

Joelle.Janes

From: Carola.Scheu
Sent: Friday, February 05, 2010 9:19 AM
To: Joelle.Janes
Subject: FW: Water quality / flow information

Carola Scheu

Manager
Yukon Water Board
Phone: (867) 456-3984

-----Original Message-----

From: Jonathan Clegg [mailto:jclegg@westerncoppercorp.com]
Sent: Thursday, February 04, 2010 4:31 PM
To: Carola.Scheu; Claire Derome
Cc: Kelly.Boutilier; Jennifer.Logan; Brad Armstrong
Subject: RE: Water quality / flow information

Hi Carola,

It is not possible to represent all the input data in a simple single spreadsheet or table.

I have prepared the attached which contains the information used. Each case is represented by a separate tab in the file.

Jonathan

From: Carola.Scheu@gov.yk.ca [mailto:Carola.Scheu@gov.yk.ca]
Sent: 4-Feb-10 9:01 AM
To: Jonathan Clegg; Claire Derome
Cc: Kelly.Boutilier@gov.yk.ca; Jennifer.Logan@gov.yk.ca
Subject: Water quality / flow information

Dear Jonathan:

At yesterday's meeting the Board also discussed the issue of water quality and flow rates as laid out in your application. For ease of reference, would it be possible to create a table that extracts the relevant information from your application? Attached is the official request to that effect. Sorry for not having sent both information requests in one letter.

Let me know if you have any questions. I'll be at a meeting away from the office but staff can get hold of me.

Carola Scheu
Manager
Yukon Water Board
Phone: (867) 456-3984

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In all cases the following receiving water flow and quality data was used

Receiving Water Flow

Month	Total Low Flow Monthly, cm	Total Low Flow Daily, cm	Total Low Flow cms	Total High Flow Monthly, cm	Total High Flow Daily, cm	Total High Flow cms	Total Median Flow Monthly, cm	Total Median Flow Daily, cm	Total Median Flow cms
Jan	60,752	1,960	0.0227	140,989	4,548	0.0526	100,871	3,254	0.0377
Feb	30,834	1,101	0.0127	71,558	2,556	0.0296	51,196	1,828	0.0212
Mar	35,210	1,136	0.0131	81,715	2,636	0.0305	58,462	1,886	0.0218
Apr	294,425	9,814	0.1136	683,287	22,776	0.2636	488,856	16,295	0.1886
May	1,376,850	44,415	0.5141	3,195,330	103,075	1.1930	2,286,090	73,745	0.8535
Jun	988,031	32,934	0.3812	2,292,977	76,433	0.8846	1,640,504	54,683	0.6329
Jul	675,215	21,781	0.2521	1,567,010	50,549	0.5851	1,121,113	36,165	0.4186
Aug	592,214	19,104	0.2211	1,374,383	44,335	0.5131	983,298	31,719	0.3671
Sep	587,664	19,589	0.2267	1,363,824	45,461	0.5262	975,744	32,525	0.3764
Oct	377,037	12,162	0.1408	875,011	28,226	0.3267	626,024	20,194	0.2337
Nov	178,269	5,942	0.0688	413,718	13,791	0.1596	295,993	9,866	0.1142
Dec	103,500	3,339	0.0386	240,198	7,748	0.0897	171,849	5,544	0.0642
Total/Mean	5,300,000	5,270,505	0.1671	12,300,000	12,231,549	0.3879	8,800,000	8,751,027	0.2775

Receiving Water Quality

Parameter	Mean background water quality, mg/l
Aluminum, Al	0.16
Copper, Cu	0.003
Iron, Fe	0.39
Ammonia, NH4	0.04
Arsenic, As	0.0005
Cadmium, Cd	0.00003
Lead, Pb	0.0004
Nickel, Ni	0.001
Nitrate, NO3	0.07
Nitrite, NO2	0.02
Selenium Se	0.0003
Zinc, Zn	0.006

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2.1 Emergency Discharge During Operations

Discharge Flow 107 m3/s (Water Treatment Plant Design Capacity during operations)

Discharge Quality CEMI March 2007 – Table 10 (Attachment 1 to Appendix)
Results from HDS Simulation Cycle 10 used to represent discharge from Water Treatment Plant when processing raffinate

Process Water Treatability Study Report
Carmacks Copper Project
March 2007

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Table 10. HDS simulation at pH 9.5 for Raffinate (in mg/L)

	MMER Limit	Raffinate	No Recycle	HDS Simulation Cycle 10
<i>pH</i>		7.98	9.40	9.51
Aluminum (Al)		5680	1.17	11.5
Antimony (Sb)		<0.005	<0.001	<0.001
Arsenic (As)	0.50	0.024	0.003	0.003
Barium (Ba)		0.02	0.009	0.016
Beryllium (Be)		0.247	<0.0002	<0.0002
Bismuth (Bi)		<0.5	<0.05	<0.05
Boron (B)		<0.08	<0.008	<0.008
Cadmium (Cd)		0.965	0.0007	<0.0001
Calcium (Ca)		492	480	609
Chromium (Cr)		2.24	<0.001	<0.001
Cobalt (Co)		18	0.0019	<0.0005
Copper (Cu)	0.30	4.88	0.069	0.0208
Iron (Fe)		1500	<0.005	0.011
Lead (Pb)	0.20	0.017	<0.0005	<0.0005
Lithium (Li)		1.08	0.036	0.032
Magnesium (Mg)		5890	340	3.56
Manganese (Mn)		688	0.546	0.011
Molybdenum (Mo)		0.37	0.141	0.025
Nickel (Ni)	0.50	14.1	<0.008	<0.008
Phosphorus (P)		5	<0.1	<0.1
Potassium (K)		15	23	24
Selenium (Se)		0.202	0.071	0.03
Silicon (Si)		102	0.22	0.2
Silver (Ag)		0.157	0.0558	0.0079
Sodium (Na)		79.5	61.6	57.9
Strontium (Sr)		0.35	2.56	5.64
Thallium (Tl)		<0.0005	0.0001	<0.0001
Tin (Sn)		<20	<1	<1
Titanium (Ti)		<0.03	<0.003	<0.003
Uranium (U)		0.451	0.0008	<0.0001
Vanadium (V)		<0.05	<0.005	<0.005
Zinc (Zn)	0.50	72	<0.005	0.01
Zirconium (Zr)		<0.05	<0.005	<0.005
Sulphur (S)		19200	973	491
Total Dissolved Solids		81900	4320	2410

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Nitrogen Loadings during Operations

Discharge Flow

Mean annual discharge from WRSA Sediment Pond
as presented in Golder Site Water Balance

14.60 m ³ /s	Average year
15.97	Wet year
13.38	Dry year

Discharge Quality

	2296 t/a	NH ₄ NO ₃ consumed in blasting
	35 %	Nitrogen content
varies	0.2 - 1 %	Loss of nitrogen in blasting (Ferguson and Leask. 1988)
varies	7 - 25 %	Percent nitrogen reporting as NH ₃ (Ferguson and Leask. 1988)
max	87 %	Percent nitrogen reporting as NO ₃ (Ferguson and Leask. 1988)
max	6 %	Percent nitrogen reporting as NO ₂ (Ferguson and Leask. 1988)
max	1.56 kg/d	Total NH ₃ nitrogen discharge
max	23.63 kg/d	Total NO ₃ nitrogen discharge
max	1.32 kg/d	Total NO ₂ nitrogen discharge

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Active Closure Rinsing

Discharge Flow Based on Golder Revised Site Water Balance Discharge figures for HLF Sediment Pond
i.e. excess precipitation to be removed from rinsing circuit

	Average Year		Wet Year		Dry Year	
	Mnthly Avg m3/h	Release m3/s	Mnthly Avg m3/h	Release m3/s	Mnthly Avg m3/h	Release m3/s
Jan	0	0.0000	0	0.0000	0	0.0000
Feb	0	0.0000	0	0.0000	0	0.0000
Mar	0	0.0000	0	0.0000	0	0.0000
Apr	0	0.0000	0	0.0000	0	0.0000
May	44	0.0121	64	0.0178	35	0.0097
Jun	36	0.0099	35	0.0098	30	0.0083
Jul	35	0.0096	35	0.0096	31	0.0086
Aug	35	0.0096	34	0.0094	32	0.0090
Sep	33	0.0092	33	0.0092	32	0.0089
Oct	25	0.0071	25	0.0071	24	0.0067
Nov	0	0.0000	0	0.0000	0	0.0000
Dec	0	0.0000	0	0.0000	0	0.0000

Discharge Quality Based on CEMI March 2008 report - Cycle 34
Included as Attachment 2 to Appendix I
results represent discharge from Water Treatment Plant when processing rinse solution

Bench Scale Treatability Study Report
Carmacks Copper Project
March 2008

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Table 2. HDS simulation results at varying operating pH (in mg/L)

	Feed	Cycle 10	Cycle 20	Cycle 28	Cycle 34
pH		9.5	9.0	8.3	8.3
Aluminum (Al)	0.061	0.256	1.74	0.188	0.048
Antimony (Sb)	<0.0005	<0.0005	<0.003	<0.0005	<0.0005
Arsenic (As)	0.0009	0.0007	0.0011	0.0011	0.001
Barium (Ba)	0.004	0.002	<0.005	0.002	0.002
Beryllium (Be)	<0.0001	<0.0001	<0.0005	<0.0001	<0.0001
Bismuth (Bi)	<0.001	<0.001	<0.005	<0.001	<0.001
Boron (B)	0.128	0.126	0.149	0.129	0.131
Cadmium (Cd)	0.00007	0.00001	0.00008	0.00003	0.00002
Calcium (Ca)	502	392	355	131	366
Chromium (Cr)	<0.001	<0.001	<0.005	<0.001	<0.001
Cobalt (Co)	0.0051	<0.0005	<0.003	0.001	0.0008
Copper (Cu)	0.0228	0.004	0.164	0.0217	0.0096
Iron (Fe)	0.008	0.005	1.63	0.016	<0.005
Lead (Pb)	<0.0002	<0.0002	0.014	<0.0002	<0.0002
Magnesium (Mg)	16.7	14.7	15.3	13.8	17.5
Manganese (Mn)	0.405	0.003	0.051	0.033	0.041
Molybdenum (Mo)	0.004	0.004	<0.005	0.009	0.004
Nickel (Ni)	0.005	<0.001	<0.005	0.003	0.001
Phosphorus (P)	<0.01	<0.01	<0.05	<0.01	<0.01
Potassium (K)	6.13	5.98	5.11	4.78	5.38
Selenium (Se)	0.0011	0.0012	0.001	0.001	0.0011
Silicon (Si)	10.1	5.47	8.42	5.89	5.8
Silver (Ag)	<0.00002	<0.00002	<0.0001	<0.00002	<0.00002
Sodium (Na)	355	346	337	584	362
Strontium (Sr)	4.22	3.42	3.31	1.72	3.33
Sulphur (S)	630	607	556	557	621
Thallium (Tl)	0.00014	0.00009	<0.0003	0.00013	0.00012
Tin (Sn)	<0.005	<0.005	<0.03	<0.005	<0.005
Titanium (Ti)	<0.005	<0.005	<0.03	<0.005	<0.005
Uranium (U)	0.0004	<0.0001	<0.0005	0.0004	0.0007
Vanadium (V)	<0.005	<0.005	<0.03	<0.005	<0.005
Zinc (Zn)	<0.005	<0.005	<0.03	<0.005	0.007
Zirconium (Zr)	<0.0005	<0.0005	<0.003	0.001	<0.0005

The results summarized in Table 2 above show that operating pH of 8.3 with 60 minute retention time would be effective to remove primary metals of concern. The cycle 20 results showed elevated concentration of copper and other metals which may be due to sample handling, otherwise cycles 28 and 34 showed excellent metals removal.

The lime consumption for the neutralization tests is provided in Table 3 below. The lime used for the testwork was purchased locally and prepared as 5% slurry. It should be noted that lab

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Discharge Flow

Based on Arcadis Report - 2009

Max Flow Rates (m3/h) to discharge stored vol in 6 months

88 m3/h

Discharge Quality

Based on water discharge quality of rinsed and neutralized test columns
Information presented as Attachment III to Appendix I

Results from Column 3 final discharge concentration used

Table 4: Final discharge concentrations from Columns 3 and 6 and humidity cell results from cycle 30 for column 3. Concentrations in mg/L.

Species	Column 3 LR=4.95	Column 6 LR=3.62	HC- Top Cycle 30	HC- Bot Cycle 31	MMER
Al	1.48	0.199	0.0407	0.0083	
Sb	<0.05	0.0004	0.00025	<0.00002	
As	<0.03	0.003	0.002	0.00011	0.50
Ba	<0.005	0.0206	0.0928	0.00571	
Be	<0.001	<0.00005	<0.00001	<0.00001	
Bi	0.2	<0.00006	0.000011	<0.000005	
B	<0.01	<0.02	<0.05	<0.05	
Cd	<0.005	0.0001	0.000023	0.000052	
Ca	556.55	137.081	17.9	37.6	
Cr	<0.01	<0.0005	0.0001	<0.0001	
Co	0.04	0.004	0.000637	0.000707	
Cu	0.26	0.202	0.0029	0.0345	0.30
Fe	0.28	0.172	0.04	0.004	
Pb	0.14	0.0091	0.000058	0.000021	0.20
Li	0.04	0.001	<0.0005	0.0012	
Mg	9.2	2.402	<0.05	0.35	
Mn	0.319	0.0559	0.00039	0.0164	
Hg	<0.02	<0.0001	<0.01	<0.01	
Mo	0.33	0.7785	0.0856	0.00183	
Ni	<0.01	<0.0002	0.0253	0.00062	0.50
P	<0.1	0.202	0.425	0.009	
K	12	4.099	1.98	1.82	
Se	<0.05	0.0094	0.00842	0.00023	
Si	49.29	11.923	38.4	7.85	
Ag	<0.02	0.0003	0.000061	0.000022	
Na	194.9	369.816	0.49	0.26	
Sr	0.693	0.1022	0.0797	0.0236	
S			<3	34	
Tl	<0.2	<0.01	0.000005	0.000038	
Sn	<0.1	<0.00001	0.00001	<0.00001	
Ti	0.01	<0.00005	0.003	<0.0005	
U			0.000004	0.000004	
W	0.2	<0.00002			
V	<0.01	0.004	0.0009	<0.0002	
Zn	0.015	0.0129	0.0006	0.0044	0.50
Zr			<0.0001	<0.0001	

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Long Term Discharge

Discharge Flow

Based on Arcadis Report - 2009

Max discharge rate from heap long term (without cover)

355 m3/h

Discharge Quality

Based on leachate from humidity cell test of rinsed and neutralized ore
Information presented as Attachment III to Appendix I

Results from HC - Bot Cycle 31 used

Table 4: Final discharge concentrations from Columns 3 and 6 and humidity cell results from cycle 30 for column 3. Concentrations in mg/L.

Species	Column 3 LR=4.95	Column 6 LR=3.62	HC- Top Cycle 30	HC- Bot Cycle 31	MMER
Al	1.48	0.199	0.0407	0.0083	
Sb	<0.05	0.0004	0.00025	<0.00002	
As	<0.03	0.003	0.002	0.00011	0.50
Ba	<0.005	0.0206	0.0928	0.00571	
Be	<0.001	<0.00005	<0.00001	<0.00001	
Bi	0.2	<0.00006	0.000011	<0.000005	
B	<0.01	<0.02	<0.05	<0.05	
Cd	<0.005	0.0001	0.000023	0.000052	
Ca	556.55	137.081	17.9	37.6	
Cr	<0.01	<0.0005	0.0001	<0.0001	
Co	0.04	0.004	0.000637	0.000707	
Cu	0.26	0.202	0.0029	0.0345	0.30
Fe	0.28	0.172	0.04	0.004	
Pb	0.14	0.0091	0.000058	0.000021	0.20
Li	0.04	0.001	<0.0005	0.0012	
Mg	9.2	2.402	<0.05	0.35	
Mn	0.319	0.0559	0.00039	0.0164	
Hg	<0.02	<0.0001	<0.01	<0.01	
Mo	0.33	0.7785	0.0856	0.00183	
Ni	<0.01	<0.0002	0.0253	0.00062	0.50
P	<0.1	0.202	0.425	0.009	
K	12	4.099	1.98	1.82	
Se	<0.05	0.0094	0.00842	0.00023	
Si	49.29	11.923	38.4	7.85	
Ag	<0.02	0.0003	0.000061	0.000022	
Na	194.9	369.816	0.49	0.26	
Sr	0.693	0.1022	0.0797	0.0236	
S			<3	34	
Tl	<0.2	<0.01	0.000005	0.000038	
Sn	<0.1	<0.00001	0.00001	<0.00001	
Ti	0.01	<0.00005	0.003	<0.0005	
U			0.000004	0.000004	
W	0.2	<0.00002			
V	<0.01	0.004	0.0009	<0.0002	
Zn	0.015	0.0129	0.0006	0.0044	0.50
Zr			<0.0001	<0.0001	

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