



Parent Company of Canadian Zinc

Memorandum

To: MVLWB

Pages: 2

Date: October 13, 2021

Re: Receiving Water Quality Predictions for Copper and Mercury, MV2021L2-0004

CZN was alerted to the fact that in the information request responses submitted by CZN on September 20, 2021 the predicted receiving water quality for total copper and total mercury exceeded the water quality objectives (WQO) during open water – high flow months (Attachments 12-4 and 12-5). Upon review, we determined that the reason for these exceedances can be attributed to high upstream water quality 90th percentiles that are skewed by elevated TSS in a limited number of samples. Data for these samples is provided in Table 1 below.

Table 1: Upstream Water Quality samples with elevated Total Copper and Total Mercury

Date	TSS mg/L	Total Cu ug/L	Dissolved Cu ug/L
20 May 2006	130	3.3	-
28 Jun 2011	205	3.1	0.25
12 Aug 2011	3990	36.85	0.25
1 Aug 2013	358	4.21	0.33
8 Sep 2010	-	5	0.6
Date	TSS mg/L	Total Hg ng/L	Dissolved Hg ng/L
12 Aug 2011	3990	31	1.55
8 Sep 2010	-	30	-

The open water – high flow 90th percentile for total copper was recalculated omitting the samples in Table 1. The percentile value reduced from 3.26 ug/L to 1.047 ug/L. The open water – high flow 90th percentile for total mercury was recalculated omitting the 12 Aug 2011 sample in Table 1. The 8 Sep 2010 sample was retained in the absence of TSS and dissolved mercury data. The percentile value reduced from 23.4 ng/L to 14.5 ng/L.

Using the revised percentiles, receiving water quality predictions are as shown in the attached pages. Total copper and total mercury concentrations now meet WQO in all seasons. We provide this evidence to continue to support the EQC proposed.

The above analysis further illustrates the difficulties arising from using high percentiles for upstream water quality definition, such as 90th percentiles, for total metals which are prone to effects from naturally elevated TSS in a limited number of samples. These effects will also come into play for downstream compliance during operations, although simultaneous upstream sampling

will allow for a comparison and fairer judgement to be made. We re-iterate that, for percentile calculations for upstream water quality relating to metals, it may be more appropriate to use only dissolved concentrations.

We believe that TSS 'distortion' effects for total metals remain in the upstream water quality database. We believe we have uncovered the more problematic results. We do not consider that further review is required at this time if the proposed EQC are adopted.

RECEIVING WATER CONCENTRATIONS - 65 L/s SCENARIO, 90TH UPSTREAM PERCENTILES - 4.8 m PIPE

Total Metal	Open Water High		Open Water Low			Under Ice					Open Water High		SSWQO's	EQC
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Ag	0.0500	0.0500	0.0500	0.0500	0.0500	0.0056	0.0050	0.0028	0.0030	0.0053	0.0500	0.0500	0.07	0.05
As	1.32	1.58	2.29	2.60	2.98	2.18	1.74	0.16	0.17	1.86	1.12	1.30	3	31.5
Cd	0.23	0.24	0.26	0.13	0.14	0.10	0.09	0.04	0.04	0.10	0.23	0.23	0.3	1.1
Cu	1.24	1.31	1.49	1.02	1.13	0.98	0.86	0.43	0.43	0.90	1.19	1.23	3	9
Fe	26.8	28.5	33.0	36.3	38.7	28.5	25.7	15.6	15.9	26.7	25.5	26.7	500	220
Hg	16.8	17.6	19.8	17.2	18.4	8.4	6.9	1.4	1.4	7.3	16.2	16.7	24	110
Pb	1.34	1.76	2.93	3.68	4.30	3.29	2.61	0.16	0.25	2.87	1.01	1.31		50.5
Sb	0.96	1.24	2.00	2.62	3.02	2.30	1.85	0.22	0.24	1.99	0.75	0.95	15	33
Se	1.35	1.38	1.44	1.90	1.93	2.06	2.03	1.92	1.91	2.03	1.34	1.35	2	4
Zn	10.32	12.29	17.43	21.16	24.65	23.26	22.49	19.04	26.80	28.76	8.98	10.24		215
NH ₄	0.047	0.059	0.094	0.126	0.144	0.101	0.080	0.005	0.005	0.086	0.037	0.046	0.2	1.5
NO ₃	0.52	0.56	0.69	0.71	0.78	0.74	0.66	0.37	0.37	0.68	0.48	0.51	2	6
NO ₂	0.013	0.015	0.018	0.018	0.0198	0.016	0.014	0.005	0.005	0.014	0.012	0.013	0.02	0.18
P	0.072	0.073	0.074	0.020	0.022	0.019	0.017	0.010	0.010	0.017	0.071	0.072		0.15
SO ₄	94.6	99.0	111.0	145.4	151.4	150.1	143.6	120.4	121.4	146.2	91.2	94.3	200	600
TDS	300	306	323	356	365	400	392	363	366	397	295	299	500	1000
DOC	1.06	1.05	1.03	0.74	0.73	0.65	0.66	0.69	0.68	0.65	1.07	1.06		
Hardness	172	176	187	276	282	279	274	257	260	264	169	172		
pH	8.09	8.09	8.10	8.24	8.25	7.88	7.87	7.85	7.85	7.87	8.09	8.09		
Pb guide	4.70	4.70	4.70	4.32	4.31	4.06	4.07	4.10	4.08	4.01	4.70	4.70		
Zn guide	18.11	18.46	19.38	24.56	24.95	23.64	23.31	22.28	22.42	22.40	17.85	18.08		
Creek to Effluent Ratio	93.24	64.35	34.25	22.42	17.20	20.58	22.89	-	-	19.50	127.80	95.49		
FLOW RATIOS														
As	17.9	16.7	15.3	12.0	10.7	9.0	7.6	6.9	6.4	7.0	17.9	17.9		20.5
NO ₂	17.8	16.5	15.1	9.4	8.4	7.4	6.3	5.6	5.1	5.7	17.8	17.8		0.095

Metals ug/L

Major ions mg/L

RECEIVING WATER CONCENTRATIONS - 65 L/s SCENARIO, 90TH UPSTREAM PERCENTILES, 8 m PIPE

Total Metal	Open Water High		Open Water Low			Under Ice					Open Water High		SSWQO's	EQC
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Ag	0.0500	0.0500	0.0500	0.0500	0.0500	0.0055	0.0052	0.0028	0.0030	0.0051	0.0500	0.0500	0.07	0.05
As	1.21	1.43	2.08	2.25	2.97	2.55	2.29	0.16	0.17	2.11	1.03	1.18	3	39
Cd	0.22	0.23	0.24	0.10	0.12	0.10	0.10	0.04	0.04	0.09	0.22	0.22	0.3	1.1
Cu	1.18	1.23	1.36	0.82	0.98	0.96	0.90	0.43	0.43	0.86	1.14	1.17	3	9
Fe	25.3	26.5	29.8	31.7	35.5	28.0	26.7	15.6	15.8	25.8	24.4	25.2	500	220
Hg	16.1	16.6	18.2	14.9	16.8	8.1	7.4	1.4	1.4	6.8	15.6	16.0	24	110
Pb	1.16	1.54	2.59	3.13	4.31	3.92	3.52	0.15	0.24	3.29	0.87	1.12		63
Sb	0.72	0.91	1.46	1.86	2.48	2.21	2.00	0.22	0.24	1.86	0.56	0.70	15	33
Se	1.33	1.35	1.39	1.85	1.89	2.06	2.04	1.92	1.91	2.03	1.32	1.33	2	4
Zn	9.34	10.99	15.47	18.35	24.04	25.27	25.51	18.26	26.05	29.52	8.16	9.20		260
NH ₄	0.036	0.044	0.069	0.092	0.119	0.097	0.087	0.005	0.005	0.080	0.029	0.035	0.2	1.5
NO ₃	0.47	0.51	0.60	0.58	0.69	0.72	0.69	0.37	0.37	0.66	0.45	0.47	2	6
NO ₂	0.012	0.014	0.017	0.016	0.0196	0.018	0.017	0.005	0.005	0.016	0.012	0.012	0.02	0.22
P	0.071	0.072	0.073	0.017	0.019	0.019	0.018	0.010	0.010	0.017	0.071	0.071		0.15
SO ₄	90.7	93.8	102.5	134.0	143.3	148.8	145.8	120.3	121.3	144.2	88.2	90.3	200	600
TDS	294	299	311	340	353	398	395	362	366	394	291	294	500	1000
DOC	1.07	1.06	1.04	0.76	0.74	0.66	0.66	0.69	0.68	0.65	1.07	1.07		
Hardness	169	172	181	268	278	281	278	256	260	263	166	168		
pH	8.08	8.08	8.09	8.24	8.24	7.87	7.87	7.85	7.85	7.86	8.08	8.08		
Pb guide	4.70	4.70	4.71	4.35	4.34	4.07	4.07	4.10	4.08	4.02	4.70	4.70		
Zn guide	17.86	18.13	18.88	24.17	24.77	23.78	23.61	22.26	22.41	22.38	17.65	17.83		
Creek to Effluent Ratio	93.24	64.35	33.41	23.19	18.62	18.77	18.73	-	-	19.50	128.43	95.49		
FLOW RATIOS														
As	19.0	17.8	16.3	13.0	14.7	12.5	11.0	10.2	9.9	10.4	18.7	18.7		31.5
NO ₂	18.8	17.5	16.0	10.2	11.5	10.4	9.1	8.4	8.1	8.6	18.4	18.4		0.145

Metals ug/L

Major ions mg/L