TECHNICAL MEMORANDUM

DATE February 12, 2014 **PROJECT No.** 13-1365-0007/DCN-204

TO Veronica Chisholm
De Beers Canada Inc.

CC John Faithful

FROM Tasha Hall **EMAIL** Tasha_Hall@golder.com

GAHCHO KUÉ PROJECT – WATER QUALITY TABLES FROM THE DRAFT EFFLUENT QUALITY REPORT

Maximum predicted concentrations in the Water Management Pond are presented in Table 1. The baseline concentrations for Lake N11 and the Kirk Lake Watershed are shown in Table 2.

Predicted concentrations at the mixing zone boundary and a comparison of predicted concentrations in Lake N11 and baseline water quality are presented in Table 3.

Table 1: Comparison of Predicted Concentrations in the Operational Discharge from the Water Management Pond in Year 3 of Operations to Baseline Concentrations (Kirk Lake Watershed)

Parameter	Units	Kirk Lake Watershed (Updated as of 2013)[a]		Predicted Water Management Pond Concentrations[c]	Predicted WMP Concentrations Greater Than Regional Baseline Less 10%?
		Mean + 2SD	Mean + 2SD Less 10%[b]	Maximum	(Yes/No)
Conventional					
Total Dissolved Solids	mg/L	39	36	302	**Yes**
Major Ions					
Chloride	mg/L	1.5	1.4	152	**Yes**
Fluoride	mg/L	0.06	0.05	0.13	**Yes**
Potassium	mg/L	0.8	0.7	4.6	**Yes**
Sulphate	mg/L	2.5	2.3	32	**Yes**
Nutrients					
Nitrate	mg N/L	0.065	0.059	8.4	**Yes**
Nitrite	mg N/L	0.013	0.012	0.0033	No
Ammonia	mg N/L	0.070	0.063	8.0	**Yes**
Total Phosphorus	mg/L	0.007	0.006	0.028	**Yes**
Total Metals[d]					
Aluminum	mg/L	0.045	0.040	0.081	**Yes**

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Table 1: Comparison of Predicted Concentrations in the Operational Discharge from the Water Management Pond in Year 3 of Operations to Baseline Concentrations (Kirk Lake Watershed) (continued)

Parameter	Units	Kirk Lake Watershed (Updated as of 2013)[a]		Predicted Water Management Pond Concentrations[c]	Predicted WMP Concentrations Greater Than Regional Baseline Less 10%?
		Mean + 2SD	Mean + 2SD Less 10%[b]	Maximum	(Yes/No)
Antimony	mg/L	0.0004	0.00036	0.0021	**Yes**
Arsenic	mg/L	0.0003	0.0002	0.0045	**Yes**
Barium	mg/L	0.0053	0.0048	0.051	**Yes**
Beryllium	mg/L	0.00001	0.000009	0.00012	**Yes**
Boron	mg/L	0.004	0.0036	0.16	**Yes**
Cadmium	mg/L	0.000040	0.000036	0.000043	**Yes**
Chromium	mg/L	0.0005	0.0004	0.0015	**Yes**
Cobalt	mg/L	0.0007	0.00067	0.0012	**Yes**
Copper	mg/L	0.0027	0.0024	0.0024	**Yes**
Iron	mg/L	0.57	0.52	0.23	No
Lead	mg/L	0.00121	0.00109	0.00036	No
Manganese	mg/L	0.13	0.11	0.05	No
Mercury	mg/L	0.000016	0.000015	0.000013	No
Molybdenum	mg/L	0.00019	0.00017	0.01	**Yes**
Nickel	mg/L	0.0022	0.0020	0.0047	**Yes**
Selenium	mg/L	0.00008	0.00007	0.00018	**Yes**
Silver	mg/L	0.00030	0.00027	0.000071	No
Strontium	mg/L	0.014	0.013	0.077	**Yes**
Thallium	mg/L	0.000016	0.000015	0.00022	**Yes**
Uranium	mg/L	0.00005	0.000047	0.0021	**Yes**
Vanadium	mg/L	0.0004	0.00036	0.0031	**Yes**
Zinc	mg/L	0.015	0.014	0.0086	No

Source: De Beers 2013, Table 2.1-1.

Note: Bolded “Yes” indicates the parameter was carried forward in the screening process.

[a] Refers to the baseline concentrations from the Kirk Lake Watershed, represented by the mean + two standard deviations (SD) (De Beers 2013, Appendix C).

[b] “Mean + 2SD Less 10%” refers to baseline concentrations from the Kirk Lake Watershed minus 10 percent (%).

[c] Refers to maximum predicted concentrations in the operational discharge from the WMP (De Beers 2013, Appendix D).

[d] The term “metals” includes metalloids such as arsenic and non-metals such as selenium.

mg/L = milligrams per Litre; N = nitrogen; SD = standard deviation; WMP = water management pond ;% = percent.

Table 2: Baseline Concentrations for the Parameters of Interest in the Kirk Lake Watershed

Parameter	Unit	Baseline - Lake N11 (2010 to 2013)					Baseline - Kirk Lake Watershed (1995 to 2013)				
		Mean	95th Percentile	Mean + 2SD	Max	n	Mean	95th Percentile	Mean + 2SD	Max	n
Conventional											
Total Dissolved Solids	mg/L	17	30	32	32	27	16	26	39	130	415
Hardness	mg/L	5	8	9	10	27	6	8	10	21	506
Total organic carbon	mg/L	3.8	5.0	5.1	5.9	27	4.3	5.1	8.3	24	421
Major Ions											
Chloride	mg/L	1.0	1.3	1.2	1.3	27	0.7	1.0	1.5	3.2	571
Fluoride	mg/L	0.05	0.04	0.05	0.05	27	0.04	0.05	0.06	0.10	525
Potassium	mg/L	0.4	0.7	0.7	0.8	27	0.5	0.6	0.8	1.6	462
Sulphate	mg/L	1.1	0.9	2.0	3.3	27	0.9	0.5	2.5	10.6	306
Nutrients											
Ammonia	mg N/L	0.018	0.075	0.1	0.087	27	0.020	0.026	0.070	0.270	509
Nitrate	mg N/L	0.009	0.023	0.038	0.078	27	0.014	0.029	0.065	0.190	481
Nitrite	mg N/L	0.004	0.007	0.011	0.007	27	0.002	0.003	0.078	0.013	445
Total Phosphorus	mg P/L	0.004	0.005	0.006	0.006	27	0.003	0.003	0.010	0.018	299
Total Metals[(a)]											
Aluminum	mg/L	0.010	0.012	0.020	0.034	27	0.014	0.020	0.045	0.210	542
Antimony	mg/L	0.00005	0.00011	0.00018	0.00035	27	0.0001	0.0002	0.0004	0.0012	569
Arsenic	mg/L	0.00011	0.00014	0.00016	0.00018	27	0.0001	0.0002	0.0003	0.0007	526
Barium	mg/L	0.0026	0.0045	0.0044	0.0051	27	0.0028	0.0039	0.0053	0.0085	534
Beryllium	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	27	0.00001	0.00001	0.00001	0.00002	252
Boron	mg/L	<0.005	<0.005	<0.005	<0.005	27	0.002	0.025	0.004	0.013	580
Cadmium	mg/L	0.000006	0.000012	0.000033	0.000076	28	0.000009	0.000010	0.000040	0.000091	276
Chromium	mg/L	0.0001	0.0002	0.0002	0.0003	26	0.0001	0.0003	0.0005	0.0027	566
Cobalt	mg/L	0.00005	0.00010	0.00021	0.00045	27	0.0001	0.0001	0.0007	0.0059	580
Copper	mg/L	0.0006	0.0009	0.0012	0.0019	27	0.0008	0.0010	0.0027	0.0080	534
Iron	mg/L	0.03	0.06	0.07	0.11	27	0.06	0.10	0.57	5.93	583
Lead	mg/L	0.0004	0.0001	0.0038	0.0092	27	0.00010	0.00004	0.0012	0.00923	515
Manganese	mg/L	0.01	0.01	0.05	0.12	27	0.02	0.02	0.13	0.76	570
Mercury	mg/L	0.00001	0.00001	0.00004	0.00009	41	0.000002	0.000010	0.000016	0.000090	450
Molybdenum	mg/L	0.00006	0.00005	0.00007	0.00009	27	0.00006	0.00003	0.00019	0.00120	522
Nickel	mg/L	0.0005	0.0004	0.0026	0.0060	27	0.001	0.0006	0.002	0.010	578
Selenium	mg/L	0.00005	0.000087	0.00008	0.00009	27	0.00004	0.000050	0.00008	0.00020	460
Silver	mg/L	0.000003	0.000003	0.000004	0.000006	28	0.00003	0.00005	0.00030	0.00088	437

Table 2: Baseline Concentrations for the Parameters of Interest in the Kirk Lake Watershed (continued)

Parameter	Unit	Baseline - Lake N11 (2010 to 2013)					Baseline - Kirk Lake Watershed (1995 to 2013)				
		Mean	95th Percentile	Mean + 2SD	Max	n	Mean	95th Percentile	Mean + 2SD	Max	n
Strontium	mg/L	0.008	0.012	0.013	0.014	27	0.008	0.011	0.014	0.025	544
Thallium	mg/L	0.000002	0.0000027	0.000003	0.000003	27	0.000003	0.000025	0.000016	0.000050	411
Uranium	mg/L	0.000008	0.000012	0.000012	0.000013	27	0.00001	0.00003	0.00005	0.00025	547
Vanadium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	27	0.0001	0.0001	0.0004	0.0025	488
Zinc	mg/L	0.00114	0.0024	0.0032	0.0058	27	0.003	0.004	0.015	0.063	586
Additional Parameters[(b)]											
pH		6.7	7.1	7.3	8.1	150	6.6	7.5	7.8	9.4	2027
Temperature	°C	12.8	16.4	17.4[(c)]	17.4	150	10.0	17.2	21.5	22.3	3499
Total Petroleum Hydrocarbons	mg/L	<2	<2	<2	<2	1	0.03	0.03	0.8	2.1	71
Total Suspended Solids	mg/L	1.2	2.7	2.3	3.0	27	1.2	2.0	7.4	55.0	506
Escherichia coli	mg/L	-	-	-	-	-	-	-	-	-	-

Source: De Beers 2013, Appendix C, Table C1.

[(a)] The term "metals" includes metalloids such as arsenic and non-metals such as selenium.

[(b)] Temperature, total suspended solids, pH, *Escherichia coli,* and total petroleum hydrocarbons were not explicitly included as Parameters of Interest in Section 2.1 of the Effluent Quality Criteria (EQC) Report (De Beers 2013) and were not included in the screening of Parameters of Potential Concern. These parameters are influenced by treatment technologies to be used at the Mine site. Relevant EQC were for these parameters were discussed in Section 4 of the EQC Report (De Beers 2013) so they have been included in this baseline data table.

[(c)] Set to the maximum observed from the historical dataset.

mg/L = milligrams per litre; SD = standard deviation; N = nitrogen; P = phosphorus; n - mean; max = maximum; "-" = no data available; °C = degrees Celsius; < = less than.

Table 3: Estimated Maximum Concentrations at the Edge of the Mixing Zone (200 m)

Parameter[a]	Unit	Baseline Water Quality[b]	Fully Mixed Lake N11 Concentrations from EIS[c]	Maximum Concentrations at the Edge of Mixing Zone	
				Submerged Diffuser Year 3	
				North Basin	South Basin
Conventional					
Total Dissolved Solids	mg/L	16	57	90	101
Major Ions					
Calcium	mg/L	1.1	9.6	16	18
Chloride	mg/L	0.49	22	39	45
Fluoride	mg/L	0.03	0.05	0.057	0.062
Magnesium	mg/L	0.43	1.8	2.8	3.2
Potassium	mg/L	0.39	1	1.5	1.7
Sodium	mg/L	0.78	5.4	9.2	10
Sulphate	mg/L	0.88	5.7	9.1	10
Nutrients					
Nitrate	mg N/L	0.019	1.5	2.2	2.7
Ammonia	mg N/L	0.019	1.4	2.1	2.6
Total Nitrogen	mg/L	0.12	3.1	4.5	5.6
Dissolved Phosphorus	mg/L	0.005	0.0067	0.011	0.012
Total Phosphorus	mg/L	0.005	0.0085	0.011	0.012
Total Metals					
Aluminum	mg/L	0.019	0.029	0.036	0.039
Antimony	mg/L	0.000062	0.00035	0.00057	0.00065
Arsenic	mg/L	0.00012	0.00074	0.0013	0.0014
Barium	mg/L	0.0027	0.01	0.016	0.018
Beryllium	mg/L	0.000064	0.000072	0.000078	0.00008
Boron	mg/L	0.0017	0.026	0.043	0.05
Cadmium	mg/L	0.000019	0.000024	0.000026	0.000027
Chromium	mg/L	0.00016	0.0004	0.00052	0.00059
Cobalt	mg/L	0.00019	0.00036	0.00046	0.00051
Copper	mg/L	0.0013	0.0015	0.0016	0.0017
Iron	mg/L	0.059	0.09	0.1	0.11
Lead	mg/L	0.000061	0.00011	0.00014	0.00016
Manganese	mg/L	0.0057	0.014	0.018	0.02
Mercury	mg/L	0.0000051	0.0000062	0.0000072	0.0000077
Molybdenum	mg/L	0.00003	0.00157	0.0027	0.0032
Nickel	mg/L	0.00047	0.0012	0.0016	0.0019
Selenium	mg/L	0.000032	0.00006	0.000071	0.000078
Silver	mg/L	0.0000081	0.00002	0.000025	0.00003
Strontium	mg/L	0.0069	0.0172	0.025	0.028
Thallium	mg/L	0.000014	0.000049	0.00007	0.000082
Uranium	mg/L	0.000016	0.00037	0.00057	0.00069
Vanadium	mg/L	0.000094	0.00051	0.00085	0.00096
Zinc	mg/L	0.0024	0.0035	0.0041	0.0044
Dissolved Metals					
Aluminum	mg/L	0.017	0.022	0.026	0.028
Antimony	mg/L	0.000053	0.00033	0.00055	0.00063
Arsenic	mg/L	0.0001	0.00072	0.0012	0.0014

Table 3: Estimated Maximum Concentrations at the Edge of the Mixing Zone (200 m) (continued)

Parameter[a]	Unit	Baseline Water Quality[b]	Fully Mixed Lake N11 Concentrations from EIS[c]	Maximum Concentrations at the Edge of Mixing Zone	
				Submerged Diffuser Year 3	
				North Basin	South Basin
Barium	mg/L	0.002	0.009	0.015	0.017
Beryllium	mg/L	0.000064	0.000072	0.000078	0.00008
Boron	mg/L	0.0017	0.026	0.043	0.05
Cadmium	mg/L	0.000019	0.000022	0.000023	0.000024
Chromium	mg/L	0.00016	0.0003	0.00037	0.0004
Cobalt	mg/L	0.00019	0.00034	0.00043	0.00048
Copper	mg/L	0.00099	0.00112	0.0012	0.0013
Iron	mg/L	0.045	0.061	0.073	0.078
Lead	mg/L	0.000027	0.000079	0.00011	0.00013
Manganese	mg/L	0.004	0.012	0.016	0.019
Mercury	mg/L	0.0000051	0.0000062	0.0000068	0.0000072
Molybdenum	mg/L	0.000014	0.00155	0.0027	0.0032
Nickel	mg/L	0.00039	0.0009	0.0012	0.0013
Selenium	mg/L	0.000032	0.00006	0.000071	0.000078
Silver	mg/L	0.0000025	0.000015	0.000021	0.000026
Strontium	mg/L	0.0069	0.017	0.025	0.028
Thallium	mg/L	0.0000012	0.0000376	0.000059	0.000072
Uranium	mg/L	0.000011	0.00037	0.00057	0.00068
Vanadium	mg/L	0.000039	0.00042	0.00074	0.00084
Zinc	mg/L	0.0024	0.0035	0.0041	0.0044

Source: De Beers 2013, Appendix E, Table E4.

[a] Shaded rows indicate parameters that were identified as substances of potential concern in the EIS Supplement (De Beers 2012).

[b] Long-term average baseline concentrations from regional lakes in De Beers (2012), Section 9.2.5.1.1, Table 9.2-17.

[c] Projected maximum concentrations during dewatering from De Beers (2012), Section 9.2.5.1.1, Table 9.2-17.

mg/L = milligrams per litre, mg N/L = milligrams per litre as nitrogen, EIS = Environmental Impact Study; n/a = not applicable.

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TH/kl

References

De Beers (De Beers Canada Inc.). 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT. April 2012.

De Beers. 2013. Draft Effluent Quality Criteria Report. Gahcho Kué Mine. Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NWT. December 2013.