CANADIAN ZINC CORPORATION

May 22, 2011

Chuck Hubert
Environmental Assessment Officer
Mackenzie Valley Review Board
Suite 200, 5102 50th Avenue,
Yellowknife, NT
X1A 2N7

Dear Mr. Hubert

RE: Environmental Assessment EA0809-002, Prairie Creek Mine Commitments to Provide Information, April 12 Technical Meeting

I refer to our letter dated May 11, 2011 (the IR2 Addendum) on the above noted subject. Since that letter, Canadian Zinc Corporation (CZN) has assembled some additional information. Most is quite brief and is provided for clarity. One item relates to the regulation of site discharge to avoid receiving water objectives bring exceeded due to the project. The additional information is described below.

Quality of Water Used in Toxicity Testing

Toxicity results were discussed in Appendix D of the IR2 reply, and a further set of results were discussed in Appendix J of the IR2 Addendum. Testing was completed on two water mixtures, one with a treated mine water to process water ratio of 4:1, and one where the ratio was 8:1 with the mine water component including water from an on-site drainage ditch to simulate runoff.

Water quality results for the waters used in the toxicity work are given in Table 1. For the first set of toxicity tests, the water quality of the individual components is given as well as that of the mixtures. For the second set of tests, new samples of treated process water and treated mine water (May 3 2011) were generated and these results are shown. The increase in TDS in treated process water from the previous sample to the second sample is because ferric chloride was used instead of ferric sulphate in the secondary treatment step. Iron is added to aid settling of particulates. Ferric chloride was substituted in an attempt to reduce the sulphate concentration in the effluent. The sulphate concentration actually increased, so we will be reverting to ferric sulphate. The same 'ditch' water was used in the second 8:1 mix.

Ratio of Process Water in the Final Discharge

In Appendix C of the IR2 Addendum, Tables 2 through 5 give the proportion of treated water in final discharge as a ratio by month for each of the four mine water flow scenarios. These ratios are based on the treated process water discharge plan shown in the tables. In Table 20 of

TABLE 1: SUMMARY OF WATER QUALITY FOR TOXICITY TESTING

			1st Set of Toxicity Tests				2nd Set of Toxicity Tests			
Sampling Date		18/10/2010	28/01/2011	28/01/2011	28/01/2011	28/01/2011	03/05/2011	03/05/2011		
	Units	**CAMP DITCH**	**MIXTURE 1**	**MIXTURE 2**	**11-040**	**11-042**	**11-117**	**11-118**	**Calculated**	**Calculated**
			4:1	8:1	Treated Process	Treated Mine	Treated Process	Treated Mine	4:1	8:1
Nitrate (N)	mg/L	0.419	0.126	0.146	<2	<2				
Alkalinity (Total as CaCO3)	mg/L	240	110	120	250	86	200	140	152	164
Alkalinity (PP as CaCO3)	mg/L	<0.5	12	11	31	11	<0.5	15	**12.05**	**10.8**
Bicarbonate (HCO3)	mg/L	290	110	120	230	78	250	130	154	171
Carbonate (CO3)	mg/L	<0.5	14	14	37	14	<0.5	19	**15.25**	**13.6**
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.25**	**0.25**
Orthophosphate (P)	mg/L	<0.005	0.003	0.001	0.025	<0.005				
Dissolved Sulphate (SO4)	mg/L	110	1200	880	4500	470	4700	470	1316	936
Dissolved Chloride (Cl)	mg/L	<0.5	63	34	310	1.7	660	1.6	133.3	**83.0**
Ammonia (N)	mg/L	0.054	0.10	0.089	0.29 (1)	0.043				
Dissolved Phosphorus (P)	mg/L		0.055	0.030						
Total Phosphorus (P)	mg/L		0.069	0.034	0.230	0.003				
Conductivity	uS/cm	637	2640	1880	8820	1010	9080	1070	2672	1993
pH	pH Units	7.96	8.88	8.88	8.91	9.09	8.22	8.95	8.80	8.70
Total Suspended Solids	mg/L	<4	4	3	26	<4	18	<4	**5.2**	**3.98**
Total Dissolved Solids	mg/L	380	2000	1300	6100	700	8100	730	2204	1587

Bold = concentrations calculated assuming that ND = 1/2DL

(1) Dissolved greater than total. Reanalysis yields similar results

TABLE 1: SUMMARY OF WATER QUALITY FOR TOXICITY TESTING (cont.)

			1st Set of Toxicity Tests				2nd Set of Toxicity Tests			
Sampling Date		18/10/2010	28/01/2011	28/01/2011	28/01/2011	28/01/2011	03/05/2011	03/05/2011		
	Units	**CAMP DITCH**	**MIXTURE 1** (4:1)	**MIXTURE 2** (8:1)	**11-040** Treated Process	**11-042** Treated Mine	**11-117** Treated Process	**11-118** Treated Mine	**Estimated** 4:1	**Estimated** 8:1
Dissolved Hardness (CaCO3)	mg/L	329	553	537	470	576	532	633		
Dissolved Aluminum (Al)	ug/L	<3	3	3	<10	11	10	33	28.4	**25.0**
Dissolved Antimony (Sb)	ug/L	1.6	46.2	33.6	116	25.0	38	24.9	27.5	22.7
Dissolved Arsenic (As)	ug/L	0.2	1.7	1.0	8.2	0.2	9.4	0.3	2.1	1.4
Dissolved Barium (Ba)	ug/L	57	0.9	8.3	<4	<1	12	5 (1)	**6.4**	**14.3**
Dissolved Beryllium (Be)	ug/L	<0.1	<0.05	<0.05	<0.4	<0.1	<0.2	<0.1	**0.1**	**0.1**
Dissolved Bismuth (Bi)	ug/L	<1	<0.03	<0.03	<4	<1	<2	<1	**0.6**	**0.6**
Dissolved Boron (B)	ug/L	<50	<300	<300	<200	<50	<100	<50	**30.0**	**28.1**
Dissolved Cadmium (Cd)	ug/L	0.04	4.61	2.56	22.6	0.05	5.7	0.04	1.2	0.7
Dissolved Chromium (Cr)	ug/L	<1	<0.5	<0.5	<4	<1	<2	<1	**0.6**	**0.6**
Dissolved Cobalt (Co)	ug/L	<0.5	0.72	0.32	3	<0.5	7 (1)	<0.5	**1.6**	**1.1**
Dissolved Copper (Cu)	ug/L	0.4	15.6	9.5	79.6	4.5	95.1 (1)	1.6	**20.3**	**13.0**
Dissolved Iron (Fe)	ug/L	<5	312	266	2620	8	3180	7	641.6	**399.7**
Dissolved Lead (Pb)	ug/L	0.5	52.3	28.4	252	1.8	142	0.4	28.7	18.0
Dissolved Lithium (Li)	ug/L	6	10	8						
Dissolved Manganese (Mn)	ug/L	<1	10.4	5.8	48	13	54	3	13.2	**8.9**
Dissolved Mercury (Hg)	ug/L	0.015 (2)	0.23	0.12	0.28	0.02	1.5	<0.05	**0.32**	**0.21**
Dissolved Molybdenum (Mo)	ug/L	4	3.6	3.5	5	2	11	5	6.2	5.6
Dissolved Nickel (Ni)	ug/L	1	2.8	2.0	13	<1	43	<1	**9.0**	**5.9**
Dissolved Phosphorus (P)	ug/L	<10			390	<10	395	<10	**83.0**	**53.4**
Dissolved Selenium (Se)	ug/L	2.5	5.4	4.1	10.1	3.2	8.4	2.7	3.8	3.4
Dissolved Silicon (Si)	ug/L	1850	4680	3870	12300	2520	7580	2690	3668.0	3160.3
Dissolved Silver (Ag)	ug/L	<0.02	0.15	0.05	0.72	<0.02	0.84	<0.02	**0.2**	**0.1**
Dissolved Strontium (Sr)	ug/L	317	140	182	52	174	54	188	161.2	192.3
Dissolved Thallium (Tl)	ug/L	<0.05	0.12	0.11	<0.2	0.17	0.1	0.14	0.1	**0.116**
Dissolved Tin (Sn)	ug/L	<5	0.45	0.30	<20	<5	<10	<5	**3.0**	**2.8**
Dissolved Titanium (Ti)	ug/L	<5	<3	<3	<20	<5	<10	<5	**3.0**	**2.8**
Dissolved Uranium (U)	ug/L	8.7	4.10	5.08	2.7	4.6	7.8	9.9	9.5	9.4
Dissolved Vanadium (V)	ug/L	<5	2	2	<20	<5	<10	<5	**3.0**	**2.8**
Dissolved Zinc (Zn)	ug/L	6	281	155	1430	<5	1030	11	214.8	136.5
Dissolved Zirconium (Zr)	ug/L	<0.5	<0.5	<0.5	<2	<0.5	<1	<0.5	0.3	0.3
Dissolved Calcium (Ca)	mg/L	70.9	33.3	38.2	67.8	23.9	54.2	20.4	27.2	32.8
Dissolved Magnesium (Mg)	mg/L	36.9	114	107	73.0	125	96.4	141	132.1	118.6
Dissolved Potassium (K)	mg/L	0.82	3.9	3.1	7.7	2.79	8.2	2.62	3.7	3.0
Dissolved Sodium (Na)	mg/L	2.95	421	229	2260	1.68	2050	1.87	411.5	256.0
Dissolved Sulphur (S)	mg/L	37	526	345	2020	176	1660	167	465.6	331.1

Bold = concentrations calculated assuming that ND = 1/2DL

(1) Dissolved greater than total. Reanalysis yields similar results

(2) Duplicate exceeds acceptance criteria due to sample matrix. Reanalysis yields similar results.

TABLE 1: SUMMARY OF WATER QUALITY FOR TOXICITY TESTING (cont.)

			1st Set of Toxicity Tests						2nd Set of Toxicity Tests			
Sampling Date		18/10/2010	28/01/2011	28/01/2011	28/01/2011	28/01/2011	28/01/2011	28/01/2011	03/05/2011	03/05/2011		
	Units	**CAMP DITCH**	**MIXTURE 1**	**MIXTURE 2**	**11-039**	**11-040**	**11-041**	**11-042**	**11-117**	**11-118**	**Estimated**	**Estimated**
			4:1	8:1	Raw Process	Treated Process	Raw Mine	Treated Mine	Treated Process	Treated Mine	4:1	8:1
Total Hardness (CaCO3)	mg/L	378	553	535	431	569			573	655	639	600
Total Aluminum (Al)	ug/L	5	6	4	<300	<30	45	4	<6	38	**31**	**28**
Total Antimony (Sb)	ug/L	2.2	44.7	33.1	647	119	35.1	25.3	49	25.4	30	25
Total Arsenic (As)	ug/L	0.8	2.1	1.3	427	9	13.9	0.2	9.0	0.3	2.0	1.5
Total Barium (Ba)	ug/L	55	1.0	8.7	<100	<10	17	<1	11	1	3.0	11.0
Total Beryllium (Be)	ug/L	<0.1	<0.05	<0.05	<10	<1	<0.1	<0.1	<0.2	<0.1	**0.06**	**0.06**
Total Bismuth (Bi)	ug/L	<1	<0.03	<0.03	<100	<10	<1	<1	<2	<1	**0.60**	**0.56**
Total Boron (B)	ug/L	<50	<300	<300	<5000	<500	<50	<50	<100	<50	**30.0**	**28.1**
Total Cadmium (Cd)	ug/L	0.35	4.64	2.62	1240	24.3	11.5	0.04	6.2	0.04	1.3	0.9
Total Chromium (Cr)	ug/L	<1	<0.5	<0.5	<100	<10	<1	<1	4	<1	**1.2**	**0.9**
Total Cobalt (Co)	ug/L	<0.5	0.65	0.36	<50	<5	1.1	<0.5	5	<0.5	**1.2**	**0.8**
Total Copper (Cu)	ug/L	2.2	16.3	9.4	3950	71	90.5	0.7	58.9	1.3	12.8	8.6
Total Iron (Fe)	ug/L	44	1160	575	<500	5400	7400	21	3390	17	691.6	439.6
Total Lead (Pb)	ug/L	23.2	61.4	32.2	30800	304	12.5	1.7	151	0.3	30.4	22.7
Total Lithium (Li)	ug/L		10	8								
Total Manganese (Mn)	ug/L	1	11.3	6.2	<100	50	50	<1	90	<1	**18.4**	**11.7**
Total Mercury (Hg)	ug/L	0.028 (1)	0.44	0.15	888	1.9	0.04	<0.02				
Total Molybdenum (Mo)	ug/L	4	2.3	2.5	<100	<10	3	2	14	6	7.6	6.7
Total Nickel (Ni)	ug/L	2	2.9	2.1	<100	12	10	2	42	<1	**8.8**	**5.9**
Total Phosphorus (P)	ug/L	<10			<1000	246	<10	<10	437	<10	**91.4**	**58.6**
Total Selenium (Se)	ug/L	2.4	5.3	4.1	116	10	2.9	2.8	8.4	2.7	3.8	3.4
Total Silicon (Si)	ug/L	2040	4950	3830	38700	13500	2850	2790	7840	2790	3800	3295
Total Silver (Ag)	ug/L	0.05	0.18	0.09	69	0.7	0.07	<0.02	4.61	<0.02	**0.93**	**0.59**
Total Strontium (Sr)	ug/L	331	138	182	<100	54	905	180	60	195	168	200
Total Thallium (Tl)	ug/L	<0.05	0.15	0.11	19	<0.5	0.28	0.16	0.2	0.16	0.17	**0.14**
Total Tin (Sn)	ug/L	<5	0.15	0.07	<500	<50	<5	<5	<10	<5	**3.0**	**2.8**
Total Titanium (Ti)	ug/L	<5	<3	<3	<500	<50	<5	<5	<10	<5	**3.0**	**2.8**
Total Uranium (U)	ug/L		4.07	5.18	<10	2	27.1	4.9	8.7	11.1	10.6	9.0
Total Vanadium (V)	ug/L	<5	1	2	<500	<50	<5	<5	<10	<5	**3.0**	**2.8**
Total Zinc (Zn)	ug/L	53	291	156	2740	1350	1530	<5	1070	15	226	152
Total Zirconium (Zr)	ug/L	<0.5	<0.5	<0.5	<50	<5	<0.5	<0.5	<1	<0.5	**0.3**	**0.3**
Total Calcium (Ca)	mg/L	80.6	33.3	36.7	16	65.1	193	25.1	57.5	22.2	29.3	36.0
Total Magnesium (Mg)	mg/L	42.9	114	108	41	65.2	92.5	123	104	146	138	124
Total Potassium (K)	mg/L	0.93	4.0	3.2	7	7.0	2.79	2.86	8.8	2.73	3.9	3.2
Total Sodium (Na)	mg/L	3.30	421	230	2110	1890	1.53	1.54	2220	1.87	445	277
Total Sulphur (S)	mg/L	46	555	361	884	1730	178	169	1900	173	518	367

Bold = concentrations calculated assuming that ND = 1/2DL (1) Dissolved greater than total. Reanalysis yields similar results

TABLE 2: RATIO OF PROCESS WATER IN FINAL DISCHARGE

LOW ESTIMATE MINE FLOWS

Normal Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	4.5	2.0	2.0	3.0	35.0	35.0	35.0	35.0	30.0	22.0	11.5	6.5
Treated process water L/s	1	0	0	1.5	9.5	11.5	11.5	11.5	10	5	2.5	1.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	4.5			3.3	4.3	4.3	4.3	4.3	4.5	4.5	4.6	4.3
Reduced Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	4.5	2.0	2.0	3.0	35.0	35.0	35.0	35.0	30.0	22.0	11.5	6.5
Treated process water L/s	0.3	0	0	0.2	9.5	11.5	11.5	10.4	7.5	3.1	1.7	0.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	15.2			31.4	4.3	4.3	4.3	4.8	6.0	7.2	6.8	12.5

BEST ESTIMATE MINE FLOWS

Normal Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	8	3	3	5	62	66	66	66	59.5	41	18	10
Treated process water L/s	1	0	0	1.5	9.5	11.5	11.5	11.5	10	5	2.5	1.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	8.0			4.7	7.2	7.0	7.0	7.0	7.5	8.3	7.2	6.7
Reduced Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	8	3	3	5	62	66	66	66	59.5	41	18	10
Treated process water L/s	0.3	0	0	0.2	9.5	11.5	11.5	10.4	7.5	3.1	1.7	0.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	27.0			44.0	7.2	7.0	7.0	7.8	10.0	13.2	10.7	19.3

HIGH K MINE FLOWS

Normal Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	10.0	6.0	5.0	9.0	91.0	147.0	147.0	147.0	120.0	68.0	27.0	15.0
Treated process water L/s	1	0	0	1.5	9.5	11.5	11.5	11.5	10	5	2.5	1.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	10.0			7.3	10.2	14.1	14.1	14.1	13.5	13.7	10.8	10.0
Reduced Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	10.0	6.0	5.0	9.0	91.0	147.0	147.0	147.0	120.0	68.0	27.0	15.0
Treated process water L/s	0.3	0	0	0.2	9.5	11.5	11.5	10.4	7.5	3.1	1.7	0.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	33.8			69.1	10.2	14.1	14.1	15.5	18.1	21.8	16.0	28.9

HIGH K + PCAA MINE FLOWS

Normal Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	93.0	86.0	71.0	133.5	210.0	210.0	210.0	206.0	205.0	200.0	143.0	93.0
Treated process water L/s	1	0	0	1.5	9.5	11.5	11.5	11.5	10	5	2.5	1.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	93.0			90.3	22.7	19.6	19.6	19.2	22.0	40.1	57.2	62.0
Reduced Process Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Treated mine water L/s	93.0	86.0	71.0	133.5	210.0	210.0	210.0	206.0	205.0	200.0	143.0	93.0
Treated process water L/s	0.3	0	0	0.2	9.5	11.5	11.5	10.4	7.5	3.1	1.7	0.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0
Total discharge L/s	9	3	3	8.5	77.5	92.5	92.5	92.5	84.5	46.5	20.5	11.5
Ratio to process water	314.3			851.3	22.7	19.6	19.6	21.2	29.5	63.8	84.6	179.4

Appendix C, reduced rates of treated process water were described which would be used if flows in Prairie Creek are abnormally low. In this case, the ratio of total discharge to treated process water would increase. Table 2 provides the ratios for both the normal and reduced process water discharge rates. The table shows that the ratios are considerably greater than 4:1, the lowest ratio selected for toxicity testing. The ratio is less than 4:1 on one occasion only, but a relatively minor adjustment of mine water and process water treatment rates could be made to ensure the ratio remains above 4:1, and CZN commits to do that.

Width of Creek Channel in Relation to Exfiltration Trench

Table 3 in Appendix B of the IR2 reply provides, amongst other things, assumptions on the length of exfiltration pipe in use by month (two pipes will be installed, one 6 m and one 8 m long). The proportion of the wetted creek channel width occupied by the pipe is also given (flow width in vertical mixing zone). An important time of year is August-October when fall spawning fish may be migrating upstream and downstream. The information from Appendix B has been modified to provide extrapolated data for the migration period, as shown in new Table 3. The estimated channel width not occupied by the trench is given for both the 6 m and 8 m long pipes for the migration period.

Table 3: Channel Width Occupied and Not Occupied by the Exfiltration Trench

Month	Jun	Jul	Aug	Sep	Oct	Apr	Dec	Mar
Vertical mixing length (m)	30.6	22.1			10.2	16.1	7.4	1.6
Length of perforated pipe	8	8	8	8	8	6	6	6
Flow width in vertical mixing zone (%)	13%	33%	39%	49%	65%	26%	51%	92%
Wetted width of channel (m)	61.5	24.2	20.4	16.3	12.3	23.1	11.8	6.5
Channel width not occupied by trench (m)	53.5	16.2	12.4	8.3	4.3	17.1	5.8	0.5
Passage width with 6 m pipe Aug-Apr (m)	53.5	16.2	14.4	10.3	6.3	17.1	5.8	0.5

Regulation of Site Discharge

An addendum to Appendix C of the IR2 Addendum is attached addressing further consideration of Water Licence conditions for the regulation of site discharge.

Yours truly,
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ADDENDUM TO APPENDIX C
IR2 ADDENDUM

ADDENDUM TO APPENDIX C
WATER BALANCE, WATER QUALITY
AND REGULATORY PROPOSALS

This document is an addendum to Appendix C of the May 11, 2011 IR2 Addendum, and gives further consideration to Water Licence conditions for the regulation of site discharge.

WATER LICENCE APPROACH

In Appendix C, Table 46 provided a summary of predicted site discharge water quality for those treated process water and treated mine water combinations that produced the highest combined parameter concentrations. Table 47 provided end-of-pipe concentrations (or effluent quality criteria (EQC)) consisting of proposed limits for a new Water Licence for mine operations. The intent of the proposed limits is to avoid significant impacts, while maintaining operational flexibility and ensuring that the EQC can reasonably and consistently be achieved. Tables 48 through 59 showed the in-stream water quality that would occur if parameter concentrations in discharges equal the proposed maximum average Water Licence limits. These concentrations also included the effect of maintaining a creek flow to process water discharge ratio above 500:1. For Low Estimate and Best Estimate mine flows, there were some excursions from objectives, but only during minimum creek flows over the winter period. Mercury and phosphorous excursions did occur September-April (Best Estimate). During 'High K' mine flows, in-stream concentrations exceeded objectives during mean flows for mercury September-January, and phosphorous September-November. Objectives were exceeded during minimum flows for lead, sulphate and TDS February-April, selenium and zinc January-April, and mercury and phosphorous July-April. Therefore, additional licence conditions are needed to regulate site discharge, especially when creek flows are low, but also in case mine flows are higher than expected (High K and High K + PCAA).

Options for additional licence conditions included: a second set of EQC for treated mine water only; a second set of EQC for part of the year, winter for example; adopting the in-stream objectives as a regulatory instrument; and, load limits for individual parameters. A second set of EQC for treated mine water was rejected because site discharge would still be regulated by the first set, and therefore the second set would not provide any additional regulatory control. A second set of EQC for part of the year was also rejected because combined discharge quality (Table 46) is predicted to not vary significantly, apart from in February and March when process water is not treated. Adopting the in-stream objectives is not favoured by regulators because of a belief that it does not provide adequate control at the point of discharge. Therefore, some form of load-based control on the discharge appears to be appropriate

Treated process water quality contains the higher concentrations of all of the parameters exceeding objectives (compared to treated mine water and ditch water). In simulations using the proposed licence limits, excursions from the objectives increased in number and magnitude according to mine flow scenario (higher mine flows). This is illogical because the majority of the load of each parameter is contained in treated process water, and this load does not increase with higher mine flows because the discharge plan for treated process water is the same for all mine flow scenarios. This is a deficiency in the simulation.

Another problem with the analysis is that discharge water quality for all scenarios is based on the proposed licence limits from Table 47, which in turn are based on the highest combined parameter concentrations in Table 46. However, the concentrations in Table 46 all occur in the Low Estimate scenario, and also when the normal treated process water discharge scheme is in operation (as opposed to the reduced scheme when creek flows are low). Nevertheless, excursions during Low Estimate and Best Estimate mine flows only occurred during minimum creek flows. During these creek flows, the reduced treated process water discharge scheme would be in operation and discharge quality would be better, but this is not reflected in the simulation of licence limits.

Table 63 shows the highest combined parameter concentrations that would occur with the reduced treated process water discharge scheme in operation during minimum creek flows. Notice that the highest concentrations again occur in the Low Estimate mine flow scenario. Also notice that concentrations are significantly lower in the December-April period when the proportion of treated process water is relatively small.

As a way of illustrating this conundrum of discharge water quality during minimum creek flows being much better than the proposed licence limits (which artificially indicate excursions from objectives), lower limits were assumed for the period December-April based on the concentrations in Table 63. The limits were as follows (all mg/L):

Cadmium – 0.005
Copper – 0.02
Mercury – 0.0003
Lead – 0.05
Zinc - 0.3
Total phosphorous – 0.05
Sulphate – 1,100
TDS – 1,400

The results of using these limits are shown in Tables 64 through 67. In this analysis, the upstream Prairie Creek concentration for mercury was set at 0.00001 mg/L. In fact, the true value may be less than this. The majority of the existing database indicated a total mercury value of <0.00002 mg/L. Concentrations above this value occurred when TSS was elevated. It is common practice to assume a value of half the detection limit. Because of detection limit issues, the site specific objective for mercury was reduced from 0.000034 mg/L to the CCME value of 0.000026 mg/L. Therefore, maintaining the background mercury concentration at 0.00002 mg/L is considered to be unrealistic and too conservative. However, water sampling and low level mercury analysis is planned to verify the assumed upstream mercury value.

For Low Estimate mine flows (Table 64), the only excursions are during minimum flows for mercury in April and phosphorous March-April. For Best Estimate mine flows, the same excursions occur but for additional months (mercury February-April and phosphorous January-April and October). The same is true for High K mine flows. No other parameters exceed objectives in these mine flow scenarios. Note, the potential for High K flows to occur was rated at 15% by RGC (Appendix C of the IR2 Addendum, Table 1). At extreme mine flows (High K + PCAA), excursions occur for multiple parameters during mean, minimum and maximum creek flows. This is a function of large volumes of mine water being assigned essentially treated process water quality, which as noted above, is not realistic.

The analysis shows that, apart for mercury and phosphorous, appropriately regulated discharges during the expected and likely mine flows (Best Estimate flows or close to that) would meet objectives. However, lower end of pipe limits during minimum flows would be impractical and difficult to apply because the limits would need to vary on a sliding scale according to creek flow. The approach would also not be load-based. A load-based method that varies according to creek flow is required to regulate discharges so that objectives are not exceeded.

Table 68 provides a calculation of allowable loads for discharge by parameter that vary according to creek flow, as measured at the Prairie Creek WSC station location. Figure 7 shows the relationship for zinc. The others will be similar. The allowable load for a given creek flow and parameter is calculated by subtracting the load in the creek upstream from the load that would occur downstream if the parameter concentration equalled the objective. We propose that these relationships be an additional basis for regulating site discharge. From a compliance perspective, the approach would be similar to the standard method employed consisting of water sample collection. The difference is that sample values would be converted to loads using records of discharge flow rate, and compared to those loads allowed for discharge according to the creek flow at the time of sampling. From an operations perspective, sentinel parameters would likely be selected and monitored closely together with flow rate in order to calculate loads before discharge. Sentinels might be zinc and cadmium which are relatively easy to analyse, and whose concentrations can be correlated with others, including mercury. Recent discharge and treated water quality history would also be important as it would indicate whether the allowable load limits are being approached. The response to either a higher predicted load in the discharge or a lower creek flow indication would be to reduce the quantity of process water being treated (unless other monitoring indicates problems elsewhere which would trigger a different contingency response). Adoption of the allowable load limits for discharge are considered more stringent than the licence limits (EQC) because they are based on the objectives, whereas the maximum grab limits in the EQC might lead to the objectives being exceeded occasionally.

A load-based approach is also an effective way to address the potential load increases that might occur with greater than expected mine flows. Load increases are not expected to be significant because concentrations in mine water will likely reduce as flows increase. However, loads could be tracked as the mine progresses, and if load increases appear to be on a trend indicating that limits could be exceeded, corrective measures could be employed will in advance of the allowable limits being exceeded.

The above analysis indicates that mercury and phosphorous could be problematic parameters. Impacts associated with them, and adaptive management, are considered by Hatfield Consultants to be best assessed as part of a broader AEMP. However, for mercury, close monitoring and on-going research will assist in the selection of appropriate management actions. For phosphorous, emphasis will need to be placed on ensuring sewage treatment plant effluent is not a significant source, irrespective of whether the Water Storage Pond (WSP) is confirmed as a significant phosphorous 'sink' due to lengthy storage of the effluent in the pond.

The main response to avoiding exceeding the allowable load limits indicated in Table 68 is proposed to be the reduction in process water treatment. This has implications for water storage capacity. Table 69 shows a modified WSP water balance with slightly adjusted process water treatment rates (the mine flow scenario is not important because process water treatment is the same for all scenarios). Slightly more process water is treated in summer and less in winter. The cumulative 'gain' in Cell A over the winter is now approximately 81,400 m^3. A revised version of Table 20 from Appendix C is also shown as Table 70. In the lower part of the table, the adjusted process water treatment rates have been inserted. Note during mean creek flows, the ratios of creek flow to process water are now all >600:1. If this ratio is maintained during low creek flows, for any given month up to an additional 8,800 m^3 may need to be stored (based on August). This would still be well within the self-imposed storage limit of 100,000 m^3 which provides a 10% contingency. Also note that low flows of the magnitude indicated in Table 70 have never occurred for an extended period, and not over successive months in the same winter.

Adoption of the allowable load limits in Table 68 places the onus on the operator to ensure that site management options are such that a significant measure of flexibility is maintained to ensure the limits can be met. Substantial contingencies are available in that, if necessary, the proportion of process water in the feed recycled to the Mill can be temporarily increased up to 100%, which would eliminate the need for process water treatment. The normal recycle rate is 65%, but this is to avoid the build up of salts over an extended period (months). The recycle rate could be temporarily increased over a period of weeks without interfering with the Mill process. Ultimately, if all contingencies are exhausted, the last resort is to stop the Mill process, and if necessary, CZN commits to do that. Stopping the Mill means no process water is being produced, and therefore process water need not be treated for discharge until conditions allow it. Clearly, this is an unpalatable circumstance for the operator, and it is why measures will be taken to minimize this risk. Such measures include adequate reserve water treatment capacity, and an efficient and reliable water treatment scheme, including effective sediment removal which is often the cause of elevated total metals values in effluent. Also, at present, the available capacity in Cell A for winter storage is based on the assumed cell size (sub-division) within the WSP (50%), and the minimum and maximum water levels (877 m and 881 m, respectively), as determined by Golder Associates for pond backslope stability. CZN is planning additional site investigation for final pond design, and with the intent of repeating stability analyses to assess whether additional storage capacity is possible (e.g. a lower minimum pond level). Failing this, Cell A might be made slightly larger (say 60%) in order to increase the winter storage capacity and thus reduce risk.

In summary, the traditional manner of discharge regulation (by the Mackenzie Valley Land and Water Board) is to set 'end of pipe' discharge limits for parameter concentrations, also known as effluent quality criteria (EQC). CZN has proposed these in Table 47. CZN proposes the following additional regulatory conditions for incorporation into a Water Licence, with rationale:

- The proportion of treated process water in final site discharge must not be greater than 20% (the 4:1 minimum ratio) to ensure that the discharge is not acutely toxic to aquatic organisms, and to minimize the potential and extent of any chronic toxicity in the immediate vicinity of the exfiltration trench (based on existing toxicity testing data);

- For any given creek flow, as determined by continuous and instantaneous water level monitoring on Prairie Creek, the rate of treated process water discharge must be 500 times less or lower (the 500:1 ratio) to minimize the risk of objectives being exceeded during low creek flows, and to minimize the potential for chronic toxicity (as some toxic potential may not be associated with those parameters regulated by the load limits referred to below); and,

- The allowable loads for discharge, as determined by the relationships described in Table 68 (and with continuous and instantaneous water level monitoring on Prairie Creek to allow tracking of discharge loads), are not to be exceeded to ensure water quality objectives are not exceeded as a result of the project.

In addition to final discharge flow rate and water quality, flow rates for treated process water and Prairie Creek flow will be recorded on a suitable time step. The computed loads discharged will be compared to the allowable load limits. All information will be provided with other results in SNP reports.

TABLE 63: HIGHEST CONCENTRATIONS OF SELECTED PARAMETERS IN BLENDED DISCHARGE REDUCED PROCESS WATER TREATMENT (mg/L)

Scenario	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Low Est Worst	As	0.00318	0.00280	0.00280	0.00222	0.00373	0.00347	0.00347	0.00338	0.00311	0.00352	0.00359	0.00326
Low Est 2011	Cd	0.00154	0.00004	0.00004	0.00091	0.00464	0.00465	0.00465	0.00431	0.00358	0.00302	0.00315	0.00183
Low Est Worst	Cu	0.01114	0.00720	0.00720	0.00723	0.01861	0.01791	0.01791	0.01699	0.01485	0.01492	0.01537	0.01191
Low Est 2010	Hg	0.00014	0.00001	0.00001	0.00008	0.00039	0.00039	0.00039	0.00037	0.00030	0.00026	0.00027	0.00016
Low Est 2011	Pb	0.02035	0.00170	0.00170	0.01936	0.06112	0.06347	0.06347	0.05929	0.05088	0.03917	0.04043	0.02403
Low Est 2010	Se	0.00551	0.00330	0.00330	0.00406	0.00995	0.00979	0.00979	0.00928	0.00815	0.00768	0.00790	0.00595
Low Est Worst	Zn	0.0992	0.0170	0.0170	0.0721	0.2720	0.2750	0.2750	0.2563	0.2170	0.1811	0.1878	0.1154
Low Est 2011	Total P	0.017	0.003	0.003	0.011	0.046	0.046	0.046	0.043	0.036	0.031	0.032	0.020
Low Est 2011	SO4	719	470	470	455	1185	1136	1136	1077	941	957	986	768
Low Est 2011	TDS	1033	700	700	743	1678	1632	1632	1554	1377	1356	1392	1099

TABLE 64: IN-STREAM CONCENTRATIONS IN PRAIRIE CREEK
REDUCED WATER LICENCE LIMITS DECEMBER-APRIL, LOW ESTIMATE MINE FLOWS

Parameter	Creek Flows	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Prairie Creek at Harrison Creek											
Total Cadmium	Mean	0.00013	0.00008	0.00009	0.00011	0.00007	0.00006	0.00008	0.00009	0.00011	0.00013	0.00013	0.00012
	Min	0.00018	0.00022	0.00027	0.00033	0.00008	0.00008	0.00013	0.00014	0.00016	0.00019	0.00018	0.00016
	Max	0.00007	0.00005	0.00006	0.00004	0.00006	0.00005	0.00006	0.00007	0.00009	0.00008	0.00011	0.00007
Total Copper	Mean	0.00056	0.00041	0.00045	0.00049	0.00038	0.00036	0.00041	0.00045	0.00051	0.00055	0.00057	0.00054
	Min	0.00087	0.00103	0.00123	0.00146	0.00041	0.00039	0.00055	0.00059	0.00066	0.00073	0.00071	0.00077
	Max	0.00039	0.00033	0.00035	0.00030	0.00034	0.00031	0.00035	0.00037	0.00044	0.00040	0.00050	0.00039
Total Lead	Mean	0.00102	0.00052	0.00064	0.00078	0.00041	0.00036	0.00052	0.00065	0.00086	0.00098	0.00106	0.00094
	Min	0.00156	0.00197	0.00246	0.00304	0.00052	0.00046	0.00099	0.00112	0.00136	0.00158	0.00151	0.00131
	Max	0.00045	0.00024	0.00031	0.00016	0.00028	0.00017	0.00032	0.00037	0.00060	0.00049	0.00080	0.00043
Total Selenium	Mean	0.00134	0.00125	0.00127	0.00130	0.00123	0.00122	0.00125	0.00127	0.00131	0.00133	0.00135	0.00132
	Min	0.00149	0.00158	0.00168	0.00181	0.00125	0.00124	0.00133	0.00136	0.00141	0.00145	0.00143	0.00143
	Max	0.00123	0.00119	0.00121	0.00118	0.00120	0.00118	0.00121	0.00122	0.00126	0.00124	0.00130	0.00123
Total Zinc	Mean	0.0083	0.0059	0.0065	0.0072	0.0053	0.0051	0.0059	0.0065	0.0075	0.0081	0.0085	0.0079
	Min	0.0126	0.0150	0.0179	0.0213	0.0059	0.0056	0.0082	0.0088	0.0101	0.0111	0.0108	0.0111
	Max	0.0055	0.0044	0.0048	0.0041	0.0047	0.0041	0.0048	0.0051	0.0063	0.0057	0.0073	0.0054
Total Arsenic	Mean	0.00021	0.00016	0.00017	0.00019	0.00015	0.00014	0.00016	0.00017	0.00019	0.00021	0.00021	0.00020
	Min	0.00042	0.00050	0.00060	0.00071	0.00016	0.00015	0.00021	0.00022	0.00024	0.00027	0.00026	0.00037
	Max	0.00015	0.00013	0.00014	0.00012	0.00014	0.00013	0.00014	0.00015	0.00017	0.00016	0.00019	0.00015
Total Mercury	Mean	0.000018	0.000014	0.000015	0.000016	0.000013	0.000013	0.000014	0.000015	0.000017	0.000018	0.000018	0.000017
	Min	0.000019	0.000021	0.000024	**0.000028**	0.000014	0.000014	0.000018	0.000019	0.000021	0.000022	0.000022	0.000018
	Max	0.000013	0.000012	0.000012	0.000011	0.000012	0.000011	0.000012	0.000013	0.000015	0.000014	0.000016	0.000013
Ammonia	Mean	0.025	0.015	0.018	0.020	0.013	0.012	0.015	0.018	0.022	0.024	0.026	0.023
	Min	0.067	0.083	0.103	0.126	0.015	0.014	0.025	0.027	0.032	0.036	0.035	0.057
	Max	0.014	0.009	0.011	0.008	0.010	0.008	0.011	0.012	0.017	0.015	0.021	0.013
Nitrate	Mean	0.249	0.200	0.212	0.226	0.189	0.184	0.200	0.213	0.233	0.245	0.253	0.241
	Min	0.456	0.536	0.633	0.747	0.200	0.194	0.246	0.259	0.283	0.305	0.298	0.407
	Max	0.193	0.172	0.179	0.164	0.176	0.166	0.180	0.185	0.208	0.197	0.228	0.192
Total Phosphorous	Mean	0.0030	0.0025	0.0026	0.0028	0.0024	0.0023	0.0025	0.0026	0.0028	0.0029	0.0030	0.0029
	Min	0.0035	0.0039	**0.0044**	**0.0049**	0.0025	0.0024	0.0030	0.0031	0.0033	0.0035	0.0035	0.0033
	Max	0.0024	0.0022	0.0023	0.0021	0.0023	0.0022	0.0023	0.0023	0.0026	0.0025	0.0028	0.0024
Sulphate	Mean	82.4	75.3	77.0	79.1	73.7	73.0	75.3	77.2	80.1	81.8	83.0	81.3
	Min	100.1	108.5	118.6	130.5	75.3	74.5	82.0	83.9	87.4	90.5	89.6	94.9
	Max	74.2	71.2	72.2	70.1	71.8	70.3	72.4	73.1	76.5	74.8	79.3	74.1
TDS	Mean	286.4	277.9	279.9	282.4	275.9	275.0	277.8	280.1	283.6	285.7	287.2	285.0
	Min	304.2	313.4	324.5	337.5	277.8	276.8	286.0	288.2	292.4	296.2	295.1	298.5
	Max	276.6	272.9	274.1	271.5	273.6	271.8	274.3	275.2	279.2	277.3	282.7	276.3

TABLE 65: IN-STREAM CONCENTRATIONS IN PRAIRIE CREEK
REDUCED WATER LICENCE LIMITS DECEMBER-APRIL, BEST ESTIMATE MINE FLOWS

Parameter	Creek Flows	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Prairie Creek at Harrison Creek											
Total Cadmium	Mean	0.00019	0.00011	0.00012	0.00013	0.00009	0.00008	0.00011	0.00013	0.00016	0.00019	0.00018	0.00016
	Min	0.00029	0.00032	0.00039	0.00044	0.00011	0.00010	0.00018	0.00020	0.00024	0.00030	0.00025	0.00022
	Max	0.00010	0.00006	0.00007	0.00005	0.00007	0.00005	0.00008	0.00008	0.00012	0.00011	0.00015	0.00009
Total Copper	Mean	0.00075	0.00049	0.00054	0.00056	0.00044	0.00042	0.00049	0.00055	0.00064	0.00074	0.00071	0.00065
	Min	0.00130	0.00140	0.00168	0.00188	0.00051	0.00048	0.00070	0.00076	0.00089	0.00107	0.00093	0.00102
	Max	0.00047	0.00036	0.00039	0.00032	0.00038	0.00033	0.00040	0.00042	0.00053	0.00050	0.00060	0.00044
Total Lead	Mean	0.00165	0.00078	0.00095	0.00102	0.00062	0.00053	0.00077	0.00097	0.00130	0.00163	0.00154	0.00134
	Min	0.00265	0.00290	0.00360	0.00412	0.00085	0.00074	0.00149	0.00170	0.00213	0.00274	0.00226	0.00194
	Max	0.00072	0.00035	0.00045	0.00020	0.00042	0.00025	0.00047	0.00054	0.00091	0.00082	0.00116	0.00062
Total Selenium	Mean	0.00146	0.00129	0.00133	0.00132	0.00127	0.00125	0.00129	0.00133	0.00139	0.00146	0.00144	0.00140
	Min	0.00172	0.00178	0.00193	0.00204	0.00131	0.00129	0.00143	0.00147	0.00155	0.00166	0.00157	0.00157
	Max	0.00128	0.00121	0.00123	0.00118	0.00123	0.00120	0.00124	0.00125	0.00132	0.00130	0.00137	0.00126
Total Zinc	Mean	0.0115	0.0071	0.0080	0.0083	0.0064	0.0059	0.0071	0.0081	0.0098	0.0114	0.0109	0.0099
	Min	0.0190	0.0205	0.0246	0.0277	0.0075	0.0070	0.0107	0.0117	0.0138	0.0169	0.0145	0.0148
	Max	0.0069	0.0050	0.0055	0.0043	0.0054	0.0045	0.0056	0.0060	0.0078	0.0073	0.0091	0.0064
Total Arsenic	Mean	0.00027	0.00019	0.00020	0.00021	0.00017	0.00016	0.00019	0.00021	0.00024	0.00027	0.00026	0.00024
	Min	0.00063	0.00068	0.00082	0.00092	0.00019	0.00018	0.00026	0.00028	0.00032	0.00038	0.00033	0.00049
	Max	0.00018	0.00014	0.00015	0.00013	0.00015	0.00013	0.00016	0.00016	0.00020	0.00019	0.00022	0.00017
Total Mercury	Mean	0.000023	0.000016	0.000017	0.000018	0.000015	0.000014	0.000016	0.000018	0.000020	0.000023	0.000022	0.000020
	Min	0.000025	**0.000027**	**0.000031**	**0.000034**	0.000015	0.000014	0.000019	0.000020	0.000022	0.000026	0.000023	0.000021
	Max	0.000016	0.000013	0.000013	0.000012	0.000013	0.000012	0.000014	0.000014	0.000017	0.000016	0.000019	0.000015
Ammonia	Mean	0.038	0.020	0.024	0.025	0.017	0.015	0.020	0.024	0.031	0.037	0.036	0.031
	Min	0.110	0.120	0.148	0.169	0.022	0.020	0.034	0.039	0.047	0.059	0.050	0.082
	Max	0.019	0.012	0.014	0.009	0.013	0.010	0.014	0.016	0.023	0.021	0.028	0.017
Nitrate	Mean	0.311	0.225	0.243	0.249	0.210	0.202	0.225	0.245	0.277	0.310	0.301	0.281
	Min	0.670	0.719	0.857	0.960	0.233	0.222	0.295	0.316	0.358	0.419	0.371	0.531
	Max	0.220	0.183	0.194	0.169	0.190	0.174	0.195	0.203	0.239	0.229	0.264	0.210
Total Phosphorous	Mean	0.0036	0.0028	0.0029	0.0030	0.0026	0.0025	0.0027	0.0029	0.0033	0.0036	0.0035	0.0033
	Min	**0.0045**	**0.0048**	**0.0054**	**0.0059**	0.0027	0.0026	0.0032	0.0033	0.0037	**0.0041**	0.0038	0.0039
	Max	0.0027	0.0023	0.0024	0.0022	0.0024	0.0022	0.0024	0.0025	0.0029	0.0028	0.0031	0.0026
Sulphate	Mean	91.5	79.0	81.5	82.4	76.7	75.5	78.9	81.8	86.5	91.2	89.9	87.0
	Min	122.5	127.6	142.1	152.9	80.1	78.4	89.1	92.2	98.3	107.1	100.2	107.9
	Max	78.2	72.8	74.3	70.7	73.9	71.5	74.6	75.6	80.9	79.5	84.5	76.7
TDS	Mean	297.4	282.3	285.3	286.4	279.6	278.1	282.2	285.6	291.4	297.1	295.5	292.0
	Min	328.7	334.3	350.2	362.0	283.6	281.6	294.6	298.2	305.6	316.3	307.9	312.8
	Max	281.3	274.8	276.7	272.3	276.1	273.2	276.9	278.2	284.6	282.9	289.0	279.5

TABLE 66: IN-STREAM CONCENTRATIONS IN PRAIRIE CREEK
REDUCED WATER LICENCE LIMITS DECEMBER-APRIL, HIGH K MINE FLOWS

Parameter	Creek Flows	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Prairie Creek at Harrison Creek											
Total Cadmium	Mean	0.00023	0.00018	0.00019	0.00018	0.00011	0.00013	0.00017	0.00021	0.00025	0.00028	0.00025	0.00022
	Min	0.00035	0.00057	0.00060	0.00064	0.00015	0.00017	0.00031	0.00034	0.00040	0.00046	0.00035	0.00031
	Max	0.00012	0.00010	0.00010	0.00006	0.00009	0.00007	0.00012	0.00013	0.00019	0.00016	0.00019	0.00012
Total Copper	Mean	0.00085	0.00071	0.00073	0.00070	0.00051	0.00055	0.00069	0.00078	0.00093	0.00102	0.00091	0.00082
	Min	0.00154	0.00241	0.00251	0.00268	0.00062	0.00068	0.00109	0.00119	0.00137	0.00155	0.00123	0.00137
	Max	0.00052	0.00046	0.00048	0.00034	0.00043	0.00039	0.00052	0.00055	0.00073	0.00064	0.00075	0.00052
Total Lead	Mean	0.00201	0.00153	0.00157	0.00148	0.00085	0.00097	0.00146	0.00177	0.00225	0.00255	0.00220	0.00190
	Min	0.00325	0.00547	0.00572	0.00614	0.00121	0.00143	0.00281	0.00312	0.00373	0.00434	0.00326	0.00282
	Max	0.00088	0.00068	0.00075	0.00029	0.00057	0.00045	0.00088	0.00099	0.00158	0.00128	0.00166	0.00088
Total Selenium	Mean	0.00153	0.00144	0.00144	0.00137	0.00131	0.00133	0.00142	0.00148	0.00157	0.00163	0.00156	0.00151
	Min	0.00166	0.00201	0.00205	0.00211	0.00138	0.00142	0.00168	0.00174	0.00185	0.00197	0.00176	0.00159
	Max	0.00131	0.00128	0.00129	0.00119	0.00126	0.00123	0.00131	0.00133	0.00145	0.00139	0.00146	0.00131
Total Zinc	Mean	0.0132	0.0109	0.0111	0.0107	0.0075	0.0081	0.0105	0.0121	0.0145	0.0160	0.0142	0.0127
	Min	0.0193	0.0303	0.0315	0.0336	0.0093	0.0104	0.0172	0.0188	0.0218	0.0248	0.0195	0.0172
	Max	0.0076	0.0067	0.0070	0.0047	0.0061	0.0055	0.0077	0.0082	0.0111	0.0096	0.0115	0.0077
Total Arsenic	Mean	0.00031	0.00026	0.00026	0.00026	0.00019	0.00020	0.00025	0.00028	0.00033	0.00036	0.00033	0.00030
	Min	0.00075	0.00119	0.00124	0.00132	0.00023	0.00025	0.00039	0.00042	0.00048	0.00054	0.00043	0.00067
	Max	0.00020	0.00018	0.00018	0.00014	0.00017	0.00015	0.00020	0.00021	0.00027	0.00024	0.00027	0.00020
Total Mercury	Mean	0.000026	0.000022	0.000022	0.000022	0.000017	0.000018	0.000021	0.000024	0.000028	0.000030	0.000027	0.000025
	Min	0.000026	**0.000036**	**0.000037**	**0.000039**	0.000017	0.000018	**0.000027**	**0.000028**	**0.000032**	**0.000036**	**0.000029**	0.000023
	Max	0.000017	0.000015	0.000016	0.000012	0.000014	0.000014	0.000017	0.000018	0.000022	0.000020	0.000023	0.000017
Ammonia	Mean	0.045	0.035	0.036	0.034	0.022	0.024	0.034	0.040	0.050	0.056	0.049	0.043
	Min	0.134	0.223	0.233	0.250	0.029	0.033	0.061	0.067	0.079	0.091	0.070	0.117
	Max	0.022	0.018	0.020	0.011	0.016	0.014	0.022	0.025	0.036	0.030	0.038	0.022
Nitrate	Mean	0.347	0.300	0.304	0.295	0.233	0.245	0.293	0.323	0.371	0.400	0.365	0.336
	Min	0.788	1.225	1.275	1.359	0.268	0.290	0.426	0.456	0.516	0.577	0.470	0.704
	Max	0.236	0.216	0.222	0.178	0.206	0.194	0.236	0.246	0.305	0.275	0.313	0.236
Total Phosphorous	Mean	0.0040	0.0035	0.0035	0.0034	0.0028	0.0029	0.0034	0.0037	0.0042	0.0045	0.0041	0.0039
	Min	0.0038	**0.0051**	**0.0052**	**0.0054**	0.0029	0.0031	**0.0042**	**0.0044**	**0.0049**	**0.0054**	**0.0045**	0.0036
	Max	0.0029	0.0027	0.0027	0.0023	0.0026	0.0024	0.0029	0.0030	0.0035	0.0032	0.0036	0.0029
Sulphate	Mean	96.6	89.8	90.4	89.1	80.0	81.7	88.7	93.2	100.1	104.4	99.3	95.1
	Min	134.8	180.6	185.9	194.6	85.2	88.4	108.1	112.5	121.2	130.0	114.6	126.0
	Max	80.4	77.6	78.5	72.0	76.1	74.4	80.5	82.0	90.5	86.2	91.7	80.5
TDS	Mean	303.5	295.3	296.1	294.5	283.5	285.6	294.1	299.4	307.9	313.0	306.8	301.8
	Min	342.3	392.4	398.2	407.8	289.7	293.6	317.5	322.8	333.4	344.0	325.3	332.6
	Max	284.0	280.6	281.7	273.9	278.8	276.7	284.1	285.9	296.2	290.9	297.6	284.1

TABLE 67: IN-STREAM CONCENTRATIONS IN PRAIRIE CREEK
REDUCED WATER LICENCE LIMITS DECEMBER-APRIL, HIGH K + PCAA MINE FLOWS

Parameter	Creek Flows	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Prairie Creek at Harrison Creek											
Total Cadmium	Mean	0.00151	0.00184	0.00186	0.00144	0.00021	0.00016	0.00022	0.00026	0.00038	0.00071	0.00102	0.00102
	Min	0.00195	0.00320	0.00324	0.00316	0.00029	0.00023	0.00041	0.00044	0.00061	0.00117	0.00149	0.00135
	Max	0.00072	0.00091	0.00098	0.00033	0.00015	0.00009	0.00015	0.00016	0.00027	0.00038	0.00079	0.00051
Total Copper	Mean	**0.00467**	**0.00565**	**0.00573**	**0.00445**	0.00078	0.00065	0.00084	0.00096	0.00130	0.00228	0.00321	0.00322
	Min	**0.00789**	**0.01284**	**0.01303**	**0.01270**	0.00104	0.00085	0.00138	0.00150	0.00198	0.00366	**0.00460**	**0.00549**
	Max	0.00233	0.00289	0.00309	0.00115	0.00061	0.00044	0.00061	0.00065	0.00099	0.00129	0.00254	0.00169
Total Lead	Mean	**0.01483**	**0.01813**	**0.01841**	**0.01410**	0.00177	0.00132	0.00196	0.00236	0.00350	0.00681	**0.00994**	**0.00996**
	Min	**0.01934**	**0.03186**	**0.03234**	**0.03151**	0.00264	0.00198	0.00378	0.00417	0.00579	0.01146	**0.01461**	**0.01326**
	Max	0.00698	**0.00886**	**0.00953**	0.00301	0.00120	0.00062	0.00119	0.00132	0.00246	0.00348	**0.00767**	0.00480
Total Selenium	Mean	**0.00394**	**0.00457**	**0.00462**	**0.00381**	0.00148	0.00140	0.00152	0.00159	0.00181	**0.00243**	**0.00302**	**0.00303**
	Min	**0.00534**	**0.00806**	**0.00817**	**0.00799**	0.00165	0.00152	0.00186	0.00193	**0.00224**	**0.00331**	**0.00390**	**0.00403**
	Max	**0.00246**	**0.00282**	**0.00295**	0.00172	0.00137	0.00126	0.00137	0.00140	0.00161	0.00180	**0.00259**	0.00205
Total Zinc	Mean	**0.0769**	**0.0934**	**0.0947**	**0.0733**	0.0121	0.0098	0.0130	0.0150	0.0207	**0.0371**	**0.0526**	**0.0528**
	Min	**0.1180**	**0.1924**	**0.1952**	**0.1903**	0.0164	0.0131	0.0220	0.0240	0.0321	**0.0602**	**0.0758**	**0.0819**
	Max	**0.0379**	**0.0473**	**0.0506**	0.0182	0.0092	0.0064	0.0092	0.0099	0.0155	0.0205	**0.0414**	0.0271
Total Arsenic	Mean	0.00158	0.00190	0.00193	0.00150	0.00028	0.00024	0.00030	0.00034	0.00046	0.00078	0.00109	0.00109
	Min	0.00393	**0.00641**	**0.00651**	**0.00634**	0.00037	0.00031	0.00048	0.00052	0.00068	0.00124	0.00155	0.00273
	Max	0.00080	0.00099	0.00105	0.00041	0.00023	0.00017	0.00023	0.00024	0.00035	0.00045	0.00087	0.00058
Total Mercury	Mean	**0.000127**	**0.000153**	**0.000155**	**0.000121**	0.000024	0.000020	0.000025	**0.000029**	**0.000038**	**0.000064**	**0.000088**	**0.000089**
	Min	**0.000122**	**0.000195**	**0.000198**	**0.000193**	0.000026	0.000022	**0.000032**	**0.000035**	**0.000044**	**0.000078**	**0.000096**	**0.000087**
	Max	**0.000065**	**0.000080**	**0.000085**	**0.000034**	0.000019	0.000015	0.000019	0.000020	**0.000029**	**0.000037**	**0.000070**	**0.000048**
Ammonia	Mean	**0.301**	**0.367**	**0.372**	**0.286**	0.040	0.031	0.044	0.052	0.075	0.141	0.203	0.204
	Min	**0.776**	**1.276**	**1.295**	**1.262**	0.057	0.044	0.080	0.088	0.120	**0.233**	**0.296**	**0.534**
	Max	0.144	0.182	0.195	0.065	0.029	0.017	0.028	0.031	0.054	0.074	0.158	0.101
Nitrate	Mean	1.610	1.935	1.963	1.538	0.323	0.279	0.342	0.382	0.494	0.819	1.128	1.130
	Min	**3.958**	**6.426**	**6.521**	**6.358**	0.409	0.345	0.521	0.560	0.720	1.278	1.588	2.760
	Max	0.836	1.022	1.088	0.446	0.267	0.210	0.266	0.279	0.392	**0.491**	**0.904**	**0.622**
Total Phosphorous	Mean	**0.0165**	**0.0198**	**0.0200**	**0.0158**	0.0037	0.0033	0.0039	**0.0043**	**0.0054**	**0.0087**	**0.0117**	**0.0118**
	Min	**0.0206**	**0.0326**	**0.0330**	**0.0323**	**0.0041**	0.0035	**0.0049**	**0.0052**	**0.0065**	**0.0109**	**0.0134**	**0.0147**
	Max	**0.0088**	**0.0107**	**0.0113**	**0.0049**	0.0032	0.0026	0.0032	0.0033	**0.0044**	**0.0054**	**0.0095**	**0.0067**
Sulphate	Mean	**280.2**	**327.6**	**331.6**	**269.8**	93.2	86.8	96.0	101.7	118.0	165.3	**210.2**	**210.5**
	Min	**467.0**	**725.5**	**735.5**	**718.4**	105.7	96.3	122.0	127.6	150.8	**231.9**	**277.0**	**341.5**
	Max	167.8	194.7	**204.4**	111.0	85.0	76.7	84.9	86.8	103.1	117.6	177.6	136.6
TDS	Mean	**525.5**	**582.7**	**587.6**	**512.9**	299.4	291.7	302.8	309.7	329.4	386.6	**440.9**	**441.2**
	Min	**706.3**	**989.6**	**1000.5**	**981.8**	314.5	303.2	334.2	341.0	369.1	**467.2**	**521.7**	**568.7**
	Max	389.6	**422.2**	**433.9**	320.9	289.5	279.5	289.4	291.7	311.5	329.0	401.5	352.0

TABLE 68: ALLOWABLE LOADS VS FLOWS IN PRAIRIE CREEK

	Upstream Conc.	Objective	Prairie Creek Flow @ WSC Station (L/sec)											
			20	40	80	160	320	640	1,280	2,560	5,120	10,240	20,480	40,960
	mg/L	mg/L	Allowable Load mg/sec											
As	0.00011	0.005	0.098	0.196	0.391	0.782	1.565	3.130	6.259	12.52	25.04	50.07	100.1	200.3
Cd	0.00003	0.00038	0.007	0.014	0.028	0.056	0.112	0.224	0.448	0.896	1.792	3.584	7.168	14.34
Cu	0.00026	0.00517	0.098	0.196	0.393	0.786	1.571	3.142	6.285	12.57	25.14	50.28	100.6	201.1
Hg	0.00001	0.000026	0.0003	0.0006	0.0013	0.0026	0.0051	0.0102	0.0205	0.0410	0.0819	0.1638	0.3277	0.6554
Pb	0.00001	0.007	0.140	0.280	0.559	1.118	2.237	4.474	8.947	17.89	35.79	71.58	143.2	286.3
Se	0.00115	0.00222	0.021	0.043	0.086	0.171	0.342	0.685	1.370	2.739	5.478	10.96	21.91	43.83
Zn	0.00333	0.035	0.633	1.267	2.534	5.067	10.13	20.27	40.54	81.08	162.2	324.3	648.6	1,297
NH3 N	0.005	0.409	8.080	16.16	32.32	64.64	129.3	258.6	517.1	1,034	2,068	4,137	8,274	16,548
NO3 N	0.15	2.9	55.00	110.0	220.0	440.0	880.0	1,760	3,520	7,040	14,080	28,160	56,320	112,640
Tot. P	0.002	0.004	0.040	0.080	0.160	0.320	0.640	1.280	2.560	5.120	10.24	20.48	40.96	81.92
SO4	68.0	200	2,640	5,280	10,560	21,120	42,240	84,480	168,960	337,920	675,840	1,351,680	2,703,360	5,406,720
TDS	269	413	2,880	5,760	11,520	23,040	46,080	92,160	184,320	368,640	737,280	1,474,560	2,949,120	5,898,240

FIGURE 7: ALLOWABLE ZINC LOAD vs PRAIRIE CREEK FLOW

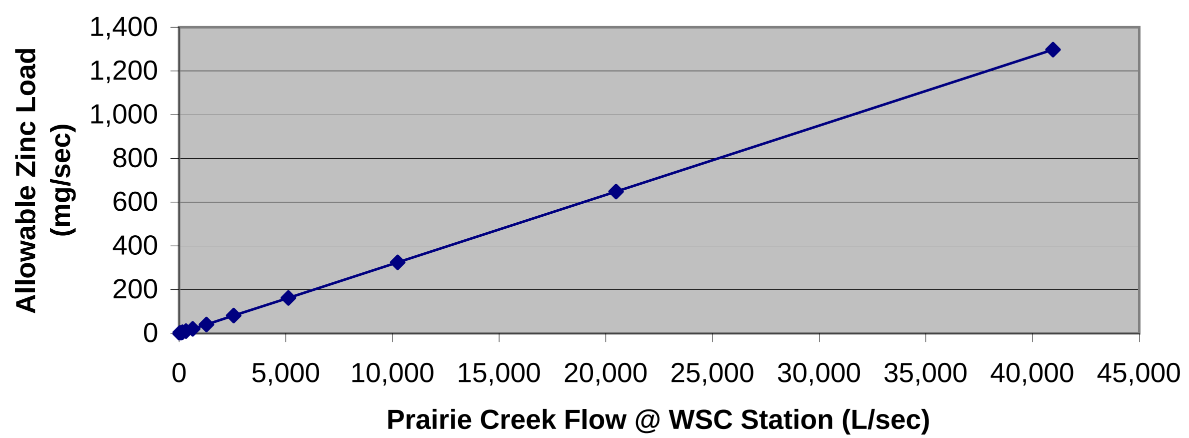

TABLE 69: SITE WATER FLOWS (LOW ESTIMATE) AND WSP WATER BALANCE - ADJUSTED PROCESS WATER TREATMENT

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	PROCESS WATER L/s												
Process Feed	14.82	14.82	14.82	14.82	14.82	14.82	14.82	14.82	14.82	14.82	14.82	14.82	22.8
Losses to solids	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Mill Effluent to WSP	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20
Cell A to WTP	0.5	0.0	0.0	1.0	9.5	12.5	12.5	12.0	10.0	4.5	2.0	1.0	5.5
	MINE WATER L/s												
Mine Drainage to WSP	15.0	15.0	15.0	15.0	21.3	31.8	46.6	38.3	31.2	28.5	25.0	20.0	25.2
Process Feed	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	8.0
Cell B to WTP	4.5	2.0	2.0	3.0	35.0	35.0	35.0	35.0	30.0	22.0	11.5	6.5	18.5
	WATER STORAGE POND WATER BALANCE												
Inflows (m^3)	**Process Water Cell (Cell A)**												
Mill Effluent	53,568	48,384	53,568	51,840	53,568	51,840	53,568	53,568	51,840	53,568	51,840	53,568	630,720
Precipitation	1,229	1,229	1,092	1,365	2,184	3,140	4,642	3,823	3,140	2,594	1,638	1,229	27,305
Total	**54,797**	**49,613**	**54,660**	**53,205**	**55,752**	**54,980**	**58,210**	**57,391**	**54,980**	**56,162**	**53,478**	**54,797**	**658,025**
Outflows (m^3)													
Mill Process Feed	39,694	35,853	39,694	38,413	39,694	38,413	39,694	39,694	38,413	39,694	38,413	39,694	467,364
Evaporation	0	0	0	0	1,075	4,096	5,461	4,096	2,731	0	0	0	17,458
To WTP	1,339	0	0	2,592	25,445	32,400	33,480	32,141	25,920	12,053	5,184	2,678	173,232
Total	**41,033**	**35,853**	**39,694**	**41,005**	**66,214**	**74,909**	**78,635**	**75,930**	**67,064**	**51,747**	**43,597**	**42,372**	**658,054**
Difference (m^3)	**13,764**	**13,760**	**14,966**	**12,200**	**-10,461**	**-19,929**	**-20,425**	**-18,540**	**-12,084**	**4,415**	**9,881**	**12,424**	**-29**
Cum. Diff. (m^3)	**13,764**	**27,524**	**42,490**	**54,690**	**44,229**	**24,300**	**3,874**	**-14,665**	**-26,749**	**-22,334**	**-12,453**	**-29**	
Cum. Diff. Oct-Apr (m^3)	**13,764**	**13,760**	**14,966**	**12,200**						**4,415**	**9,881**	**12,424**	**81,411**
Inflows (m^3)	**Mine Water Cell (Cell B)**												
Mine Drainage	40,176	36,288	40,176	38,880	57,050	82,524	124,803	102,689	80,919	76,430	64,800	53,568	798,304
Sewage Water	1,004	907	1,004	972	1,004	972	1,004	1,004	972	1,004	972	1,004	11,826
Waste Rock Pile	0	0	0	0	6,756	2,045	3,023	2,489	2,045	0	0	0	16,358
Stockpiles	0	0	0	0	319	96	142	117	96	0	0	0	771
Precipitation	1,229	1,229	1,092	1,365	2,184	3,140	4,642	3,823	3,140	2,594	1,638	1,229	27,305
Total	**42,409**	**38,424**	**42,273**	**41,217**	**67,314**	**88,777**	**133,614**	**110,123**	**87,172**	**80,028**	**67,410**	**55,801**	**854,563**
Outflows (m^3)													
Process Feed	21,374	19,305	21,374	20,684	21,374	20,684	21,374	21,374	20,684	21,374	20,684	21,374	96
To WTP	12,053	4,838	5,357	7,776	93,744	90,720	93,744	93,744	77,760	58,925	29,808	17,410	585,878
Evaporation	0	0	0	0	1,075	4,096	5,461	4,096	2,731	0	0	0	17,458
Total	**33,426**	**24,144**	**26,730**	**28,460**	**116,193**	**115,500**	**120,579**	**119,213**	**101,175**	**80,298**	**50,492**	**38,783**	**603,432**
Difference (m^3)	**8,983**	**14,280**	**15,542**	**12,757**	**-48,879**	**-26,722**	**13,036**	**-9,090**	**-14,002**	**-270**	**16,918**	**17,018**	**-430**
Cum. Diff. (m^3)	**8,983**	**23,263**	**38,805**	**51,562**	**2,683**	**-24,039**	**-11,004**	**-20,094**	**-34,096**	**-34,366**	**-17,448**	**-430**	
Cum. Diff. Nov-Apr (m^3)	**8,983**	**14,280**	**15,542**	**12,757**							**16,918**	**17,018**	**85,498**
Mine water treatment m^3	12,053	5,357	5,357	8,035	93,744	93,744	93,744	93,744	80,352	58,925	30,802	17,410	593,266
Process water treatment m^3	1,339	0	0	2,678	25,445	33,480	33,480	32,141	26,784	12,053	5,357	2,678	175,435
Treated mine water L/s	4.5	2	2	3	35	35	35	35	30	22	11.5	6.5	18.5
Treated process water L/s	0.5	0	0	1	9.5	12.5	12.5	12	10	4.5	2	1	5.5
Ditches L/s	0	0	0	2	6	15	15	15	15	0.5	0	0	5.7
Total discharge L/s	5	2	2	6	50.5	62.5	62.5	62	55	27	13.5	7.5	29.6
Ratio to process mill water	9.0			5.0	4.3	4.0	4.0	4.2	4.5	5.0	5.8	6.5	

TABLE 70: COMPUTED MEAN, LOW AND HIGH FLOWS
RATIO OF CREEK FLOW TO PROCESS WATER DISCHARGE
PRAIRIE CREEK AT HARRISON CREEK AND THE PARK BOUNDARY

FLOWS AT STATIONS ON PRAIRIE CREEK (L/sec)

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WSC Station	Mean	530	381	309	819	12,358	17,237	11,780	9,336	6,318	2,762	1,294	838
	Min	145	48	38	78	7,840	10,800	5,960	5,120	3,660	1,540	828	254
	Max	1,230	868	661	4,340	18,400	37,400	19,700	16,900	9,080	5,610	1,720	1,840
Prairie Ck at Harrison	Mean	540	388	315	835	12,608	17,587	12,019	9,526	6,446	2,818	1,320	855
	Min	148	49	39	80	7,999	11,019	6,081	5,224	3,734	1,571	845	259
	Max	1,255	886	674	4,428	18,774	38,160	20,100	17,243	9,264	5,724	1,755	1,877
Prairie Ck at Park Boundary	Mean	602	433	351	930	14,040	19,584	13,384	10,607	7,178	3,138	1,470	952
	Min	165	55	43	89	8,908	12,271	6,772	5,817	4,158	1,750	941	289
	Max	1,397	986	751	4,931	20,905	42,492	22,382	19,201	10,316	6,374	1,954	2,091

FLOWS AT STATIONS ON PRAIRIE CREEK (m^3/sec)

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WSC Station	Mean	0.530	0.381	0.309	0.819	12.358	17.237	11.780	9.336	6.318	2.762	1.294	0.838
	Min	0.145	0.048	0.038	0.078	7.840	10.800	5.960	5.120	3.660	1.540	0.828	0.254
	Max	1.230	0.868	0.661	4.340	18.400	37.400	19.700	16.900	9.080	5.610	1.720	1.840
Prairie Ck at Harrison	Mean	0.540	0.388	0.315	0.835	12.608	17.587	12.019	9.526	6.446	2.818	1.320	0.855
	Min	0.148	0.049	0.039	0.080	7.999	11.019	6.081	5.224	3.734	1.571	0.845	0.259
	Max	1.255	0.886	0.674	4.428	18.774	38.160	20.100	17.243	9.264	5.724	1.755	1.877
Prairie Ck at Park Boundary	Mean	0.602	0.433	0.351	0.930	14.040	19.584	13.384	10.607	7.178	3.138	1.470	0.952
	Min	0.165	0.055	0.043	0.089	8.908	12.271	6.772	5.817	4.158	1.750	0.941	0.289
	Max	1.397	0.986	0.751	4.931	20.905	42.492	22.382	19.201	10.316	6.374	1.954	2.091

PRAIRIE CREEK FLOW TO TREATED PROCESS WATER RATIO

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Treated process water L/s	0.5	0	0	1	9.5	12.5	12.5	12	10	4.5	2	1	
Ratio to Mean PC@H Flow	1081			835.1	1,327	1,407	962	793.82	644.58	626.3	659.9	855.2	
Ratio to Min PC@H Flow	295.9			79.58	842.02	881.55	486.48	435.33	373.43	349.2	422.4	259.2	
Treated PW L/s @ 600:1	0.2			0.1			10.1	8.7	6.2	2.6	1.4	0.4	
Difference L/s	0.3			0.9			2.4	3.3	3.8	1.9	0.6	0.6	
Difference m^3	679			2,323			6,334	8,821	10,114	5,039	1,586	1,522	36,417

Note: PC@H = Prairie Creek @ Harrison, and PW = Process Water