zooplankton biomass and edible phytoplankton biomass. No concerns were raised by reviewers.
Fish Health Program/Fish Tissue Chemistry	Sampling Locations	Discontinue fish health sampling in Northeast Lake	Low catch rates of Lake Chub in Northeast Lake, and more fishing effort required to catch those few fish relative to the other study lakes, has resulted in limited usefulness (i.e., unable to complete robust statistical comparisons) for fish health and tissue chemistry data collected in Northeast Lake in the last two sampling program. Fish capture numbers in Lake 13 were appropriate for completing fish health and tissue chemistry statistical analyses relative to Snap Lake in these years. Therefore, one reference lake (i.e., Lake 13) is proposed for ongoing fish health and tissue chemistry monitoring. The loss of supporting environmental data resulting from the removal of Lake 13 as a reference lake by the non-fish AEMP components (i.e., benthic invertebrates, sediment, and water quality) is expected to be mitigated by additional effort during the fish health program (e.g., collecting supporting water quality samples). No concerns were raised by reviewers.
Fish Tissue Chemistry	Field Methods	Discontinue large-bodied fish tissue chemistry program.	Small-bodied fish tissue chemistry results will act as an indicator of changes in fish tissue chemistry in Snap Lake. Large-bodied fish tissue chemistry would be assessed in the future if the small-bodied fish tissue chemistry results indicate it is necessary. No concerns were raised by reviewers.
Fish Tissue Chemistry	Laboratory Methods	Remove gallium, rhenium, thorium, and yttrium from the variable list	These metals were removed from the metals analytical package at the analytical laboratory in 2014, and have been demonstrated as unnecessary because they are not contaminants of concern at the mine; therefore, their removal from the design plan was proposed for clarity and consistency. No concerns were raised by reviewers.
Updates to Parameters and AEMP Benchmarks:			

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	Laboratory Analyses	Monitoring of dissolved organic carbon, instead of total organic carbon, in Snap Lake and Northeast Lake is proposed.	Discontinuation of monitoring TOC was proposed because this parameter is not required to assess the effects on aquatic life in Snap Lake as a result of changes in water quality; there is no AEMP benchmark for TOC and it is not used to calculate AEMP benchmarks. Instead of TOC, monitoring of DOC was proposed because this parameter is required to calculate AEMP benchmarks for selected parameters and is therefore useful in assessing effects on aquatic life in Snap Lake. Measured concentrations of DOC in Snap and Northeast lakes will be used to calculate the updated AEMP benchmark for zinc, which was completed in the most recent AEMP annual report (De Beers 2020b). Measurements of DOC may also be used in the calculation of future AEMP benchmarks because DOC is a toxicity-modifying factor for many metals and may be considered in future updates to Canadian water quality guidelines. In the current Water Licence MV2019L2-004, DOC has replaced TOC in the list of nutrients in the SNP (MVLWB 2020). ECCC raised concerns regarding the discontinuation of TOC monitoring in Snap and Northeast lakes; see information request ECCC-3 and response from De Beers regarding discontinuation of TOC. No concerns were raised by reviewers to the proposed addition of DOC monitoring in the AEMP.
Water Quality	Laboratory Analyses	Discontinue analyses of organic parameters (BTEX [benzene, toluene, ethylbenzene, xylene], total oil and grease, total extractable hydrocarbons, total volatile hydrocarbons F1 (C6-C10) and F2 (>C10-C16)) at the edge of the mixing zone in Snap Lake.	Monitoring of organics in Snap Lake is no longer required because concentrations of these parameters have been consistently low at the diffuser stations (i.e., stations closest to the discharge), including in 2019 (De Beers 2020b) and compliance monitoring will continue in the discharges to Snap Lake for comparisons to the Water Licence limit (MVLWB 2020). The current Water Licence MV2019L2-004 also no longer requires that organics be monitored at the edge of the mixing zone in the Surveillance Network Program (MVLWB 2020). Concentrations of organics measured at the edge of the mixing zone have been near or below the detection limit during Operations and Care and Maintenance (see Section 3.1.5 of the 2012 to 2017 Aquatic Effects Re-evaluation Report [Golder 2020] and Appendix D in De Beers 2020b) and well below concentrations that may be harmful to aquatic life. During Closure, increases in concentrations of organics in the discharge are not anticipated, due to the application of best management practices for these contaminants as outlined in plans that require approval of the MVLWB (e.g., Waste Management Plan and Spill Contingency Plan). SLEMA raised concerns regarding the discontinuation of organics monitoring at the mixing zone stations; see information request SLEMA-18 and response from De Beers regarding discontinuation of monitoring of organics.

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	AEMP Benchmarks	Update the SSWQOs for TDS, chloride, and sulphate.	The ionic composition of Snap Lake is predicted to change during Closure and Post-closure; therefore, SSWQOs for TDS, chloride and sulphate that were based on the predicted ionic composition of TDS may not longer be appropriate. The proposed AEMP benchmarks for chloride and sulphate were used in the development of the approved effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). An AEMP benchmark of 500 mg/L for TDS was agreed to by De Beers and the MVLWB in the Water Licence MV2019L2-004 Reasons for Decision (MVLWB 2020). Proposed AEMP benchmarks for chloride and sulphate are based on a SSWQO for chloride that considers the toxicity modification factor of hardness and the BC aquatic life guideline for sulphate. The proposed AEMP benchmarks for chloride and sulphate were used in the development of effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). No concerns were raised by reviewers.
Water Quality	AEMP Benchmarks	Update the SSWQO for fluoride to use as an AEMP benchmark	An updated aquatic life SSWQO, which uses the same toxicity dataset as the previously proposed aquatic life SSWQO for Snap Lake (1.94 mg/L; McPherson et. al 2014a) but a better-fit model (i.e., the normal model) for the SSD, is recommended as the updated AEMP benchmark for fluoride. The previous AEMP benchmark was based on the Health Canada drinking water guideline (1.5 mg/L) because it was lower than previously proposed SSWQO to fluoride of 1.94 mg/L. The normal model, which resulted in a SSWQO of 1.19 mg/L, provided a better overall fit to the SSD, based on a lower Anderson-Darling test statistic than the Gumbel model, which resulted in a SSQWO of 1.94 mg/L (test statistic was 0.298 for the normal model compared to 0.389 for the Gumbel model) (De Beers 2020c). The normal model provided a better fit to the lower tail of the distribution, with a mean square error of 0.0151 for the normal model compared to 0.0181 for the Gumbel model). Fitting the lower tail of the distribution is of greater relevance to the purpose of the benchmark (i.e., providing adequate protection to 95% of the species) than fitting the upper tail of the distribution (De Beers 2020c). No concerns were raised by reviewers to the proposed AEMP benchmark for fluoride; the Government of Northwest was in support of the proposed AEMP benchmark for fluoride (GNWT-ENR-EAM-14).

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	AEMP Benchmarks	Update the SSWQO for nitrate to use as an AEMP benchmark.	To protect both drinking water and aquatic life, the recommended AEMP benchmark is proposed to be the lower of: the health-based drinking water quality guideline of 10 mg-N/L (Health Canada 2020), and the hardness-dependent SSWQO developed by Rescan (2012). The hardness-dependent SSWQO for nitrate has been used as the AEMP benchmark since 2015 when it was approved by the MVLWB (MVLWB 2015). The approved AEMP benchmark has been used most recently to derive effluent quality criteria for nitrate, which have also been approved in the current Water Licence MV2019L2-004 (MVLWB 2020). De Beers has summarized its position on the use of ambient hardness concentrations to calculate the hardness dependent SSWQO in the Response to Interventions (De Beers 2019). The Government of Northwest Territories raised previous concerns related to the proposed hardness-adjusted nitrate toxicity derivation; see information request GNWT-ENR-EAM-17 and response from De Beers regarding the hardness-adjusted nitrate toxicity derivation.
Water Quality	AEMP Benchmarks	Update the Environmental Assessment Report (EAR) benchmarks for cadmium and hexavalent chromium, originally developed in 2002 (De Beer 2002), to the water quality guidelines from BC MOE and ECCC.	The hardness-dependent BC WQG for cadmium (BC ENV 2019) is recommended to replace the site-specific EAR benchmark for cadmium, because it incorporates more recent toxicity data relative to the 2002 EAR benchmark and CCME WQG for aquatic life (CCME 1999). The FEQG for hexavalent chromium (ECCC 2018) is recommended to replace the site-specific EAR benchmark because it incorporates more recent toxicity data and updated protocols for deriving SSWQO relative to the 2002 EAR benchmark and CCME WQG for aquatic life (CCME 1999). Environment Canada has approved a new FEQG for the protection of aquatic life for hexavalent chromium because sufficient chronic toxicity data are now available to meet the minimum data requirements for updated CCME protocols in developing water quality guidelines, which were updated in 2007. The FEQG developed for hexavalent chromium is consistent with the current CCME guiding principle and 2007 protocol and is therefore intended to protect all forms of freshwater aquatic life for indefinite exposure periods, thus providing sufficient protection for aquatic life in Snap Lake. The proposed AEMP benchmarks for cadmium and hexavalent chromium were used in development of the approved effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). No concerns were raised by reviewers for the updates to the AEMP benchmarks for cadmium and hexavalent chromium.

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	AEMP Benchmarks	Decrease the upper range of the AEMP benchmark for lead.	The health-based drinking WQG of 5 µg/L (Health Canada 2020) is recommended to be adopted as the upper limit of the AEMP benchmark for lead, because it is lower than the upper range in the aquatic life CCME guideline for lead (7 µg/L) for the predicted maximum hardness in Snap Lake. The lower range of the proposed AEMP benchmark for lead has not changed and was used in development of the approved effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). No concerns were raised by reviewers.
Water Quality	AEMP Benchmarks	Update the SSWQO for strontium to use as the AEMP benchmark.	Since the preparation of the AEMP Design Plan for Closure V.1 (De Beers 2020a), an FEQG for strontium has been published (ECCC 2020). This nationally applicable guideline includes more recent toxicity data compared to McPherson et al (2014b) used to derive the SSWQO and is lower than the drinking water guideline for strontium (Health Canada 2020); therefore, De Beers proposes to use the FEQG for strontium (2.5 mg/L) as the AEMP benchmark. Reviewers have not had a chance to review this proposed AEMP benchmark.
Water Quality	AEMP Benchmarks	Adopt new AEMP benchmarks for antimony, cobalt, and vanadium.	The health-based drinking water guideline of 6 µg/L is recommended to be adopted as the AEMP benchmark, because it is lower than the BC ENV aquatic life WQG of 9 µg/L for antimony III (BC ENV 2017) and no CCME WQG for aquatic life for antimony is available. The hardness-dependent FEQG for cobalt is recommended to be adopted for the AEMP benchmark (ECCC 2017) because it is more conservative than the BC ENV WQG (BC ENV 2019), particularly at lower hardness, and there is no CCME WQG for cobalt. The FEQG for vanadium (ECCC 2016) is recommended to be adopted as an AEMP benchmark. The FEQG represents the concentration below which no or low likelihood of adverse effects on aquatic life is expected. No WQG for aquatic life (freshwater) have been developed by CCME or BC ENV. No concern were raised by reviewers.

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	AEMP Benchmarks	Adopt the new AEMP benchmark for barium.	The BC WQG of 1,000 µg/L (BC ENV 2017) is recommended to be adopted as the AEMP benchmark because the BC WQG is equal to the health-based drinking water guideline (Health Canada 2020). For relevant parameters that did not have an AEMP benchmark under the previous AEMP Design Plan, federal or provincial WQGs were preferentially selected as the basis of the new benchmark. There is no Canadian WQG for barium and only BC has a working WQG for barium. The maximum observed barium concentration in Snap Lake was 41 µg/L, which was measured during operations in 2015; barium concentrations are not predicted to increase in the future. There is no need to deviate from the published provincial WQG and derive SSWQO for barium. An AEMP benchmark of 1000 µg/L for barium is consistent with benchmarks used by other diamond mines in Northwest Territories. For example, Diavik Diamond Mine adopted the BC WQG of 1000 µg/L as its Effects Benchmark (Golder 2017b), and the Gahcho Kue Diamond Mine adopted the Health Canada drinking water quality guideline of 1000 µg/L as its SSWQO (De Beers 2018). The proposed AEMP benchmark for barium was used in the development of effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). The Government of Northwest Territories raised concerns over De Beers proposed AEMP benchmark; see information request GNWT-ENR-EAM-12 and response from De Beers regarding the proposed AEMP benchmark for barium.

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Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Water Quality	AEMP Benchmarks	Adopt new AEMP benchmark for manganese.	The health-based drinking WQG of 120 µg/L is recommended to be adopted as an AEMP benchmark for manganese because it is lower than the applicable CCME aquatic life WQG (CCME 1999) and BC's WQG for aquatic life (BC ENV 2019). The proposed AEMP benchmark for manganese was used in the development of effluent quality criteria in the current Water Licence MV2019L2-004 (MVLWB 2020, Golder 2019). If manganese concentrations in Snap Lake are below the proposed AEMP benchmark (i.e., the health-based drinking water guideline), the risk to aquatic life related to manganese concentrations is negligible because the drinking water guideline is below the aquatic life guideline from CCME (CCME 1999); however, manganese concentrations that are above the AEMP benchmark but remain below the CCME WQG for aquatic life also present a negligible risk to aquatic life in Snap Lake. Therefore, De Beers proposes using the drinking water guideline for manganese as the most conservative "screening" AEMP benchmark for all potential water quality risks; however, assessment of Action Levels for toxicological impairment of aquatic life and the Weight of Evidence assessment, which is related to ecological health and not drinking water, should be based on the CCME WQG for aquatic life for manganese. The Government of Northwest Territories requested clarification on the use of the proposed AEMP benchmark; see information request GNWT-ENR-EAM-16 and response from De Beers regarding the intended use of the proposed AEMP benchmark for manganese.
Other Updates:			
Water Quality, Toxicity	Sampling Locations	Commence monitoring at four new mixing zone stations (i.e., two stations at the edge of the new mixing zone in the main basin and two stations at the edge of the new mixing zone in the northwest arm) as required in the current Water Licence MV2019L2-004 (MVLWB 2020)[1].	De Beers is committed to meeting all monitoring requirements as outlined in their current Water Licence MV2019L2-004 (MVLWB 2020). No concerns were raised by reviewers.

[1] Due to discrepancies in the new Water Licence (MVLWB 2021) for toxicity monitoring, the 2021 toxicity tests at the four new mixing zone stations would be conducted per the proposed toxicity monitoring presented in the "*Toxicity Test Requirement Discrepancies in Snap Lake Water Licence MV2019L2-0004*" letter submitted to MVLWB on 6 January 2021 (De Beers 2021).

Table 1: Proposed Changes to Monitoring under the 2021 Snap Lake AEMP

Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Fish Health Program	Field Methods	Additional fishing methods beyond those needed to target Lake Chub (e.g., set lines, gill nets, electrofishing) will be implemented during the small-bodied fish health field program to assess community composition and target all species in Snap Lake	It is being recommended in Section 3.8.5 that the large-bodied fish community monitoring program for the AEMP be discontinued; therefore, to meet the Mine's specific Water Licence requirements (Part G, Schedule 6; Item 1a [iv] and 1e), additional fishing methods should be employed during the small-bodied fish health program to target all species and confirm their ongoing presence in the lake. The Lake Chub data collected (i.e., lethal and non-lethal surveys) during the small-bodied fish health program will be used as an indicator of the fish population and year class strength of fish in Snap Lake. No concerns were raised by reviewers.
Fish Health Program	Field Methods	Stomach contents will no longer be collected and archived	Stomach content data has been of limited to no value historically because the contents have not been identifiable (i.e., materials are not intact due to digestive processes). No concerns were raised by reviewers.
Fish Tissue Chemistry	Laboratory Methods	Updated analytical detection limits.	Detection limits were updated according to currently achievable detection limits by the analytical laboratory, which also correspond with data requirements for interpretation of the AEMP fish tissue chemistry data. No concerns were raised by reviewers.

a) Based on comments received on the Snap Lake AEMP Design Plan Version 1.0 (De Beers 2020a) and supporting document, 2012 to 2017 Aquatic Effects Re-evaluation Report Snap Lake Mine (Golder 2020).

AEMP = Aquatic Effects Monitoring Program; SNP = Surveillance Network Program; LCB = Lac Capot Blanc; DSL2 = Downstream Lake 2; EAR = Environmental Assessment Report; TDS = total dissolved solids; SSWQO = site-specific water quality objectives; KING01 = upstream of King Lake; NEL = Northeast Lake; MVLWB = Mackenzie Valley Land and Water Board; CCME = Canadian Council of Ministers of the Environment; BC = British Columbia; FEQG = Federal Environmental Quality Guideline; WQG = water quality guideline; ECCC = Environment and Climate Change Canada; SLEMA = Snap Lake Environmental Monitoring Agency; TOC = total organic carbon; DOC = dissolved organic carbon; µg/L = micrograms per litre; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; % = percent; F1 (C6-C10) = hydrocarbon fraction 1 encompasses the range of equivalent carbon number from C6 to C10; F2 (>C10-C16) = hydrocarbon fraction 2 encompasses the range of equivalent carbon number from >C10 to C16.

References

BC ENV (British Columbia Ministry of Environment). 2017. British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Protection & Sustainability Branch. Ministry of Environment. British Columbia. June 2017.

BC ENV. 2019. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report. Water Protection and Sustainability Branch. Ministry of Environment & Climate Change Strategy. British Columbia. August 2019.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2018. Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada. Available at: http://st-ts.ccme.ca/. Accessed June 2020.

De Beers (De Beers Canada Inc.). 2002. Snap Lake Diamond Project: Environmental Assessment Report. Submitted to the Mackenzie Valley Environmental Impact Review Board. Yellowknife, NT, Canada.

De Beers. 2018. Effluent Quality Criteria Report. Gahcho Kué Mine. Submitted to the Mackenzie Valley Land and Water Board as part of the 2018 Water Licence Amendment Application, Yellowknife, NT, Canada. March 2018.

De Beers. 2019. Snap Lake Water Licence (MV2019L2-0004) Application and Final Closure and Reclamation Plan - Response to Interventions. Submitted to the Mackenzie Valley Land and Water Board, Yellowknife, NT, Canada. 22 October 2019.

De Beers. 2020a. Snap Lake Mine Aquatic Effects Monitoring Program Design Plan for Closure V.1. Submitted to the Mackenzie Valley Land and Water Board. September 2020.

De Beers. 2020b. 2019 Annual Report in Support of the Aquatics Effects Monitoring Program Water Licence (MV2011L2-0004), Snap Lake Project. Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NT, Canada.

De Beers. 2020c. Responses to Information Requests for Gahcho Kué - 2020 Water Licence and Land Use Permit Amendment – Technical Session. Gahcho Kué Water Licence (MV2005L2-0015) and Land Use Permit (MV2005C0032). Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NT, Canada. 30 July 2020.

De Beers. 2021. Toxicity Test Requirement Discrepancies in Snap Lake Water License (MV2019L2-0004). Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NT, Canada. 6 January 2021.

ECCC (Environment and Climate Change Canada). 2016. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines Vanadium. May 2016.

ECCC. 2017. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines Cobalt. May 2017.

ECCC. 2018. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines Hexavalent Chromium. May 2018.

ECCC. 2020. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines Strontium. July 2020.

Golder (Golder Associates Ltd.). 2017a. Snap Lake Mine 2017 Downstream Watercourses Special Study Report Version 2. Prepared for De Beers Canada Inc., Yellowknife, NT, Canada. Submitted to the Mackenzie Valley Land and Water Board, October 2017.

Golder. 2017b. Diavik Diamond Mine Inc. – Aquatic Effects Monitoring Program Design Plan Version 4.1. Prepared for Diavik Diamond Mines (2012) Inc. Yellowknife, NT, Canada. June 2017

Golder. 2019. Snap Lake Mine. Effluent Quality Criteria Report for Closure and Post-closure – Version 2. Prepared for De Beers Canada Inc., Calgary, AB, Canada. Golder Document No.: 18105918/DCN-013. August 2019. 75 pp.

Golder. 2020. 2012 to 2017 Aquatic Effects Re-evaluation Report Snap Lake Mine. Prepared for De Beers Canada Inc., Calgary, AB, Canada. Golder Document No.: 19127683/DCN-013. September 2020. 346 pp.

Health Canada. 2020. Guidelines for Canadian Drinking Water Quality – Summary Table. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water. Ottawa, ON, Canada.

MVLWB (Mackenzie Valley Land and Water Board). 2015. Mackenzie Valley Land and Water Board Updated Water Licence # MV2011L2-0004 Reasons for Decision. June 2015. Yellowknife, NWT, Canada.

MVLWB. 2020. Issuance of Type A Water Licence (MV2019L2-004). De Beers Canada Inc. – Closure and Post-Closure, Snap Lake Mine. May 2020.

McPherson CA, Lee DHY, Chapman PM. 2014a. Development of a fluoride chronic effects benchmark for aquatic life in freshwater. Environ Toxicol Chem. 33(11): 2472-2478.

McPherson CA, Lawrence GS, Elphick JR, Chapman PM. 2014b. Development of a strontium chronic effects benchmark for aquatic life in freshwater. Environ Toxicol Chem. 33(11): 2472-2478.