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Mark Cliffe-Phillips
Executive Director
Mackenzie Valley Environmental Impact Review Board
P.O. Box 938
Yellowknife, NT X1A 2N7

29 July 2019

Dear Mr. Cliffe-Phillips:

Subject: DDMI Response to MVEIRB Supplemental Information Requests for the Environmental Assessment of the Processed Kimberlite to Mine Workings Proposal (MVEIRB File No.: EA1819-01)

Diavik Diamond Mines (2012) Inc. (DDMI) is pleased to provide the Mackenzie Valley Environmental Impact Review Board (MVEIRB or the Board) with responses to the Board's Supplemental Information Requests (IRs) issued on July 26, 2019.

Please note that DDMI's responses appended to this letter address MVEIRB's Supplemental IRs #1 to #4. DDMI's response to the Board's Supplemental IR#5, including the requested additonal water quality modelling, will be provided under separate cover by August 9, 2019.

In the responses to the Supplemental IRs (#1 to #4), DDMI has included clarifications on the rationale for proposing to establish hydrological connection between pit lake(s) and Lac de Gras, the intent and consequences of a "no-reconnection" or "pit isolation" scenario, and the water quality thresholds used in the effects assessment.

We thank the MVEIRB for the opportunity to clarify our previous responses to the Board's and Parties' IRs. Please do not hesitate to contact the undersigned or Kofi Boa-Antwi (867 447 3001 or kofi.boa-antwi@riotinto.com) if you have any questions related to this submission.

Sincerely,

Sean Sinclair
Superintendent, Environment

cc: Catherine Fairbairn, MVEIRB
Kate Mansfield, MVEIRB
Ryan Fequet, WLWB
Anneli Jokela, WLWB

Diavik Diamond Mines Inc.

Processed Kimberlite to Mine Workings

Response to Supplemental Information Requests from the Mackenzie Valley Environmental Impact Review Board

Document #: ENVI-987-0719 R0

29 July 2019

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1. MVEIRB-Supplemental IR#1

In response to Review Board IR30, Diavik indicated that it is necessary to have a hydrological connection between the pit lake(s) and Lac de Gras (for example, by fracturing the water-retaining plastic concrete wall that forms the core of the dike).

a) Please confirm Diavik's understanding and intent of pit "isolation". For example, does isolation mean preventing fish from swimming into the pit(s) or does it mean preventing water exchange between the pit(s) and Lac de Gras?

b) Please provide support for Diavik's position that the pits need to be hydrologically connected to Lac de Gras in some way.

c) Please describe the methods that Diavik would use to connect the pit(s) to Lac de Gras if the dikes were not breached.

1.1 Developer's Response to MVEIRB-Supplemental IR#1

a) The intent of a no-reconnection or pit "isolation" scenario is to prevent fish from using the pit lake area. It has been described as a contingency if for some reasons water quality conditions in the pit lakes were not suitable for fish and aquatic life. It does not mean preventing water exchange between the pit lakes and Lac de Gras.

b) A hydrologic connection is required to decommission the dikes. Preventing a hydrologic connection would mean operating and maintaining the dikes as water retaining engineered structures in perpetuity. Without a hydrologic connection, the pit lakes would accumulate water over time from both direct precipitation and runoff. Water would need to be regularly removed from the pit lake to prevent water levels from rising above engineered limits of the dike. This would require DDMI to have a site presence in perpetuity. With a hydrologic connection the dikes would no longer be functioning as engineered water retaining structures and would not require long term operations or maintenance.

c) Two concepts have been considered to create a hydrologic connection while not allowing fish passage into the pit lake area. One is to excavate breaches, as previously described, to remove the plastic concrete core and then immediately backfill the excavation with rock. Water would be able to flow through the backfilled rock, but fish could not travel through. Another option would be to drill into the plastic concrete wall from the surface of the dike and hydraulically fracture the wall in numerous locations. Water would be able to flow through the fractured rock and concrete wall, but fish could not travel through.

2. MVEIRB-Supplemental IR#2

Diavik indicated in its response to Review Board IR31 that if pit water quality is determined to pose a risk to water quality, fish and fish habitat, caribou, humans, or cultural land uses, it could 're-isolate' the pit lake from Lac de Gras. Please clarify if water connectivity would still be required and how the re-isolation would proceed.

2.1 Developer's Response to MVEIRB-Supplemental IR#2

Water connectivity (passage of water between the pit lake(s) and Lac de Gras) would still be required in the example described in response to MVEIRB IR#31. In this scenario, the "re-isolation" would be achieved by filling the breach excavations with rock. Water would flow through the backfilled rock, but fish could not travel through, the same as described in DDMI's response to 1c above.

3. MVEIRB-Supplemental IR#3

Diavik has used the Aquatic Effects Monitoring Program benchmarks for determining the safety of the pit water. Please clarify and discuss how these relate to:

a) chronic and toxic effects to aquatic life

b) Canadian Council of Ministers of the Environment guidelines for the protection of aquatic life

c) drinking water quality guidelines

3.1 Developer's Response to MVEIRB-Supplemental IR#3

Aquatic Effects Monitoring Program (AEMP) Benchmarks are used to define:

- When water quality is acceptable to allow re-connection of the pit lakes with Lac de Gras; and

- Magnitude of water quality effects (see Table 4-2 of the Summary Impact Statement [SIS] for the Processed Kimberlite to Mine Workings Project).

AEMP Benchmarks are effectively equivalent to Canadian Water Quality Guidelines for Protection of Aquatic Life (CWQG PAL). They are also equivalent to the Ecological Thresholds for Water Quality used to define magnitude of effects in the original Diavik Environmental Impact Statement (See DDMI 1998 Fish and Water Table 6-2; a copy of the table from the original Diavik Environmental Impact Statement is included in Appendix A for reference). Specific values have changed somewhat over time but the intent remains the same.

This is further described in the SIS at Page 43:

The magnitude of effects on water quality is defined using water quality benchmarks developed for the AEMP (Golder 2017a), which were established to maintain changes in water quality of Lac de Gras within acceptable ranges. The AEMP benchmarks are the lower of benchmarks developed for the protection of aquatic life (CWQG PAL) or the health of humans who may drink the water (GCDWQ). Where the CWQG PAL and GCDWQ are not available from the two primary sources, equivalent benchmark values from other jurisdictions may be adopted. In some cases (e.g., where natural background concentrations in Lac de Gras exceed the guidelines), adjustments have been made to the benchmark values. The CWQG PAL and the GCDWQ are intentionally and conservatively set at levels that are protective of their intended receptors. Thus, at the AEMP benchmark levels, there are no expected adverse effects to aquatic life or to human health. However, even if the AEMP benchmark levels are occasionally exceeded by modest margins or for short periods of time, it does not follow that there would be adverse effects to aquatic life or to human health.

4. MVEIRB-Supplemental IR#4

Please discuss the risk (in terms of likelihood and consequence) that water from the pits will mix with Lac de Gras if the dikes are not breached and the walls are not fractured. Please describe the possible pathways of water exchange between the pit lake and Lac de Gras (for example, from water level in pit rising so that it overtops the dike, or from weathering and eventual failure over the very long term).

4.1 Developer's Response to MVEIRB-Supplemental IR#4

Water from the pit lakes will mix with Lac de Gras if dikes are not breached and the walls are not fractured because as described in the response to 1b above, DDMI would be required to operate and maintain the dikes as engineered water retaining structures. In this example, water from precipitation and runoff would cause water levels in the pit lakes to rise. These water levels would likely be managed by periodic pumping of excess water to Lac de Gras. If water was not pumped it would eventually over-top the dike plastic concrete wall and water would flow to Lac de Gras.

5. MVEIRB-Supplemental IR#5

Using deposition scenario 3A for pit A418[1] as a basis for modelling, please provide responses to the following:

Scenario 1: pit lake remains completely isolated from Lac de Gras (that is, no water flows between the pit lake and Lac de Gras).

Please provide:

a) long term water quality modelling results (from closure until pit lake water quality stabilizes). Include modelled maximum water quality concentrations in the pit lake at surface and 40 m depths, and describe when those maximums would occur.

b) a description of how this would change the effects assessment provided in the *Summary Impact Statement*.

[1] This scenario includes the largest volume of processed kimberlite and the shallowest freshwater cap for pit A418, which is Diavik's preferred location for depositing kimberlite.

Scenario 2: dikes are not breached, but water from the pit lake can still mix with Lac de Gras (for example, as a result of fracturing the water-retaining plastic concrete wall that forms the core of the dike).

Please provide:

a) long term water quality modelling results (from closure until pit water quality reaches equilibrium [as defined in Diavik's response to IR12]).

- Include modelled maximum water quality concentrations in the pit lake at surface and 40 m depths, and describe when those maximums would occur.

- Describe the size of the mixing zone, if any.

- Describe predicted changes to water quality for the mixing zone and far field areas of Lac de Gras.

b) a description of how this would change the effects assessment provided in the *Summary Impact Statement*.

5.1 Developer's Response to MVEIRB-Supplemental IR#5

The requested information, including additional water quality modelling, will submitted separately by August 9, 2019.

APPENDIX A

Ecological Thresholds for Water Quality (*Environmental Impact Statement for the Diavik Diamond Project, 1998*) and Current AEMP Effects Benchmarks (Diavik AEMP Design Plan Version 4.1)

<u>Ecological Thresholds for Water Quality</u>: Environmental Impact Statement for the Diavik Diamond Project, 1998

Table 6-2 Ecological Thresholds for Water Quality

		Drinking Water Thresholds		Aquatic Life (Fish) Thresholds	
Parameter	Units	Threshold	Source	Threshold	Source
Hardness	mg/L				CWQG
pH	-	6.5-8.5	CWQG	6.5-9.0	CWQG
Total dissolved solids	mg/L	500.0	CWQG		
Total suspended solids	mg/L			10.0	CWQG
Sodium	mg/L	200.00	CDWG		
Ammonia as N	mg/L			2.200	CWQG
Chloride	mg/L	250.00	CDWG	230.00	USEPA CHRONIC
Sulphate	mg/L	500.00	CDWG		
Nitrate as N	mg/L	10.00	CDWG		
Nitrite as N	mg/L			0.060	CWQG
Total phosphorus	mg/L			0.005	Site specific
Boron	mg/L	5.000	CDWG		
Aluminum	mg/L			0.025	Site specific
Antimony	mg/L	0.0450	USEPA		
Arsenic	mg/L	0.0250	CDWG	0.0500	CWQG
Barium	mg/L	1.0000	CDWG		
Beryllium	mg/L	0.0053	USEPA	0.0053	USEPA CHRONIC
Cadmium	mg/L	0.00500	CDWG	0.0001*	USEPA
Chromium	mg/L	0.0500	CDWG	0.0020	CWQG
Cobalt	mg/L			0.0500	USEPA CHRONIC
Copper	mg/L	1.0000	CDWG	0.0020	CWQG
Iron	mg/L	0.30	CDWG	0.30	CWQG
Lead	mg/L	0.0100	CDWG	0.0010	CWQG
Manganese	mg/L	0.050	CDWG		
Mercury	mg/L	0.0010	CDWG	0.0001	CWQG
Molybdenum	mg/L	0.2500	BCMELP		
Nickel	mg/L			0.025	CWQG
Selenium	mg/L	0.0100	CDWG	0.0010	CWQG
Silver	mg/L			0.0001	CWQG
Thallium	mg/L	0.0017	USEPA HHNC		
Vanadium	mg/L	0.1000	BC		
Zinc	mg/L	5.000	CDWG	0.030	CWQG
Uranium	mg/L	0.1	CDWG		
Fecal coliforms	MPN/dL	0	CDWG		
BOD	mg/L			Dissolved oxygen of 5.0 - 9.5	CWQG

*Calculated at a hardness of 4.5 mg/L

CWQG = Canadian Water Quality Guidelines; USEPA HHNC= U.S. Environmental Protection Agency Human Health Non-Carcinogenic Criteria (USEPA 1984); CDWG = Canadian Drinking Water Guidelines (Health Canada 1996); BCMELP = BC Ministry of Environment, Lands and Parks Drinking Water (BCMELP 1994)

Current Diavik AEMP Effects Benchmarks: the Effects Benchmarks used for the AEMP are generally consistent with those established during the EA (referred to as ecological thresholds in the EA), but have incorporated a number of revisions so that they are up-to-date and suitable for the Lac de Gras environment. For variables with both aquatic life and drinking water values, the Effects Benchmark will be the lower of the two.

Table 5.3-1: Effects Benchmarks for Water Quality Variables

Variable	Units	Effects Benchmarks[i]	
		Protection of Aquatic Life	Drinking Water
Conventional Parameters			
pH	pH Units	6.5 to 9.0	6.5 to 8.5
Dissolved oxygen	mg/L	Cold water: early life stages = 9.5; other life stages = 6.5	-
Total dissolved solids	mg/L	500[a]	500
Total Alkalinity	mg/L	n/a[b]	
Total suspended solids	mg/L	+5 (24 h to 30 days); +25 (24-h period)[c]	
Turbidity	NTU	2.2 (long-term, IC)[d] 2.3 (long-term, OW)[d]	-
Major Ions			
Chloride	mg/L	120	250
Sodium	mg/L	52[d]	200
Fluoride	mg/L	0.12	1.5
Sulphate	mg/L	100[e]	500
Nutrients			
Ammonia as nitrogen	µg/L	4,730[f]	-
Nitrate as nitrogen	µg/L	3,000	10,000
Nitrite as nitrogen	µg/L	60	1,000
Total Metals			
Aluminum (total)	µg/L	87[d]	100/200[g]
Aluminum (dissolved)	µg/L	Variable with pH[e]	-
Antimony	µg/L	33[d]	6
Arsenic	µg/L	5	10
Barium	µg/L	1,000[e]	1,000
Boron	µg/L	1,500	5,000
Cadmium	µg/L	0.1[f]	5
Chromium	µg/L	1 (Cr VI)[h]	50

Table 5.3-1: Effects Benchmarks for Water Quality Variables

Variable	Units	Effects Benchmarks[j]	
		Protection of Aquatic Life	Drinking Water
Copper	µg/L	2	1,000
Iron	µg/L	300	300
Lead	µg/L	1	10
Manganese	µg/L	-	50
Mercury	µg/L	0.026 (inorganic); 0.004 (methyl)	1
Molybdenum	µg/L	73	-
Nickel	µg/L	25	-
Selenium	µg/L	1	10
Silicon	µg/L	2100[d]	-
Silver	µg/L	0.1	-
Strontium	µg/L	30,000[i]	-
Thallium	µg/L	0.8	-
Tin	µg/L	73[d]	-
Uranium	µg/L	15	20
Zinc	µg/L	30	5,000

- = benchmark not available.

a) Adopted from Alaska DEC (2012) and as dictated by the WLWB (2013).

b) Alkalinity should be no lower than 25% of natural background level. There is no maximum guideline (USEPA 1998).

c) Average increase of 5 (24 hours to 30 days) or maximum increase of 25 mg/L in a 24 h-period).

d) See Appendix B for description.

e) BCMOE (2013).

f) See Appendix IV.1 in DDMI (2007a) and BC MOE (2001) for description.

g) 100 µg/L for conventional treatment and 200 µg/L for other treatment types.

h) Total chromium concentrations will be compared to the benchmark for chromium VI.

i) Based on results from HydroQual (2009) and Pacholski (2009). See text for more information.

j) Unless noted, benchmarks are derived from current CWQGs and Canadian Drinking Water Quality Guidelines; the Effects Benchmark is selected as the lower of the two values.