DE BEERS GROUP

March 31, 2021

Jacqueline Ho
Mackenzie Valley Land and Water Board
PO Box 2130
Yellowknife, NT X1A 2P6

Via Email: jho@mvlwb.ca

Dear Ms. Ho:

Re: Proposed changes for the 2021 Snap Lake AEMP Design Plan for Care and Maintenance (MV2019L2-0004)

De Beers submitted a letter to the MVLWB on 02 Feb 2021 (De Beers 2021a) to request changes to monitoring under the 2013 AEMP Design Plan Update for Care and Maintenance (Golder 2016) at Snap Lake until the AEMP Design Plan for Closure and Post Closure is approved. The MVLWB met on 11 March 2021 to review De Beers' proposed 2021 AEMP Design Plan for Care and Maintenance (i.e., that included the requested changes to the 2013 AEMP Design Plan Update for Care and Maintenance) and issued their interim approval letter on March 16, 2021.

The MVLWB interim approval letter requested that De Beers resubmit the requested changes to 2013 AEMP Design Plan Update for Care and Maintenance in accordance with Board directives, as summarized in Table 1 (MVLWB 2021); this new submission will be referred to as the 2021 AEMP Design Plan for Care and Maintenance.

The proposed changes 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

De Beers Canada inc.

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A member of the Anglo American plc group

Cc: Michelle Peters, DBCI

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Component(s)	Category	Description of Proposed Change from the 2013 AEMP Design Plan Updated for Care and Maintenance	Rationale[a]
Proposed Reductions:			
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 and benthic invertebrate components. 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).
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 2020a]). 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 2020b). 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.
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.
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.
Plankton	Parameters	Discontinue Microcystin-LR analysis at Snap Lake stations. Microcystin-LR will still be collected at SNP 02-15.	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 currently approved Action Level for microcystin-LR can continue to be assessed by comparing concentrations of microcystin-LR collected at SNP 02-15 to the Action Level values.
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.
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.

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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.
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.
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.
Updates to Parameters and AEMP Benchmarks:			
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 MV2019L2-0004 (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 MV2019L2-0004 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 MV2019L2-0004 (MVLWB 2020, Golder 2019).

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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	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).
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 MV2019L2-0004 (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).

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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	Update the Environmental Assessment Report (EAR) benchmarks for cadmium and hexavalent chromium, originally developed in 2002 (De Beers 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 MV2019L2-0004 (MVLWB 2020, Golder 2019).
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 MV2019L2-0004 (MVLWB 2020, Golder 2019).
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.

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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 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.
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 Kué 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 MV2019L2-0004 (MVLWB 2020, Golder 2019).
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 MV2019L2-0004 (MVLWB 2020)[1].	De Beers is committed to meeting all monitoring requirements as outlined in their current Water Licence MV2019L2-0004 (MVLWB 2020), which includes chronic toxicity tests for algae and does not include early life stage testing for Rainbow Trout.

[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 2021b).

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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.
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).
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.

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.

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