

## **BILAGA A**

### **A HANNUKAINENS GRUVOBJEKTS KÄLLTERMER**

# A1

## Deponeringsområdena för Hannukainens gräberg – basnivån efter stängning (ingen lindring)

Analyte	Units	IFC Mine Effluent	AV @ FS10	Equilibrium (Concs)						Seepage m3/day	Equilibrium (Loadings)						Proportioned Equilibrium Loadings				
				East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB		East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB	Hannukainen Pit	Kuervitikko Pit	Akasjoki	Kuerjoki	Valkeajoki
pH	s.u.	6	6.5	7.3	3.1	7	7.4	3.2	7	mol	0.000081	0.26	0.000042	0.000081	0.042	0.000015	0.3		0.000016	0.000015	
Alkalinity	mg/L			100	-590	15	110	-330.00	15	g/day	16000	-200000	6200	22000	-22000	2300	-180000		2300	2200	
Chloride	mg/L		150	3.4	3.8	39	3.5	3.2	39	g/day	550	1300	16000	710	210	5900	13000		6000	5700	
Phosphate	mg/L		0.01926	0.0013	1.4		0.0014	1.2		g/day	0.21	460		0.28	80		540				
Sulfate	mg/L		65	1000	16000	26	690	13000	26	g/day	160000	5300000	11000	140000	870000	3900	6500000		4100	3800	
Silver	mg/L			0.0045	0.047		0.0039	0.035		g/day	0.73	16		0.79	2.3		20				
Aluminium	mg/L		0.1	0.0076	290	0.0081	0.0075	240	0.0081	g/day	1.2	96000	3.4	1.5	16000	1.2	110000		1.3	1.2	
Arsenic	mg/L	0.1	0.005	0.000035	0.00042	0.0000035	0.000027	0.00033	0.0000035	g/day	0.00057	0.14	0.00015	0.00055	0.022	0.000053	0.16		0.000056	0.000051	
Boron	mg/L			3.7	3		2	2.3		g/day	600	990		400	150		2100				
Barium	mg/L		0.01792	0.0058	0.00082	0.062	0.0066	0.00095	0.062	g/day	0.94	0.27	26	1.3	0.064	9.3	19		9.7	9	
Nitrate	mg/L		20	1.9	2	3.2	1.3	1.5	3.2	g/day	310	660	1300	260	100	480	2200		490	470	
Calcium	mg/L			590	290	53	410	300	53	g/day	96000	96000	22000	83000	20000	8000	310000		8200	7800	
Cadmium	mg/L	0.05	0.00008	0.00079	0.028	0.00029	0.0006	0.018	0.00029	g/day	0.13	9.3	0.12	0.12	1.2	0.044	11		0.045	0.043	
Cobalt	mg/L		0.004	0.017	21	0.029	0.057	6	0.029	g/day	2.8	7000	12	12	400	4.4	7400		4.5	4.3	
Chromium	mg/L	0.1	0.001	0.000017	0.6	0.0000008	0.000013	0.34	0.0000008	g/day	0.00028	200	0.00033	0.00026	23	0.00012	220		0.00012	0.00012	
Copper	mg/L	0.3	0.005	0.000084	210	0.00019	0.00013	25	0.00019	g/day	0.014	70000	0.079	0.026	1700	0.029	72000		0.03	0.028	
Iron	mg/L	2	0.975	0.0012	1100	0.0019	0.001	630	0.0019	g/day	0.19	360000	0.79	0.2	42000	0.29	400000		0.3	0.28	
Mercury	mg/L	0.002	0.00005	0.00014	0.0047		0.00015	0.0034		g/day	0.023	1.6		0.03	0.23		1.9				
Potassium	mg/L			540	2000	11	340	1600	11	g/day	87000	660000	4600	69000	110000	1700	930000		1700	1600	
Lithium	mg/L			0.44	2.4		0.3	2.2		g/day	71	800		61	150		1100				
Magnesium	mg/L			94	1000	16	64	800	16	g/day	15000	330000	6700	13000	54000	2400	420000		2500	2300	
Manganese	mg/L		0.7	6.7	380	0.83	4.4	290	0.83	g/day	1100	130000	350	890	19000	130	150000		130	130	
Molybdenum	mg/L		1	0.16	0.18	0.023	0.14	0.086	0.023	g/day	26	60	9.6	28	5.8	3.5	130		3.6	3.4	
Sodium	mg/L		2.794	380	670	50	260	510	50	g/day	62000	220000	21000	53000	34000	7500	380000		7900	7300	
Nickel	mg/L	0.5	0.02	0.0072	25	0.052	0.083	12	0.052	g/day	1.2	8300	22	17	800	7.8	9100		8.2	7.6	
Lead	mg/L	0.2	0.0072	0.000039	0.48	0.0000047	0.000035	0.27	0.0000047	g/day	0.00063	160	0.002	0.00071	18	0.00071	180		0.00075	0.00069	
Antimony	mg/L		0.005	0.042	0.016		0.029	0.016		g/day	6.8	5.3		5.9	1.1		19				
Selenium	mg/L			0.00057	0.86		0.00049	0.56		g/day	0.092	290		0.099	37		330				
Silicon	mg/L			6.9	6.4	7	7	6.6	7	g/day	1100	2100	2900	1400	440	1100	6900		1100	1100	
Tin	mg/L			0.0055	0.05		0.0065	0.032		g/day	0.89	15		1.3	2.1		19				
Strontium	mg/L		0.03014	1.7	5.3	0.43	1.1	5.5	0.43	g/day	280	1800	180	220	370	65	2800		67	63	
Uranium	mg/L		0.015	0.0021	1.8	0.000013	0.00065	4.8	0.000013	g/day	0.34	600	0.00054	0.13	320	0.0002	920		0.0002	0.00019	
Vanadium	mg/L			0.00065	0.77		0.00045	0.38		g/day	0.11	260		0.091	25		290				
Zinc	mg/L	0.5	0.03	0.004	9.2	0.067	0.012	9.3	0.067	g/day	0.65	3100	28	2.4	620	10	3700		10	9.7	

Exceeds IFC effluent discharge guidelines

Exceeds Akasjoki water quality objective action value (FS10)

**A2 Deponeringsområdena för Hannukainens gräberg – Efter stängning (alternativet geosyntetisk torr täckning)**

Analyte	Units	IFC Mine Effluent	AV @ FS10	Equilibrium (Concs)						Seepage m3/day	Equilibrium (Loadings)						Proportioned Equilibrium Loadings				
				East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB		East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB	Hannukainen Pit	Kuervitikko Pit	Akasjoki	Kuerjoki	Valkeajoki
pH	s.u.	6	6.5	7.3	3.1	7	7.4	3.2	7	mol	162	332	416	202	66.9	151	0.3		0.00016	0.00015	
Alkalinity	mg/L			100	-590	15	110	-330.00	15	g/day	16000	-200000	6200	22000	-22000	2300	-180000		2300	2200	
Chloride	mg/L		150	3.4	3.8	39	3.5	3.2	39	g/day	550	1300	16000	710	210	5900	13000		6000	5700	
Phosphate	mg/L		0.01926	0.0013	1.4		0.0014	1.2		g/day	0.21	460		0.28	80		540				
Sulfate	mg/L		65	1000	16000	26	690	13000	26	g/day	160000	5300000	11000	140000	870000	3900	6500000		4100	3800	
Silver	mg/L			0.0045	0.047		0.0039	0.035		g/day	0.73	16		0.79	2.3		20				
Aluminium	mg/L		0.1	0.0076	290	0.0081	0.0075	240	0.0081	g/day	1.2	96000	3.4	1.5	16000	1.2	110000		1.3	1.2	
Arsenic	mg/L	0.1	0.005	0.000035	0.00042	0.0000035	0.000027	0.00033	0.0000035	g/day	0.00057	0.14	0.00015	0.00055	0.022	0.000053	0.16		0.000056	0.000051	
Boron	mg/L			3.7	3		2	2.3		g/day	600	990		400	150		2100				
Barium	mg/L		0.01792	0.0058	0.00082	0.062	0.0066	0.00095	0.062	g/day	0.94	0.27	26	1.3	0.064	9.3	19		9.7	9	
Nitrate	mg/L		20	1.9	2	3.2	1.3	1.5	3.2	g/day	310	660	1300	260	100	480	2200		490	470	
Calcium	mg/L			590	290	53	410	300	53	g/day	96000	96000	22000	83000	20000	8000	310000		8200	7800	
Cadmium	mg/L	0.05	0.00008	0.00079	0.028	0.00029	0.0006	0.018	0.00029	g/day	0.13	9.3	0.12	0.12	1.2	0.044	11		0.045	0.043	
Cobalt	mg/L		0.004	0.017	21	0.029	0.057	6	0.029	g/day	2.8	7000	12	12	400	4.4	7400		4.5	4.3	
Chromium	mg/L	0.1	0.001	0.000017	0.6	0.000008	0.000013	0.34	0.000008	g/day	0.00028	200	0.00033	0.00026	23	0.00012	220		0.00012	0.00012	
Copper	mg/L	0.3	0.005	0.000084	210	0.00019	0.00013	25	0.00019	g/day	0.014	70000	0.079	0.026	1700	0.029	72000		0.03	0.028	
Iron	mg/L	2	0.975	0.0012	1100	0.0019	0.001	630	0.0019	g/day	0.19	360000	0.79	0.2	42000	0.29	400000		0.3	0.28	
Mercury	mg/L	0.002	0.00005	0.00014	0.0047	0.00015	0.0034			g/day	0.023	1.6		0.03	0.23		1.9				
Potassium	mg/L			540	2000	11	340	1600	11	g/day	87000	660000	4600	69000	110000	1700	930000		1700	1600	
Lithium	mg/L			0.44	2.4	0.3	0.3	2.2	0.3	g/day	71	800		61	150		1100				
Magnesium	mg/L			94	1000	16	64	800	16	g/day	15000	330000	6700	13000	54000	2400	420000		2500	2300	
Manganese	mg/L		0.7	6.7	380	0.83	4.4	290	0.83	g/day	1100	130000	350	890	19000	130	150000		130	130	
Molybdenum	mg/L		1	0.16	0.18	0.023	0.14	0.086	0.023	g/day	26	60	9.6	28	5.8	3.5	130		3.6	3.4	
Sodium	mg/L		2.794	380	670	50	260	510	50	g/day	62000	220000	21000	53000	34000	7500	380000		7900	7300	
Nickel	mg/L	0.5	0.02	0.0072	25	0.052	0.083	12	0.052	g/day	1.2	8300	22	17	800	7.8	9100		8.2	7.6	
Lead	mg/L	0.2	0.0072	0.000039	0.48	0.000047	0.000035	0.27	0.000047	g/day	0.00063	160	0.002	0.00071	18	0.00071	180		0.00075	0.00069	
Antimony	mg/L		0.005	0.042	0.016		0.029	0.016		g/day	6.8	5.3		5.9	1.1		19				
Selenium	mg/L			0.00057	0.86		0.00049	0.56		g/day	0.092	290		0.099	37		330				
Silicon	mg/L			6.9	6.4	7	7	6.6	7	g/day	1100	2100	2900	1400	440	1100	6900		1100	1100	
Tin	mg/L			0.0055	0.05		0.0065	0.032		g/day	0.89	15		1.3	2.1		19				
Strontium	mg/L		0.03014	1.7	5.3	0.43	1.1	5.5	0.43	g/day	280	1800	180	220	370	65	2800		67	63	
Uranium	mg/L		0.015	0.0021	1.8	0.000013	0.00065	4.8	0.000013	g/day	0.34	600	0.00054	0.13	320	0.0002	920		0.0002	0.00019	
Vanadium	mg/L			0.00065	0.77		0.00045	0.38		g/day	0.11	260		0.091	25		290				
Zinc	mg/L	0.5	0.03	0.004	9.2	0.067	0.012	9.3	0.067	g/day	0.65	3100	28	2.4	620	10	3700		10	9.7	

Exceeds IFC effluent discharge guidelines Exceeds Akasjoki water quality objective action value (FS10)

**A3**

				Equilibrium (Concs)						Equilibrium (Loadings)						Proportioned Equilibrium Loadings					
Analyte	Units	IFC Mine Effluent	AV @ FS10	East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB		East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB	Hannukainen Pit	Kuervitikko Pit	Akasjoki	Kuerjoki	Valkeajoki
										Seepage m3/day	162	5	416	202	1.0	151					
pH	s.u.	6	6.5	7.3	3.2	7	7.4	3.2	7	mol	0.000081	0.0033	0.000042	0.000081	0.00066	0.000015	0.004		0.000016	0.000015	
Alkalinity	mg/L			100	-280	15	110	-190.00	15	g/day	16000	-1500	6200	22000	-200	2300	40000		2300	2200	
Chloride	mg/L		150	3.4	3.8	39	3.5	3.4	39	g/day	550	20	16000	710	3.6	5900	11000		6000	5700	
Phosphate	mg/L		0.01926	0.0013	1.1		0.0014	0.92		g/day	0.21	5.7		0.28	0.96		7.2				
Sulfate	mg/L		65	1000	11000	26	690	8800	26	g/day	160000	57000	11000	140000	9200	3900	370000		4100	3800	
Silver	mg/L			0.0045	0.029		0.0039	0.023		g/day	0.73	0.15		0.79	0.024		1.7				
Aluminium	mg/L		0.1	0.0076	230	0.0081	0.0075	180	0.0081	g/day	1.2	1200	3.4	1.5	190	1.2	1400		1.3	1.2	
Arsenic	mg/L	0.1	0.005	0.0000035	0.00031	0.00000035	0.0000027	0.00026	0.00000035	g/day	0.00057	0.0016	0.00015	0.00055	0.00027	0.000053	0.0031		0.000056	0.000051	
Boron	mg/L			3.7	1.9		2	1.5		g/day	600	9.9		400	1.6		1000				
Barium	mg/L		0.01792	0.0058	0.0011	0.062	0.0066	0.0012	0.062	g/day	0.94	0.0057	26	1.3	0.0013	9.3	19		9.7	9	
Nitrate	mg/L		20	1.9	1.2	3.2	1.3	0.98	3.2	g/day	310	6.2	1300	260	1	480	1400		490	470	
Calcium	mg/L			590	320	53	410	330	53	g/day	96000	1700	22000	83000	350	8000	200000		8200	7800	
Cadmium	mg/L	0.05	0.00008	0.00079	0.017	0.00029	0.0006	0.012	0.00029	g/day	0.13	0.088	0.12	0.12	0.013	0.044	0.43		0.045	0.043	
Cobalt	mg/L		0.004	0.017	13	0.029	0.057	4.7	0.029	g/day	2.8	68	12	12	4.9	4.4	95		4.5	4.3	
Chromium	mg/L	0.1	0.001	0.0000017	0.36	0.0000008	0.0000013	0.22	0.0000008	g/day	0.00028	1.9	0.00033	0.00026	0.23	0.00012	2.1		0.00012	0.00012	
Copper	mg/L	0.3	0.005	0.000084	130	0.00019	0.00013	19	0.00019	g/day	0.014	680	0.079	0.026	20	0.029	700		0.03	0.028	
Iron	mg/L	2	0.975	0.0012	530	0.0019	0.001	360	0.0019	g/day	0.19	2800	0.79	0.2	380	0.29	3200		0.3	0.28	
Mercury	mg/L	0.002	0.00005	0.00014	0.003	0.00015	0.00015	0.0023	0.00015	g/day	0.023	0.016		0.03	0.0024		0.071				
Potassium	mg/L			540	1300	11	340	1100	11	g/day	87000	6800	4600	69000	1200	1700	170000		1700	1600	
Lithium	mg/L			0.44	1.5		0.3	1.4		g/day	71	7.8		61	1.5		140				
Magnesium	mg/L			94	640	16	64	540	16	g/day	15000	3300	6700	13000	570	2400	36000		2500	2300	
Manganese	mg/L		0.7	6.7	260	0.83	4.4	210	0.83	g/day	1100	1400	350	890	220	130	3800		130	130	
Molybdenum	mg/L		1	0.16	0.11	0.023	0.14	0.057	0.023	g/day	26	0.57	9.6	28	0.06	3.5	61		3.6	3.4	
Sodium	mg/L		2.794	380	420	50	260	340	50	g/day	62000	2200	21000	53000	360	7500	130000		7900	7300	
Nickel	mg/L	0.5	0.02	0.0072	16	0.052	0.083	10	0.052	g/day	1.2	83	22	17	10	7.8	130		8.2	7.6	
Lead	mg/L	0.2	0.0072	0.0000039	0.29	0.0000047	0.0000035	0.17	0.0000047	g/day	0.00063	1.5	0.002	0.00071	0.18	0.00071	1.7		0.00075	0.00069	
Antimony	mg/L		0.005	0.042	0.015		0.029	0.016		g/day	6.8	0.078		5.9	0.017		13				
Selenium	mg/L			0.00057	0.54		0.00049	0.37		g/day	0.092	2.8		0.099	0.39		3.4				
Silicon	mg/L			6.9	6.6	7	7	6.7	7	g/day	1100	34	2900	1400	7	1100	4400		1100	1100	
Tin	mg/L			0.0055	0.03		0.0065	0.022		g/day	0.89	0.15		1.3	0.023		2.4				
Strontium	mg/L		0.03014	1.7	4.3	0.43	1.1	3.7	0.43	g/day	280	22	180	220	3.9	65	640		67	63	
Uranium	mg/L		0.015	0.0021	1.1	0.0000013	0.00065	4	0.0000013	g/day	0.34	5.7	0.00054	0.13	4.2	0.0002	10		0.0002	0.00019	
Vanadium	mg/L			0.00065	0.48		0.00045	0.26		g/day	0.11	2.5		0.091	0.27		3				
Zinc	mg/L	0.5	0.03	0.004	5.8	0.067	0.012	7.4	0.067	g/day	0.65	30	28	2.4	7.8	10	59		10	9.7	

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

**A4 Deponeringsområdena för Hannukainens gräberg – Efter stängning (alternativet addering av kalksten)**

				Equilibrium (Concs)						Equilibrium (Loadings)						Proportioned Equilibrium Loadings					
Analyte	Units	IFC Mine Effluent	AV @ FS10	East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB		East_NAF	East_PAF	East_OVB	West_NAF	West_PAF	West_OVB	Hannukainen Pit	Kuervitikko Pit	Akasjoki	Kuerjoki	Valkeajoki
										Seepage m3/day	162	332	416	202	66.9	151					
pH	s.u.	6	6.5	7.3	7.6	7	7.4	7.6	7	mol	0.0000081	0.0000083	0.000042	0.0000081	0.0000017	0.000015	0.000053		0.000016	0.000015	
Alkalinity	mg/L			100	250	15	110	230.00	15	g/day	16000	83000	6200	22000	15000	2300	140000		2300	2200	
Chloride	mg/L		150	3.4	3.8	39	3.5	3.3	39	g/day	550	1300	16000	710	220	5900	13000		6000	5700	
Phosphate	mg/L		0.01926	0.0013	0.0073		0.0014	0.0075		g/day	0.21	2.4		0.28	0.5		3.4				
Sulfate	mg/L		65	1000	8600	26	690	7500	26	g/day	160000	2900000	11000	140000	500000	3900	3700000		4100	3800	
Silver	mg/L			0.0045	0.0029		0.0039	0.0029		g/day	0.73	0.96		0.79	0.19		2.7				
Aluminium	mg/L		0.1	0.0076	0.00011	0.0081	0.0075	0.00011	0.0081	g/day	1.2	0.036	3.4	1.5	0.0074	1.2	4.9		1.3	1.2	
Arsenic	mg/L	0.1	0.005	0.0000035	0.0000071	0.0000035	0.0000027	0.0000058	0.0000035	g/day	0.00057	0.00024	0.00015	0.00055	0.000039	0.000053	0.0015		0.000056	0.000051	
Boron	mg/L			3.7	2.8		2	2.1		g/day	600	930		400	140		2100				
Barium	mg/L		0.01792	0.0058	0.001	0.062	0.0066	0.0011	0.062	g/day	0.94	0.33	26	1.3	0.074	9.3	19		9.7	9	
Nitrate	mg/L		20	1.9	2	3.2	1.3	1.5	3.2	g/day	310	660	1300	260	100	480	2200		490	470	
Calcium	mg/L			590	310	53	410	320	53	g/day	96000	100000	22000	83000	21000	8000	310000		8200	7800	
Cadmium	mg/L	0.05	0.00008	0.00079	0.00034	0.00029	0.0006	0.00019	0.00029	g/day	0.13	0.11	0.12	0.12	0.013	0.044	0.45		0.045	0.043	
Cobalt	mg/L		0.004	0.017	0.43	0.029	0.057	0.14	0.029	g/day	2.8	140	12	12	9.4	4.4	170		4.5	4.3	
Chromium	mg/L	0.1	0.001	0.0000017	0.00000015	0.0000008	0.0000013	7.6E-09	0.0000008	g/day	0.00028	0.000005	0.00033	0.00026	0.00000051	0.00012	0.00076		0.00012	0.00012	
Copper	mg/L	0.3	0.005	0.000084	0.0034	0.00019	0.00013	0.00047	0.00019	g/day	0.014	1.1	0.079	0.026	0.031	0.029	1.2		0.03	0.028	
Iron	mg/L	2	0.975	0.0012	0.00058	0.0019	0.001	0.0006	0.0019	g/day	0.19	0.19	0.79	0.2	0.04	0.29	1.1		0.3	0.28	
Mercury	mg/L	0.002	0.00005	0.00014	0.0000098		0.00015	0.0000086		g/day	0.023	0.0032		0.03	0.00058		0.057				
Potassium	mg/L			540	2200	11	340	1700	11	g/day	87000	730000	4600	69000	110000	1700	1000000		1700	1600	
Lithium	mg/L			0.44	2.4		0.3	2.1		g/day	71	800		61	140		1100				
Magnesium	mg/L			94	250	16	64	260	16	g/day	15000	83000	6700	13000	17000	2400	130000		2500	2300	
Manganese	mg/L		0.7	6.7	2	0.83	4.4	1.7	0.83	g/day	1100	660	350	890	110	130	3000		130	130	
Molybdenum	mg/L		1	0.16	0.03	0.023	0.14	0.017	0.023	g/day	26	9.9	9.6	28	1.1	3.5	71		3.6	3.4	
Sodium	mg/L		2.794	380	670	50	260	500	50	g/day	62000	220000	21000	53000	33000	7500	380000		7900	7300	
Nickel	mg/L	0.5	0.02	0.0072	0.083	0.052	0.083	0.045	0.052	g/day	1.2	28	22	17	3	7.8	63		8.2	7.6	
Lead	mg/L	0.2	0.0072	0.0000039	0.0000014	0.0000047	0.0000035	0.0000069	0.0000047	g/day	0.00063	0.00046	0.002	0.00071	0.000046	0.00071	0.0031		0.00075	0.00069	
Antimony	mg/L		0.005	0.042	0.048		0.029	0.034		g/day	6.8	16		5.9	2.3		31				
Selenium	mg/L			0.00057	0.0011		0.00049	0.00087		g/day	0.092	0.36		0.099	0.058		0.61				
Silicon	mg/L			6.9	6.7	7	7	6.7	7	g/day	1100	2200	2900	1400	450	1100	7000		1100	1100	
Tin	mg/L			0.0055	0.05		0.0065	0.034		g/day	0.89	15		1.3	2.3		19				
Strontium	mg/L		0.03014	1.7	5.9	0.43	1.1	5.4	0.43	g/day	280	2000	180	220	360	65	3000		67	63	
Uranium	mg/L		0.015	0.0021	0.12	0.0000013	0.00065	0.2	0.0000013	g/day	0.34	40	0.00054	0.13	13	0.0002	53		0.0002	0.00019	
Vanadium	mg/L			0.00065	0.000016		0.00045	0.00001		g/day	0.11	0.0053		0.091	0.00067		0.21				
Zinc	mg/L	0.5	0.03	0.004	0.017	0.067	0.012	0.017	0.067	g/day	0.65	5.6	28	2.4	1.1	10	28		10	9.7	

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

**BILAGA B**

**HANNUKAINENS DAGBROTTSJÖ**

### A5 Hannukainen dagbrottsjö – Basnivå (alternativet ingen lindring)

Analyte	Units	Guidelines		Steady State Concentration in pit		Volume (m3/day)	Steady State Discharge load from pit		Steady State load from whole site to Rivers		
		IFC Mine Effluent	AV @ FS10	Hannukainen Steady State	Kuervittiko Steady state		Hannukainen Steady State	Kuervittiko Steady state	Akasjoki	Kuerjoki	Valkeajoki
							<b>3,295</b>	<b>1,879</b>			
pH	s.u.	6	6.5	3.30	7	mol/day	1.7	0.00019	1.7	0.00021	-
Alkalinity	mg/L			-63.00	6.8	g/day	-210000	13000	-190000	15000	-
Chloride	mg/L		150	8.2	2.1	g/day	27000	3900	43000	9600	-
PO4	mg/L		0.01926	0.13	0.051	g/day	430	96	530	96	-
Sulfate	mg/L		65	2100	7.7	g/day	6900000	14000	6900000	18000	-
Silver	mg/L			0.0064	0.00032	g/day	21	0.6	22	0.6	-
Aluminium	mg/L		0.1	34	0.0017	g/day	110000	3.2	110000	4.4	-
Arsenic	mg/L	0.1	0.005	0.0014	0.00048	g/day	4.6	0.9	5.5	0.9	-
Boron	mg/L			0.64	0.0018	g/day	2100	3.4	2100	3.4	-
Barium	mg/L		0.01792	0.0025	0.0078	g/day	8.2	15	42	24	-
Nitrate	mg/L		20	4.3	0.093	g/day	14000	170	15000	640	-
Calcium	mg/L			120	4.9	g/day	400000	9200	430000	17000	-
Cadmium	mg/L	0.05	0.00008	0.0037	0.000046	g/day	12	0.086	12	0.13	-
Cobalt	mg/L		0.004	2.3	0.0035	g/day	7600	6.6	7600	11	-
Chromium	mg/L	0.1	0.001	0.07	0.0000017	g/day	230	0.0032	230	0.0033	-
Copper	mg/L	0.3	0.005	22	0.0013	g/day	72000	2.4	72000	2.4	-
Iron	mg/L	2	0.975	99	0.0014	g/day	330000	2.6	330000	2.9	-
Mercury	mg/L	0.002	0.00005	0.00059	0.0000065	g/day	1.9	0.012	1.9	0.012	-
Potassium	mg/L			290	1.6	g/day	960000	3000	970000	4600	-
Lithium	mg/L			0.34	0.012	g/day	1100	23	1100	23	-
Magnesium	mg/L			130	1.8	g/day	430000	3400	440000	5700	-
Manganese	mg/L		0.7	46	0.015	g/day	150000	28	150000	160	-
Molybdenum	mg/L		1	0.044	0.003	g/day	140	5.6	150	9	-
Sodium	mg/L		2.794	130	7.7	g/day	430000	14000	460000	21000	-
Nickel	mg/L	0.5	0.02	2.8	0.0033	g/day	9200	6.2	9200	14	-
Lead	mg/L	0.2	0.0072	0.058	0.00005	g/day	190	0.094	190	0.095	-
Antimony	mg/L		0.005	0.0059	0.000067	g/day	19	0.13	19	0.13	-
Selenium	mg/L			0.11	0.0058	g/day	360	11	370	11	-
Silicon	mg/L			7.9	3.5	g/day	26000	6600	35000	7700	-
Tin	mg/L			0.0058	0.000023	g/day	19	0.043	19	0.043	-
Strontium	mg/L		0.03014	0.96	0.022	g/day	3200	41	3400	100	-
Thallium	mg/L			0.014	0.0029	g/day	46	5.4	51	5.4	-
Uranium	mg/L		0.015	0.29	0.0018	g/day	960	3.4	960	3.4	-
Vanadium	mg/L			0.093	0.0031	g/day	310	5.8	320	5.8	-
Zinc	mg/L	0.5	0.03	1.1	0.0046	g/day	3600	8.6	3600	18	-

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

## A6 Hannukainen dagbrottsjö – Alternativet geosyntetisk täckning

Analyte	Units	Guidelines		Steady State Concentration in pit		Volume (m3/day)	Steady State Discharge load from pit		Steady State load from whole site to Rivers		
		IFC Mine Effluent	AV @ FS10	Hannukainen Steady State	Kuervittiko Steady state		Hannukainen Steady State	Kuervittiko Steady state	Akasjoki	Kuerjoki	Valkeajoki
							<b>3,295</b>	<b>1,879</b>			
pH	s.u.	6	6.5	5.50	7	mol/day	0.01	0.00019	0.01	0.00021	-
Alkalinity	mg/L			-0.02	6.8	g/day	-76	13000	17000	15000	-
Chloride	mg/L		150	7.6	2.1	g/day	25000	3900	41000	9600	-
PO4	mg/L		0.01926	0.027	0.051	g/day	89	96	190	96	-
Sulfate	mg/L		65	200	7.7	g/day	660000	14000	680000	18000	-
Silver	mg/L			0.00089	0.00032	g/day	2.9	0.6	3.5	0.6	-
Aluminium	mg/L		0.1	0.0095	0.0017	g/day	31	3.2	37	4.4	-
Arsenic	mg/L	0.1	0.005	0.001	0.00048	g/day	3.3	0.9	4.2	0.9	-
Boron	mg/L			0.31	0.0018	g/day	1000	3.4	1000	3.4	-
Barium	mg/L		0.01792	0.01	0.0078	g/day	33	15	67	24	-
Nitrate	mg/L		20	3.2	0.093	g/day	11000	170	12000	640	-
Calcium	mg/L			88	4.9	g/day	290000	9200	320000	17000	-
Cadmium	mg/L	0.05	0.00008	0.00045	0.000046	g/day	1.5	0.086	1.7	0.13	-
Cobalt	mg/L		0.004	0.044	0.0035	g/day	140	6.6	160	11	-
Chromium	mg/L	0.1	0.001	0.000047	0.0000017	g/day	0.15	0.0032	0.15	0.0033	-
Copper	mg/L	0.3	0.005	0.27	0.0013	g/day	890	2.4	890	2.4	-
Iron	mg/L	2	0.975	0.059	0.0014	g/day	190	2.6	190	2.9	-
Mercury	mg/L	0.002	0.00005	0.000033	0.0000065	g/day	0.11	0.012	0.12	0.012	-
Potassium	mg/L			55	1.6	g/day	180000	3000	190000	4600	-
Lithium	mg/L			0.055	0.012	g/day	180	23	200	23	-
Magnesium	mg/L			15	1.8	g/day	49000	3400	57000	5700	-
Manganese	mg/L		0.7	1.2	0.015	g/day	4000	28	4300	160	-
Molybdenum	mg/L		1	0.022	0.003	g/day	72	5.6	85	9	-
Sodium	mg/L		2.794	50	7.7	g/day	160000	14000	190000	21000	-
Nickel	mg/L	0.5	0.02	0.057	0.0033	g/day	190	6.2	210	14	-
Lead	mg/L	0.2	0.0072	0.0015	0.00005	g/day	4.9	0.094	5	0.095	-
Antimony	mg/L		0.005	0.0041	0.000067	g/day	14	0.13	14	0.13	-
Selenium	mg/L			0.0069	0.0058	g/day	23	11	34	11	-
Silicon	mg/L			7.5	3.5	g/day	25000	6600	34000	7700	-
Tin	mg/L			0.00079	0.000023	g/day	2.6	0.043	2.6	0.043	-
Strontium	mg/L		0.03014	0.3	0.022	g/day	990	41	1200	100	-
Thallium	mg/L			0.007	0.0029	g/day	23	5.4	28	5.4	-
Uranium	mg/L		0.015	0.013	0.0018	g/day	43	3.4	46	3.4	-
Vanadium	mg/L			0.006	0.0031	g/day	20	5.8	26	5.8	-
Zinc	mg/L	0.5	0.03	0.038	0.0046	g/day	130	8.6	160	18	-

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

### A7 Hannukainen dagbrottsjö – Alternativet addering av kalksten till PAFWRD

Analyte	Units	Guidelines		Steady State Concentration in pit		Steady State Discharge load from pit	Steady State load from whole site to Rivers				
		IFC Mine Effluent	AV @ FS10	Hannukainen Steady State	Kuervittiko Steady state		Hannukainen Steady State	Kuervittiko Steady state	Akasjoki	Kuerjoki	Valkeajoki
						Volume (m3/day)	3,295	1,879			
pH	s.u.	6	6.5	6.80	7	mol/day	0.00052	0.00019	0.00075	0.00021	-
Alkalinity	mg/L			4.80	6.8	g/day	16000	13000	33000	15000	-
Chloride	mg/L		150	8.2	2.1	g/day	27000	3900	43000	9600	-
PO4	mg/L		0.01926	0.01	0.051	g/day	33	96	130	96	-
Sulfate	mg/L		65	1200	7.7	g/day	4000000	14000	4000000	18000	-
Silver	mg/L			0.0012	0.00032	g/day	4	0.6	4.6	0.6	-
Aluminium	mg/L		0.1	0.0021	0.0017	g/day	6.9	3.2	13	4.4	-
Arsenic	mg/L	0.1	0.005	0.00015	0.00048	g/day	0.49	0.9	1.4	0.9	-
Boron	mg/L			0.64	0.0018	g/day	2100	3.4	2100	3.4	-
Barium	mg/L		0.01792	0.0028	0.0078	g/day	9.2	15	43	24	-
Nitrate	mg/L		20	4.3	0.093	g/day	14000	170	15000	640	-
Calcium	mg/L			120	4.9	g/day	400000	9200	430000	17000	-
Cadmium	mg/L	0.05	0.00008	0.00045	0.000046	g/day	1.5	0.086	1.7	0.13	-
Cobalt	mg/L		0.004	0.067	0.0035	g/day	220	6.6	240	11	-
Chromium	mg/L	0.1	0.001	0.0000037	0.0000017	g/day	0.012	0.0032	0.015	0.0033	-
Copper	mg/L	0.3	0.005	0.013	0.0013	g/day	43	2.4	45	2.4	-
Iron	mg/L	2	0.975	0.0027	0.0014	g/day	8.9	2.6	12	2.9	-
Mercury	mg/L	0.002	0.00005	0.000027	0.0000065	g/day	0.089	0.012	0.1	0.012	-
Potassium	mg/L			310	1.6	g/day	1000000	3000	1000000	4600	-
Lithium	mg/L			0.34	0.012	g/day	1100	23	1100	23	-
Magnesium	mg/L			44	1.8	g/day	140000	3400	150000	5700	-
Manganese	mg/L		0.7	0.85	0.015	g/day	2800	28	3100	160	-
Molybdenum	mg/L		1	0.026	0.003	g/day	86	5.6	99	9	-
Sodium	mg/L		2.794	130	7.7	g/day	430000	14000	460000	21000	-
Nickel	mg/L	0.5	0.02	0.037	0.0033	g/day	120	6.2	140	14	-
Lead	mg/L	0.2	0.0072	0.0002	0.00005	g/day	0.66	0.094	0.76	0.095	-
Antimony	mg/L		0.005	0.0095	0.000067	g/day	31	0.13	31	0.13	-
Selenium	mg/L			0.0058	0.0058	g/day	19	11	30	11	-
Silicon	mg/L			7.7	3.5	g/day	25000	6600	34000	7700	-
Tin	mg/L			0.0058	0.000023	g/day	19	0.043	19	0.043	-
Strontium	mg/L		0.03014	1	0.022	g/day	3300	41	3500	100	-
Thallium	mg/L			0.014	0.0029	g/day	46	5.4	51	5.4	-
Uranium	mg/L		0.015	0.021	0.0018	g/day	69	3.4	72	3.4	-
Vanadium	mg/L			0.0023	0.0031	g/day	7.6	5.8	13	5.8	-
Zinc	mg/L	0.5	0.03	0.028	0.0046	g/day	92	8.6	120	18	-

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

## A8 Hannukainen dagbrottstj – Behandling i dagbrottet

Analyte	Units	Guidelines		Steady State Concentration in pit		Volume (m3/day)	Steady State Discharge load from pit		Steady State load from whole site to Rivers		
		IFC Mine Effluent	AV @ FS10	Hannukainen Steady State	Kuervittiko Steady state		Hannukainen Steady State	Kuervittiko Steady state	Akasjoki	Kuerjoki	Valkeajoki
							<b>3,295</b>	<b>1,879</b>			
pH	s.u.	6	6.5	7.90	7	mol/day	0.000041	0.00019	0.00027	0.00021	-
Alkalinity	mg/L			57.00	6.8	g/day	190000	13000	210000	15000	-
Chloride	mg/L		150	8.2	2.1	g/day	27000	3900	43000	9600	-
PO4	mg/L		0.01926	0.0011	0.051	g/day	3.6	96	100	96	-
Sulfate	mg/L		65	2100	7.7	g/day	6900000	14000	6900000	18000	-
Silver	mg/L			0.0014	0.00032	g/day	4.6	0.6	5.2	0.6	-
Aluminium	mg/L		0.1	0.0024	0.0017	g/day	7.9	3.2	14	4.4	-
Arsenic	mg/L	0.1	0.005	0.00000014	0.00048	g/day	0.00046	0.9	0.9	0.9	-
Boron	mg/L			0.64	0.0018	g/day	2100	3.4	2100	3.4	-
Barium	mg/L		0.01792	0.0025	0.0078	g/day	8.2	15	42	24	-
Nitrate	mg/L		20	4.3	0.093	g/day	14000	170	15000	640	-
Calcium	mg/L			350	4.9	g/day	1200000	9200	1200000	17000	-
Cadmium	mg/L	0.05	0.00008	0.0021	0.000046	g/day	6.9	0.086	7.1	0.13	-
Cobalt	mg/L		0.004	1.6	0.0035	g/day	5300	6.6	5300	11	-
Chromium	mg/L	0.1	0.001	0.0000027	0.0000017	g/day	0.0089	0.0032	0.012	0.0033	-
Copper	mg/L	0.3	0.005	0.0085	0.0013	g/day	28	2.4	30	2.4	-
Iron	mg/L	2	0.975	0.00027	0.0014	g/day	0.89	2.6	4.1	2.9	-
Mercury	mg/L	0.002	0.00005	0.00039	0.0000065	g/day	1.3	0.012	1.3	0.012	-
Potassium	mg/L			290	1.6	g/day	960000	3000	970000	4600	-
Lithium	mg/L			0.34	0.012	g/day	1100	23	1100	23	-
Magnesium	mg/L			130	1.8	g/day	430000	3400	440000	5700	-
Manganese	mg/L		0.7	3.6	0.015	g/day	12000	28	12000	160	-
Molybdenum	mg/L		1	0.037	0.003	g/day	120	5.6	130	9	-
Sodium	mg/L		2.794	130	7.7	g/day	430000	14000	460000	21000	-
Nickel	mg/L	0.5	0.02	0.98	0.0033	g/day	3200	6.2	3200	14	-
Lead	mg/L	0.2	0.0072	0.000051	0.00005	g/day	0.17	0.094	0.27	0.095	-
Antimony	mg/L		0.005	0.0059	0.000067	g/day	19	0.13	19	0.13	-
Selenium	mg/L			0.0029	0.0058	g/day	9.6	11	21	11	-
Silicon	mg/L			7.8	3.5	g/day	26000	6600	35000	7700	-
Tin	mg/L			0.0058	0.000023	g/day	19	0.043	19	0.043	-
Strontium	mg/L		0.03014	0.96	0.022	g/day	3200	41	3400	100	-
Thallium	mg/L			0.014	0.0029	g/day	46	5.4	51	5.4	-
Uranium	mg/L		0.015	0.0016	0.0018	g/day	5.3	3.4	8.7	3.4	-
Vanadium	mg/L			0.000011	0.0031	g/day	0.036	5.8	5.8	5.8	-
Zinc	mg/L	0.5	0.03	0.18	0.0046	g/day	590	8.6	620	18	-

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

### A9 Hannukainen dagbrottsjö – Tillämpande av geosyntetisk täkning för PAF-VRDn i kombination med addering av kalksten internt i dagbrottet

Analyte	Units	Guidelines		Steady State Concentration in pit		Volume (m3/day)	Steady State Discharge load from pit		Steady State load from whole site to Rivers		
		IFC Mine Effluent	AV @ FS10	Hannukainen Steady State	Kuervittiko Steady state		Hannukainen Steady State	Kuervittiko Steady state	Akasjoki	Kuerjoki	Valkeajoki
							<b>3,295</b>	<b>1,879</b>			
pH	s.u.	6	6.5	8.00	7	mol/day	0.000033	0.00019	0.00026	0.00021	-
Alkalinity	mg/L			64.00	6.8	g/day	210000	13000	230000	15000	-
Chloride	mg/L		150	7.6	2.1	g/day	25000	3900	41000	9600	-
PO4	mg/L		0.01926	0.0011	0.051	g/day	3.6	96	100	96	-
Sulfate	mg/L		65	200	7.7	g/day	660000	14000	680000	18000	-
Silver	mg/L			0.00088	0.00032	g/day	2.9	0.6	3.5	0.6	-
Aluminium	mg/L		0.1	0.0025	0.0017	g/day	8.2	3.2	14	4.4	-
Arsenic	mg/L	0.1	0.005	0.0000016	0.00048	g/day	0.0053	0.9	0.91	0.9	-
Boron	mg/L			0.31	0.0018	g/day	1000	3.4	1000	3.4	-
Barium	mg/L		0.01792	0.011	0.0078	g/day	36	15	70	24	-
Nitrate	mg/L		20	3.2	0.093	g/day	11000	170	12000	640	-
Calcium	mg/L			110	4.9	g/day	360000	9200	390000	17000	-
Cadmium	mg/L	0.05	0.00008	0.00041	0.000046	g/day	1.4	0.086	1.6	0.13	-
Cobalt	mg/L		0.004	0.043	0.0035	g/day	140	6.6	160	11	-
Chromium	mg/L	0.1	0.001	0.0000032	0.0000017	g/day	0.011	0.0032	0.014	0.0033	-
Copper	mg/L	0.3	0.005	0.0069	0.0013	g/day	23	2.4	25	2.4	-
Iron	mg/L	2	0.975	0.00021	0.0014	g/day	0.69	2.6	3.9	2.9	-
Mercury	mg/L	0.002	0.00005	0.000033	0.0000065	g/day	0.11	0.012	0.12	0.012	-
Potassium	mg/L			55	1.6	g/day	180000	3000	190000	4600	-
Lithium	mg/L			0.055	0.012	g/day	180	23	200	23	-
Magnesium	mg/L			15	1.8	g/day	49000	3400	57000	5700	-
Manganese	mg/L		0.7	1	0.015	g/day	3300	28	3600	160	-
Molybdenum	mg/L		1	0.023	0.003	g/day	76	5.6	89	9	-
Sodium	mg/L		2.794	50	7.7	g/day	160000	14000	190000	21000	-
Nickel	mg/L	0.5	0.02	0.05	0.0033	g/day	160	6.2	180	14	-
Lead	mg/L	0.2	0.0072	0.000064	0.00005	g/day	0.21	0.094	0.31	0.095	-
Antimony	mg/L		0.005	0.0041	0.000067	g/day	14	0.13	14	0.13	-
Selenium	mg/L			0.0025	0.0058	g/day	8.2	11	19	11	-
Silicon	mg/L			7.5	3.5	g/day	25000	6600	34000	7700	-
Tin	mg/L			0.00079	0.000023	g/day	2.6	0.043	2.6	0.043	-
Strontium	mg/L		0.03014	0.3	0.022	g/day	990	41	1200	100	-
Thallium	mg/L			0.007	0.0029	g/day	23	5.4	28	5.4	-
Uranium	mg/L		0.015	0.00022	0.0018	g/day	0.72	3.4	4.1	3.4	-
Vanadium	mg/L			0.00001	0.0031	g/day	0.033	5.8	5.8	5.8	-
Zinc	mg/L	0.5	0.03	0.025	0.0046	g/day	82	8.6	110	18	-

Exceeds IFC effluent discharge guidelines
  Exceeds Akasjoki water quality objective action value (FS10)

**BILAGA C**

**KONSEKVENSER FÖR ÄKÄSJOKI OCH KUERJOKI**

### A10 Hamukainen dagbrottsjö – Basnivå (alternativet ingen lindring)

Post closure Akasjoki Concentrations (@FS10)							Post closure Kuerjoki Concentrations (@FS40)						
		TV	AV	Annual 7 day Low	Winter Average	Annual Average			TV	AV	Annual 7 day Low	Winter Average	Annual Average
<b>Key Parameters</b>							<b>Key Parameters</b>						
pH		n/d	6	4.7	4.8	5.4	pH		n/d	6	6.8	6.8	6.8
Sulfate	mg/L	4	65	83	68	20	Sulfate	mg/L	4	65	2.8	2.3	2.1
Aluminium	mg/L	0.051	0.1	1.3	1.1	0.29	Aluminium	mg/L	0.051	0.1	0.027	0.027	0.027
Arsenic	mg/L	0.000091	0.005	0.00013	0.00011	0.000075	Arsenic	mg/L	0.000091	0.005	0.000098	7.3E-05	0.000066
Barium	mg/L	0.0089	0.018	0.0087000	0.0086	0.0083	Barium	mg/L	0.0089	0.018	0.0056	0.005	0.0048
Nitrate	mg/L	0.067	20	0.18	0.15	0.045	Nitrate	mg/L	0.067	20	0.029	0.012	0.0073
Cadmium	mg/L	0.0000027	0.00008	0.00014	0.00012	0.000031	Cadmium	mg/L	0.0000027	0.00008	8.1E-06	4.5E-06	0.0000036
Cobalt	mg/L	0.00008	0.004	0.088	0.072	0.018	Cobalt	mg/L	0.00008	0.004	0.0005	0.00019	0.00012
Chromium	mg/L	0.00033	0.001	0.0029	0.0024	0.00083	Chromium	mg/L	0.00033	0.001	0.00035	0.00035	0.00035
Copper	mg/L	0.00055	0.005	0.83	0.68	0.17	Copper	mg/L	0.00055	0.005	0.0003	0.00024	0.00022
Iron	mg/L	0.38	1.1	4.1	3.4	1.1	Iron	mg/L	0.38	1.1	0.32	0.32	0.32
Mercury	mg/L	0.0000021	0.00005	0.000023	0.000019	5.6E-06	Mercury	mg/L	0.0000021	0.00005	1.5E-06	1.2E-06	0.0000011
Manganese	mg/L	0.021	0.7	1.7	1.4	0.37	Manganese	mg/L	0.021	0.7	0.0098	0.0053	0.0042
Molybdenum	mg/L	0.00021	1	0.0019	0.0016	0.00056	Molybdenum	mg/L	0.00021	1	0.00053	0.00028	0.00021
Nickel	mg/L	0.00031	0.02	0.11	0.087	0.022	Nickel	mg/L	0.00031	0.02	0.00072	0.00033	0.00024
Lead	mg/L	0.000054	0.0072	0.0022	0.0018	0.00049	Lead	mg/L	0.000054	0.0072	0.000041	3.8E-05	0.000038
Antimony	mg/L^	0.000012	0.005	0.00022	0.00018	0.000051	Antimony	mg/L^	0.000012	0.005	0.000016	1.2E-05	0.000011
Selenium	mg/L"	n/d	0.001	0.0043	0.0035	0.00089	Selenium	mg/L"	n/d	0.001	0.00047	0.00017	0.00009
Uranium	mg/L	0.00011	0.015	0.011	0.0091	0.0024	Uranium	mg/L	0.00011	0.015	0.00026	0.00016	0.00014
Vanadium	mg/L~	n/d	0.04	0.0037	0.003	0.00077	Vanadium	mg/L	n/d	0.04	0.00025	8.7E-05	0.000048
Zinc	mg/L	0.0017	0.03	0.043	0.035	0.0095	Zinc	mg/L	0.0017	0.03	0.0018	0.0013	0.0011
<b>Other Parameters</b>							<b>Other Parameters</b>						
Alkalinity	mg/L	n/d	n/d	-2.2	-1.8	-0.46	Alkalinity	mg/L	n/d	n/d	0.64	0.23	0.12
Calcium	mg/L	4.2	n/d	8.4	7.5	4.4	Calcium	mg/L	4.2	n/d	3.4	3	2.8
Chloride	mg/L	0.9	150	1.2	1.1	0.8	Chloride	mg/L	0.9	150	0.91	0.64	0.58
Phosphate	mg/L	0.008	n/d	0.013	0.012	0.008	Phosphate	mg/L	0.008	n/d	0.013	0.0099	0.0093
Potassium	mg/L	0.58	n/d	12	9.6	2.8	Potassium	mg/L	0.58	n/d	0.59	0.46	0.43
Magnesium	mg/L	1.1	n/d	6	5	2	Magnesium	mg/L	1.1	n/d	1.1	0.96	0.92
Silicon	mg/L	5.9	n/d	4.7	4.6	4.4	Silicon	mg/L	5.9	n/d	5.1	4.9	4.9
Sodium	mg/L	1.9	n/d	6.9	5.9	2.7	Sodium	mg/L	1.9	n/d	2.5	1.9	1.8
Strontium	mg/L	0.02	n/d	0.056	0.049	0.025	Strontium	mg/L	0.02	n/d	0.021	0.019	0.018
" AV set to USEPA freshwater guideline							" AV set to USEPA freshwater guideline						
^ AV taken to be equal to Arsenic							^ AV taken to be equal to Arsenic						
~ AV from Sprague et al 1978							~ AV from Sprague et al 1978						
n/d Guideline not determined							n/d Guideline not determined						
Predicted exceedence of guideline trigger value							Predicted exceedence of guideline trigger value						
Predicted exceedence of guidelines action value							Predicted exceedence of guidelines action value						

### A11 Hamukainen dagbrottsjö – Alternativet geosyntetisk täckning

Post closure Akasjoki Concentrations (@FS10)							Post closure Kuerjoki Concentrations (@FS40)						
		TV	AV	Annual 7 day Low	Winter Average	Annual Average			TV	AV	Annual 7 day Low	Winter Average	Annual Average
<b>Key Parameters</b>							<b>Key Parameters</b>						
pH		n/d	6	6.6	6.7	6.8	pH		n/d	6	6.8	6.8	6.8
Sulfate	mg/L	4	65	11	9.5	4.7	Sulfate	mg/L	4	65	2.8	2.3	2.1
Aluminium	mg/L	0.051	0.1	0.022	0.022	0.022	Aluminium	mg/L	0.051	0.1	0.027	0.027	0.027
Arsenic	mg/L	0.000091	0.005	0.00011	0.0001	0.000072	Arsenic	mg/L	0.000091	0.005	0.000098	7.3E-05	0.000066
Barium	mg/L	0.0089	0.018	0.0090000	0.0088	0.0084	Barium	mg/L	0.0089	0.018	0.0056	0.005	0.0048
Nitrate	mg/L	0.067	20	0.15	0.12	0.038	Nitrate	mg/L	0.067	20	0.029	0.012	0.0073
Cadmium	mg/L	0.0000027	0.00008	0.000022	0.000019	6.6E-06	Cadmium	mg/L	0.0000027	0.00008	8.1E-06	4.5E-06	0.0000036
Cobalt	mg/L	0.00008	0.004	0.0019	0.0016	0.00043	Cobalt	mg/L	0.00008	0.004	0.0005	0.00019	0.00012
Chromium	mg/L	0.00033	0.001	0.00028	0.00028	0.00028	Chromium	mg/L	0.00033	0.001	0.00035	0.00035	0.00035
Copper	mg/L	0.00055	0.005	0.011	0.0088	0.0025	Copper	mg/L	0.00055	0.005	0.0003	0.00024	0.00022
Iron	mg/L	0.38	1.1	0.29	0.29	0.29	Iron	mg/L	0.38	1.1	0.32	0.32	0.32
Mercury	mg/L	0.0000021	0.00005	0.0000024	0.0000021	1.3E-06	Mercury	mg/L	0.0000021	0.00005	1.5E-06	1.2E-06	0.0000011
Manganese	mg/L	0.021	0.7	0.061	0.052	0.021	Manganese	mg/L	0.021	0.7	0.0098	0.0053	0.0042
Molybdenum	mg/L	0.00021	1	0.0012	0.001	0.0004	Molybdenum	mg/L	0.00021	1	0.00053	0.00028	0.00021
Nickel	mg/L	0.00031	0.02	0.0027	0.0022	0.00075	Nickel	mg/L	0.00031	0.02	0.00072	0.00033	0.00024
Lead	mg/L	0.000054	0.0072	0.000089	0.000078	0.000043	Lead	mg/L	0.000054	0.0072	0.000041	3.8E-05	0.000038
Antimony	mg/L <sup>^</sup>	0.000012	0.005	0.00017	0.00014	0.000039	Antimony	mg/L <sup>^</sup>	0.000012	0.005	0.000016	1.2E-05	0.000011
Selenium	mg/L <sup>"</sup>	n/d	0.001	0.00039	0.00032	0.000082	Selenium	mg/L <sup>"</sup>	n/d	0.001	0.00047	0.00017	0.00009
Uranium	mg/L	0.00011	0.015	0.00063	0.00053	0.00021	Uranium	mg/L	0.00011	0.015	0.00026	0.00016	0.00014
Vanadium	mg/L <sup>~</sup>	n/d	0.04	0.0003	0.00024	0.000062	Vanadium	mg/L	n/d	0.04	0.00025	8.7E-05	0.000048
Zinc	mg/L	0.0017	0.03	0.0028	0.0024	0.0013	Zinc	mg/L	0.0017	0.03	0.0018	0.0013	0.0011
<b>Other Parameters</b>							<b>Other Parameters</b>						
Alkalinity	mg/L	n/d	n/d	0.2	0.16	0.041	Alkalinity	mg/L	n/d	n/d	0.64	0.23	0.12
Calcium	mg/L	4.2	n/d	7.1	6.4	4.2	Calcium	mg/L	4.2	n/d	3.4	3	2.8
Chloride	mg/L	0.9	150	1.2	1.1	0.8	Chloride	mg/L	0.9	150	0.91	0.64	0.58
Phosphate	mg/L	0.008	n/d	0.0089	0.0085	0.0072	Phosphate	mg/L	0.008	n/d	0.013	0.0099	0.0093
Potassium	mg/L	0.58	n/d	2.7	2.3	0.95	Potassium	mg/L	0.58	n/d	0.59	0.46	0.43
Magnesium	mg/L	1.1	n/d	1.6	1.4	1	Magnesium	mg/L	1.1	n/d	1.1	0.96	0.92
Silicon	mg/L	5.9	n/d	4.7	4.6	4.4	Silicon	mg/L	5.9	n/d	5.1	4.9	4.9
Sodium	mg/L	1.9	n/d	3.8	3.4	2.1	Sodium	mg/L	1.9	n/d	2.5	1.9	1.8
Strontium	mg/L	0.02	n/d	0.031	0.028	0.02	Strontium	mg/L	0.02	n/d	0.021	0.019	0.018
" AV set to USEPA freshwater guideline							" AV set to USEPA freshwater guideline						
^ AV taken to be equal to Arsenic							^ AV taken to be equal to Arsenic						
~ AV from Sprague et al 1978							~ AV from Sprague et al 1978						
n/d Guideline not determined							n/d Guideline not determined						
<div style="background-color: #d9ead3; padding: 2px;">Predicted exceedence of guideline trigger value</div> <div style="background-color: #f4cccc; padding: 2px;">Predicted exceedence of guidelines action value</div>							<div style="background-color: #d9ead3; padding: 2px;">Predicted exceedence of guideline trigger value</div> <div style="background-color: #f4cccc; padding: 2px;">Predicted exceedence of guidelines action value</div>						

## A12 Hannukainen dagbrottsjö – Alternativet addering av kalksten till PAF-VRD:n

Post closure Akasjoki Concentrations (@FS10)							Post closure Kuerjoki Concentrations (@FS40)						
		TV	AV	Annual 7 day Low	Winter Average	Annual Average			TV	AV	Annual 7 day Low	Winter Average	Annual Average
<b>Key Parameters</b>							<b>Key Parameters</b>						
pH		n/d	6	6.9	6.9	6.9	pH		n/d	6	6.8	6.8	6.8
Sulfate	mg/L	4	65	49	41	13	Sulfate	mg/L	4	65	2.8	2.3	2.1
Aluminium	mg/L	0.051	0.1	0.022	0.022	0.022	Aluminium	mg/L	0.051	0.1	0.027	0.027	0.027
Arsenic	mg/L	0.000091	0.005	0.000078	0.000075	0.000065	Arsenic	mg/L	0.000091	0.005	0.000098	7.3E-05	0.000066
Barium	mg/L	0.0089	0.018	0.0087000	0.0086	0.0083	Barium	mg/L	0.0089	0.018	0.0056	0.005	0.0048
Nitrate	mg/L	0.067	20	0.18	0.15	0.045	Nitrate	mg/L	0.067	20	0.029	0.012	0.0073
Cadmium	mg/L	0.0000027	0.00008	0.000022	0.000019	6.6E-06	Cadmium	mg/L	0.0000027	0.00008	8.1E-06	4.5E-06	0.0000036
Cobalt	mg/L	0.00008	0.004	0.0028	0.0023	0.00062	Cobalt	mg/L	0.00008	0.004	0.0005	0.00019	0.00012
Chromium	mg/L	0.00033	0.001	0.00028	0.00028	0.00028	Chromium	mg/L	0.00033	0.001	0.00035	0.00035	0.00035
Copper	mg/L	0.00055	0.005	0.00092	0.00082	0.00051	Copper	mg/L	0.00055	0.005	0.0003	0.00024	0.00022
Iron	mg/L	0.38	1.1	0.29	0.29	0.29	Iron	mg/L	0.38	1.1	0.32	0.32	0.32
Mercury	mg/L	0.0000021	0.00005	0.0000022	0.0000019	1.2E-06	Mercury	mg/L	0.0000021	0.00005	1.5E-06	1.2E-06	0.0000011
Manganese	mg/L	0.021	0.7	0.047	0.04	0.018	Manganese	mg/L	0.021	0.7	0.0098	0.0053	0.0042
Molybdenum	mg/L	0.00021	1	0.0013	0.0011	0.00044	Molybdenum	mg/L	0.00021	1	0.00053	0.00028	0.00021
Nickel	mg/L	0.00031	0.02	0.0019	0.0016	0.00059	Nickel	mg/L	0.00031	0.02	0.00072	0.00033	0.00024
Lead	mg/L	0.000054	0.0072	0.00004	0.000038	0.000033	Lead	mg/L	0.000054	0.0072	0.000041	3.8E-05	0.000038
Antimony	mg/L^	0.000012	0.005	0.00036	0.0003	0.000079	Antimony	mg/L^	0.000012	0.005	0.000016	1.2E-05	0.000011
Selenium	mg/L"	n/d	0.001	0.00035	0.00028	0.000072	Selenium	mg/L"	n/d	0.001	0.00047	0.00017	0.00009
Uranium	mg/L	0.00011	0.015	0.00093	0.00078	0.00027	Uranium	mg/L	0.00011	0.015	0.00026	0.00016	0.00014
Vanadium	mg/L~	n/d	0.04	0.00015	0.00012	0.000031	Vanadium	mg/L	n/d	0.04	0.00025	8.7E-05	0.000048
Zinc	mg/L	0.0017	0.03	0.0023	0.002	0.0012	Zinc	mg/L	0.0017	0.03	0.0018	0.0013	0.0011
<b>Other Parameters</b>							<b>Other Parameters</b>						
Alkalinity	mg/L	n/d	n/d	0.38	0.31	0.079	Alkalinity	mg/L	n/d	n/d	0.64	0.23	0.12
Calcium	mg/L	4.2	n/d	8.4	7.5	4.4	Calcium	mg/L	4.2	n/d	3.4	3	2.8
Chloride	mg/L	0.9	150	1.2	1.1	0.8	Chloride	mg/L	0.9	150	0.91	0.64	0.58
Phosphate	mg/L	0.008	n/d	0.0082	0.0079	0.007	Phosphate	mg/L	0.008	n/d	0.013	0.0099	0.0093
Potassium	mg/L	0.58	n/d	12	9.9	2.9	Potassium	mg/L	0.58	n/d	0.59	0.46	0.43
Magnesium	mg/L	1.1	n/d	2.6	2.3	1.3	Magnesium	mg/L	1.1	n/d	1.1	0.96	0.92
Silicon	mg/L	5.9	n/d	4.7	4.6	4.4	Silicon	mg/L	5.9	n/d	5.1	4.9	4.9
Sodium	mg/L	1.9	n/d	6.9	5.9	2.7	Sodium	mg/L	1.9	n/d	2.5	1.9	1.8
Strontium	mg/L	0.02	n/d	0.058	0.05	0.025	Strontium	mg/L	0.02	n/d	0.021	0.019	0.018
" AV set to USEPA freshwater guideline							" AV set to USEPA freshwater guideline						
^ AV taken to be equal to Arsenic							^ AV taken to be equal to Arsenic						
~ AV from Sprague et al 1978							~ AV from Sprague et al 1978						
n/d Guideline not determined							n/d Guideline not determined						
<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value							<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value						
<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value							<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value						

### A13 Hannukainen dagbrottstj – Behandling i dagbrottet

Post closure Akasjoki Concentrations (@FS10)							Post closure Kuerjoki Concentrations (@FS40)						
		TV	AV	Annual 7 day Low	Winter Average	Annual Average			TV	AV	Annual 7 day Low	Winter Average	Annual Average
<b>Key Parameters</b>							<b>Key Parameters</b>						
pH		n/d	6	6.9	6.9	6.9	pH		n/d	6	6.8	6.8	6.8
Sulfate	mg/L	4	65	83	68	20	Sulfate	mg/L	4	65	2.8	2.3	2.1
Aluminium	mg/L	0.051	0.1	0.022	0.022	0.022	Aluminium	mg/L	0.051	0.1	0.027	0.027	0.027
Arsenic	mg/L	0.000091	0.005	0.000072	0.00007	0.000064	Arsenic	mg/L	0.000091	0.005	0.000098	7.3E-05	0.000066
Barium	mg/L	0.0089	0.018	0.0087000	0.0086	0.0083	Barium	mg/L	0.0089	0.018	0.0056	0.005	0.0048
Nitrate	mg/L	0.067	20	0.18	0.15	0.045	Nitrate	mg/L	0.067	20	0.029	0.012	0.0073
Cadmium	mg/L	0.0000027	0.00008	0.000085	0.000069	0.00002	Cadmium	mg/L	0.0000027	0.00008	8.1E-06	4.5E-06	0.0000036
Cobalt	mg/L	0.00008	0.004	0.061	0.05	0.013	Cobalt	mg/L	0.00008	0.004	0.0005	0.00019	0.00012
Chromium	mg/L	0.00033	0.001	0.00028	0.00028	0.00028	Chromium	mg/L	0.00033	0.001	0.00035	0.00035	0.00035
Copper	mg/L	0.00055	0.005	0.00075	0.00068	0.00047	Copper	mg/L	0.00055	0.005	0.0003	0.00024	0.00022
Iron	mg/L	0.38	1.1	0.29	0.29	0.29	Iron	mg/L	0.38	1.1	0.32	0.32	0.32
Mercury	mg/L	0.0000021	0.00005	0.000016	0.000013	4.1E-06	Mercury	mg/L	0.0000021	0.00005	1.5E-06	1.2E-06	0.0000011
Manganese	mg/L	0.021	0.7	0.15	0.12	0.04	Manganese	mg/L	0.021	0.7	0.0098	0.0053	0.0042
Molybdenum	mg/L	0.00021	1	0.0017	0.0014	0.00051	Molybdenum	mg/L	0.00021	1	0.00053	0.00028	0.00021
Nickel	mg/L	0.00031	0.02	0.037	0.03	0.0079	Nickel	mg/L	0.00031	0.02	0.00072	0.00033	0.00024
Lead	mg/L	0.000054	0.0072	0.000034	0.000034	0.000032	Lead	mg/L	0.000054	0.0072	0.000041	3.8E-05	0.000038
Antimony	mg/L^	0.000012	0.005	0.00022	0.00018	0.000051	Antimony	mg/L^	0.000012	0.005	0.000016	1.2E-05	0.000011
Selenium	mg/L"	n/d	0.001	0.00024	0.0002	0.00005	Selenium	mg/L"	n/d	0.001	0.00047	0.00017	0.00009
Uranium	mg/L	0.00011	0.015	0.0002	0.00018	0.00012	Uranium	mg/L	0.00011	0.015	0.00026	0.00016	0.00014
Vanadium	mg/L~	n/d	0.04	0.000067	0.000055	0.000014	Vanadium	mg/L	n/d	0.04	0.00025	8.7E-05	0.000048
Zinc	mg/L	0.0017	0.03	0.0081	0.0067	0.0024	Zinc	mg/L	0.0017	0.03	0.0018	0.0013	0.0011
<b>Other Parameters</b>							<b>Other Parameters</b>						
Alkalinity	mg/L	n/d	n/d	2.4	2	0.5	Alkalinity	mg/L	n/d	n/d	0.64	0.23	0.12
Calcium	mg/L	4.2	n/d	17	15	6.3	Calcium	mg/L	4.2	n/d	3.4	3	2.8
Chloride	mg/L	0.9	150	1.2	1.1	0.8	Chloride	mg/L	0.9	150	0.91	0.64	0.58
Phosphate	mg/L	0.008	n/d	0.0079	0.0076	0.0069	Phosphate	mg/L	0.008	n/d	0.013	0.0099	0.0093
Potassium	mg/L	0.58	n/d	12	9.6	2.8	Potassium	mg/L	0.58	n/d	0.59	0.46	0.43
Magnesium	mg/L	1.1	n/d	6	5	2	Magnesium	mg/L	1.1	n/d	1.1	0.96	0.92
Silicon	mg/L	5.9	n/d	4.7	4.6	4.4	Silicon	mg/L	5.9	n/d	5.1	4.9	4.9
Sodium	mg/L	1.9	n/d	6.9	5.9	2.7	Sodium	mg/L	1.9	n/d	2.5	1.9	1.8
Strontium	mg/L	0.02	n/d	0.056	0.049	0.025	Strontium	mg/L	0.02	n/d	0.021	0.019	0.018
" AV set to USEPA freshwater guideline							" AV set to USEPA freshwater guideline						
^ AV taken to be equal to Arsenic							^ AV taken to be equal to Arsenic						
~ AV from Sprague et al 1978							~ AV from Sprague et al 1978						
n/d Guideline not determined							n/d Guideline not determined						
<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value							<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value						
<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value							<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value						

### A14 Hannukainen dagbrottsjö – Tillämpande av geosyntetisk tätning för PAF-VRDn i kombination med addering av kalksten internt i dagbrottet

Post closure Akasjoki Concentrations (@FS10)							Post closure Kuerjoki Concentrations (@FS40)						
		TV	AV	Annual 7 day Low	Winter Average	Annual Average			TV	AV	Annual 7 day Low	Winter Average	Annual Average
<b>Key Parameters</b>							<b>Key Parameters</b>						
pH		n/d	6	6.9	6.9	6.9	pH		n/d	6	6.8	6.8	6.8
Sulfate	mg/L	4	65	11	9.5	4.7	Sulfate	mg/L	4	65	2.8	2.3	2.1
Aluminium	mg/L	0.051	0.1	0.022	0.022	0.022	Aluminium	mg/L	0.051	0.1	0.027	0.027	0.027
Arsenic	mg/L	0.000091	0.005	0.000073	0.000071	0.000064	Arsenic	mg/L	0.000091	0.005	0.000098	7.3E-05	0.000066
Barium	mg/L	0.0089	0.018	0.0090000	0.0089	0.0084	Barium	mg/L	0.0089	0.018	0.0056	0.005	0.0048
Nitrate	mg/L	0.067	20	0.15	0.12	0.038	Nitrate	mg/L	0.067	20	0.029	0.012	0.0073
Cadmium	mg/L	0.0000027	0.00008	0.000021	0.000018	6.3E-06	Cadmium	mg/L	0.0000027	0.00008	8.1E-06	4.5E-06	0.0000036
Cobalt	mg/L	0.00008	0.004	0.0019	0.0016	0.00043	Cobalt	mg/L	0.00008	0.004	0.0005	0.00019	0.00012
Chromium	mg/L	0.00033	0.001	0.00028	0.00028	0.00028	Chromium	mg/L	0.00033	0.001	0.00035	0.00035	0.00035
Copper	mg/L	0.00055	0.005	0.00069	0.00064	0.00046	Copper	mg/L	0.00055	0.005	0.0003	0.00024	0.00022
Iron	mg/L	0.38	1.1	0.29	0.29	0.29	Iron	mg/L	0.38	1.1	0.32	0.32	0.32
Mercury	mg/L	0.0000021	0.00005	0.0000024	0.0000021	1.3E-06	Mercury	mg/L	0.0000021	0.00005	1.5E-06	1.2E-06	0.0000011
Manganese	mg/L	0.021	0.7	0.053	0.045	0.02	Manganese	mg/L	0.021	0.7	0.0098	0.0053	0.0042
Molybdenum	mg/L	0.00021	1	0.0012	0.001	0.00041	Molybdenum	mg/L	0.00021	1	0.00053	0.00028	0.00021
Nickel	mg/L	0.00031	0.02	0.0023	0.0019	0.00068	Nickel	mg/L	0.00031	0.02	0.00072	0.00033	0.00024
Lead	mg/L	0.000054	0.0072	0.000035	0.000034	0.000032	Lead	mg/L	0.000054	0.0072	0.000041	3.8E-05	0.000038
Antimony	mg/L^	0.000012	0.005	0.00017	0.00014	0.000039	Antimony	mg/L^	0.000012	0.005	0.000016	1.2E-05	0.000011
Selenium	mg/L"	n/d	0.001	0.00022	0.00018	0.000046	Selenium	mg/L"	n/d	0.001	0.00047	0.00017	0.00009
Uranium	mg/L	0.00011	0.015	0.00015	0.00014	0.00011	Uranium	mg/L	0.00011	0.015	0.00026	0.00016	0.00014
Vanadium	mg/L~	n/d	0.04	0.000067	0.000055	0.000014	Vanadium	mg/L	n/d	0.04	0.00025	8.7E-05	0.000048
Zinc	mg/L	0.0017	0.03	0.0022	0.0019	0.0012	Zinc	mg/L	0.0017	0.03	0.0018	0.0013	0.0011
<b>Other Parameters</b>							<b>Other Parameters</b>						
Alkalinity	mg/L	n/d	n/d	2.7	2.2	0.55	Alkalinity	mg/L	n/d	n/d	0.64	0.23	0.12
Calcium	mg/L	4.2	n/d	7.9	7.1	4.3	Calcium	mg/L	4.2	n/d	3.4	3	2.8
Chloride	mg/L	0.9	150	1.2	1.1	0.8	Chloride	mg/L	0.9	150	0.91	0.64	0.58
Phosphate	mg/L	0.008	n/d	0.0079	0.0076	0.0069	Phosphate	mg/L	0.008	n/d	0.013	0.0099	0.0093
Potassium	mg/L	0.58	n/d	2.7	2.3	0.95	Potassium	mg/L	0.58	n/d	0.59	0.46	0.43
Magnesium	mg/L	1.1	n/d	1.6	1.4	1	Magnesium	mg/L	1.1	n/d	1.1	0.96	0.92
Silicon	mg/L	5.9	n/d	4.7	4.6	4.4	Silicon	mg/L	5.9	n/d	5.1	4.9	4.9
Sodium	mg/L	1.9	n/d	3.8	3.4	2.1	Sodium	mg/L	1.9	n/d	2.5	1.9	1.8
Strontium	mg/L	0.02	n/d	0.031	0.028	0.02	Strontium	mg/L	0.02	n/d	0.021	0.019	0.018
" AV set to USEPA freshwater guideline							" AV set to USEPA freshwater guideline						
^ AV taken to be equal to Arsenic							^ AV taken to be equal to Arsenic						
~ AV from Sprague et al 1978							~ AV from Sprague et al 1978						
n/d Guideline not determined							n/d Guideline not determined						
<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value							<div style="background-color: #d9ead3; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guideline trigger value						
<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value							<div style="background-color: #f4cccc; width: 100%; height: 10px; margin-bottom: 2px;"></div> Predicted exceedence of guidelines action value						

## **BILAGA D**

### **B PHREEQC-SKRIPT FÖR HANNUKAINENS WRD (EXEMPEL)**

## KNOPPAR

```

-uppreparingar      10000
-konvergens_tolerans 1e-008
-toleranss          1e-015
-stegstorlek        10
-pe_stegstorlek     5

```

## VALD\_FUNKTION

```

-fil                Hannukainen_WRD_V5.out
-vald_ut            ja
-hög_precision     ja
-simulation         ja
-läge              ja
-lösning           ja
-avstånd           nej
-tid               nej
-steg              nej
-ph                ja
-pe                ja
-alkaliskhet       ja
-jonisk_styrka     ja
-vatten            ja
-laddningens_balans ja
-sammanlagt        C(4)  Cl   F   P   S(6) Ag  Al  As
                   B   Ba  N   Bi  Ca  Cd  Co  Cr  Cu  Fe  Hg  K
                   Li  Mg  Mn  Mo  Na  Ni  Pb  Sb  Se  Si  Sn  Sr
                   Ti  Tl  U   V   W   Zn

```

## SLUT

## FASER

```

fixa_pe
e- = e-
log_k    0

```

## fixa\_pH

H+ = H+

log\_K 0

## Augit

```

Ca2MgFeSi4O12 + 4H2O = 2Ca+2 + Mg+2 + Fe+2 + 4H2SiO4-2
log_k          0

```

## Slut

## YT\_SORTER

```

2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2 + 2H+
log_k      -6,06
-ej_granskning
##-mol_balans (Hfo_wO)2UO2
Hfo_sOH + UO2+2 = Hfo_sOUO2 + H+
log_k      4,2
-ej_granskning
##-mol_balans (Hfo_wO)2UO2
H2CO3 + Hfo_wOH = Hfo_wOCO2H + H2O
log_k      2,9
H2CO3 + Hfo_wOH = Hfo_wOCO2- + H+ + H2O
log_k      -5,20
CO3-2 + 2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2CO3-2 + 2H+
log_k      2,7
-ej_granskning
##-mol_balans (Hfo_wO)2UO2CO3-2

```

CO3-2 + Hfo\_sOH + UO2+2 = Hfo\_sOUO2CO3-2 + H+  
 log\_k 4,33  
 -ej\_granskning  
 ##-mol\_balans (Hfo\_sO)2UO2CO3-2

Slut

LÖSNINGENS\_DISPERSION

-enheter		mg/kgw	pe	Temperatur	C(4)	
Cl	pH	F	P	S(6)	Ag	
		Al	As	B	Ba	
		N(5)	Bi	Ca	Cd	
		Co	Cr	Cu	Fe	
		Hg(0)	K	Li	Mg	
		Mn	Mo	Na	Ni	
		Pb	Sb	Se	Si	
		Sn	Sr	Ti	Tl	
		U	V	W	Zn	
				mg/kgw som HCO3		
				mg/kgw som SO4		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
mg/kgw		mg/kgw	mg/kgw	mg/kgw		
5,68667029		6,31332971		5	7482,30502	
390,3948027		680,7502706			3061,79844	
0,124276851		47,20807457			10,5152526	
1,785711172		1,190435461			2031,106597	
0,012427685		0,142682356			0,849416613	
4,579343846		0,012517871			1,242768513	
277,2651968		0,778306577			1066,004199	
0,196575065		0,124276851			0,173814926	
2351,201707		0,119043546			57,58120014	
0,119043546		3,002783829			0,761280424	
0,340840269						
2,763899971		9,236100029		5	948,7953247	
460,2023738		269,798455			70117,55513	
0,118863057		1909,594661			7,760777433	
19,80293402		1,138577272			8956,148818	
0,070324243		53,68383604			551,0379978	
5273,861668		0,012109087			6,238690756	
2582,347418		130,4789569			1706,549541	
63,69226114		1,368156786			2,528957874	
22818,97596		0,113857727			2,811396963	
0,161000485		4,681006787			0,144336188	
23,39584687						
4,153871964		7,846128036		5	373,34318	
39,1622		0		0	26,3872	
0		1,8312		0,001547	0	0,16338
		0,721		0	52,934	0,0003122
		0,029596		0,01848	0,0134218	9,1742
		0		11,3414	0	16,296
		0,84		0,02856	50,414	0,058338
		0,0029792		0	0	164,92
		0		0,4305	0	0
		0,0032256		0	0	0,09422

5,690097077	6,309902923		5	4964,808044
250,800463	355,4445053	8,412771432		1963,738541
0,084127714	28,34123977	0,104731502		5,531962832
1,231265252	0,805850915	0,080585092		1314,136361
0,008412771	0,176797397	1,733796247		0,356352679
2,897860227	0,008405808	950,4499339		0,841277143
186,9385837	0,592730632	0,731576425		722,8915602
0,758027088	0,084127714	0,080585092		0,114125668
1563,178147	0,080585092	3,165140369		46,97620559
0,080585092	0,382590743	3,856630411		0,497586889
0,347017305				
2,997296642	9,002703358		5	410,9188341
251,891012	153,7888269	34,23322406		41622,62994
0,0692066	1108,148141	0,077368937		4,575783186
12,24180321	0,66292306	0,066292306		5305,514703
0,036581426	10,03872184	0,760155514		45,38612382
2936,209104	0,006891634	3484,827247		4,372161184
1606,121313	85,26942977	0,214400045		1025,539731
19,18875373	0,623014986	0,068048996		1,293307623
13672,36862	0,066292306	11,03709225		1,202102935
0,087283315	7,398601973	0,766676311		0,076072356
15,05243812				
4,153871964	7,846128036		5	373,34318
39,1622	0	0		26,3872
0	1,8312	0,001547		0
	0,721	0		0,16338
	0,029596	0,01848		52,934
	0	11,3414		0,0134218
	0,84	0,02856		0
	0,0029792	0		50,414
	0	0,4305		0
	0,0032256	0		0
				0,09422

Slut

## BALANSLÄGETS\_FASER 11

Silver	0	0
Alunit	0	0
Anglesit	0	0
Baryt	0	0
Be(OH)2(am)	0	0
Boehmit	0	10
Kalcit	0	0
Celestin	0	0
Cerussit	0	0
Co(OH)2	0	0
CoCO3	0	0
CO2(g)	-2,5	10
Cr(OH)3(am)	0	0
Cu(OH)2	0	0
Dolomit (beställd)	0	0
Ferrihydrit	0	0.03189373
#Na-Jarosit	0	0
Manganit	0	10
Fluorit	0	0
# Gibbsit	0	0
Gips	0	0
Kvicksilver(1)		0
Hydroxylapatit	0	0
Malakit	0	0
Ni(OH)2		0
O2(g)	-32	10

```

Otavit          0 0
Pb(OH)2         0 0
Pyromorfit     0 0
Rodokrosit     0 0
SbO2           0 0
Siderit        0 0
Kristobalit    0 10
Smithsonit     0 0
Strontianit    0 0
# Tyuyamunit   0 0
Carnotit       0 0
UO2(OH)2(beta) 0 0
Zincocit      0 0
PbMoO4        0 0
Sn(OH)4       0 0
Använd Lösning 1
SPARA balanslägets_faser 11
SPARA lösningen 11
slut
YTA 11
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 11 ## använd sedimenterad ferrihydrit som reaktiv
yta
Använd Yta 11
ANVÄND Lösning 11
SPARA Lösning 21 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 1
  H2O          -1
  0 mol

ANVÄND Lösning 21
Slut
BALANSLÄGETS_FASER 12
  Silver       0 0
  Alunit
  Anglesit
  Baryt        0 0
  Be(OH)2(am) 0 0
  Kalcit       0 0
  Celestin    0 0
  Cerussit    0 0
  Co(OH)2     0 0
  CO2(g)      -2,5 10
  Cu(OH)2     0 0
  Cr(OH)3(am) 0 0
  Dolomit (beställd) 0 0
  Ferrihydrit 0 0,73039120
  Fluorit     0 0
  # Gibbisit  0 0
Diaspor       0 0
Gips          0 0
  Kvicksilver(1) 0 0
  # Hydroxylapatit 0 0
  Malakit     0 0
MnHPO4        0 10
  Ni(OH)2     0 0
  O2(g)       -32 10

```

```

Otavit          0 0
Pb(OH)2        0 0
Pyromorfit     0 0
Rodokrosit     0 0
SbO2           0 0
Siderit        0 0
Kristobalit    0 10
Smithsonit     0 0
Strontianit    0 0
# Tyuyamunit   0 0
Carnotit       0 0
UO2(OH)2(beta) 0 0
Zincocit       0 0

```

ANVÄND Lösning 2

SPARA balanslägets\_faser 12

SPARA lösningen 12

slut

YTA 12

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0.2

ANVÄND balanslägets\_faser 12

ANVÄND Lösning 12

Använd yta 12

SPARA Lösning 22 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 2

H2O -1

0 mol

ANVÄND Lösning 22

SLUT

BALANSLÄGETS\_FASER 13

```

Silver          0 0
Alunit          0 10
Anglesit        0 0
Baryt           0 10
Be(OH)2(am)    0 0
Boehmit         0 10
Kalцит         0 10
Celestin        0 0
Cerussit        0 0
Co(OH)2         0 0
CoCO3           0 0
CO2(g)         -2,5 10
Cr(OH)3(am)    0 10
Cu(OH)2         0 0
Dolomit(beställd) 0 0
Ferrihydrit    0 0
#Na-Jarosit    0 0
Manganit        0 10
# Fluorit       0 0
# Gibbisit      0 0
Gips            0 10
Kvicksilver(1) 0 0
Hydroxylapatit 0 0
Malakit         0 0
Ni(OH)2         0 0

```

```

O2(g)          -32 10
Otavit         0 0
Pb(OH)2        0 0
Pyromorfit     0 0
# Rodokrosit   0 0
SbO2           0 0
# Siderit      0 0
Kristobalit    0 10
Smithsonit     0 0
Strontianit    0 0
# Tyuyamunit   0 0
Carnotit       0 0
UO2(OH)2(beta) 0 0
Zinkosit       0 0
PbMoO4         0 10
Sn(OH)4        0 10
Använd Lösning 3
SPARA balanslägets_faser 13
SPARA lösningen 13
slut
YTA 13
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 5,90 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 13
Använd Lösning 13
SPARA Lösning 23 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 3
  H2O          -1
  0 mol

ANVÄND Lösning 23
Slut
BALANSLÄGETS_FASER 14

Silver         0 0
Alunit         0 0
Anglesit       0 0
Baryt          0 0
Be(OH)2(am)    0 0
Boehmit        0 10
Kalcit         0 0
Celestin       0 0
Cerussit       0 0
Co(OH)2        0 0
CoCO3          0 0
CO2(g)         -2,5 10
Cr(OH)3(am)    0 0
Cu(OH)2        0 0
Dolomit(beställd) 0 0
Ferrihydrit    0 0,02045561
#Na-Jarosit    0 0
Manganit       0 10
Fluorit        0 0
# Gibbsit      0 0
Gips           0 0
Kvicksilver(1) 0 0

```

```

Hydroxylapatit 0 0
Malakit 0 0
Ni(OH)2 0 0
O2(g) -32 10
Otavit 0 0
Pb(OH)2 0 0
Pyromorfit 0 0
Rodokrosit 0 0
SbO2 0 0
Siderit 0 0
Kristobalit 0 10
Smithsonit 0 0
Strontianit 0 0
# Tyuyamunit 0 0
Carnotit 0 0
UO2(OH)2(beta) 0 0
Zincocit 0 0
PbMoO4 0 0
Sn(OH)4 0 0

```

Använd Lösning 4

SPARA balanslägets\_faser 14

SPARA lösningen 14

slut

YTA 14

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 6,35 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 14

Använd Lösning 14

SPARA Lösning 24 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 4

H2O -1

0 mol

ANVÄND Lösning 24

Slut

BALANSLÄGETS\_FASER 15

Silver 0 0

Alunit 0 0

Anglesit

Baryt 0 0

Be(OH)2(am) 0 0

Kalcit 0 0

Celestin 0 0

Cerussit 0 0

Co(OH)2 0 0

CO2(g) -2,5 10

Cu(OH)2 0 0

Cr(OH)3(am) 0 0

Dolomit(beställd) 0 0

Ferrihydrit 0 0,43356906

Fluorit 0 0

# Gibbisit 0 0

Diaspor 0 0

Gips 0 0

Kvicksilver(1) 0 0

```

# Hydroxylapatit 0 0
Malakit 0 0
MnHPO4 0 10
Ni(OH)2 0 0
O2(g) -32 10
Otavit 0 0
Pb(OH)2 0 0
Pyromorfit 0 0
Rodokrosit 0 0
SbO2 0 0
Siderit 0 0
Kristobalit 0 10
Smithsonit 0 0
Strontianit 0 0
# Tyuyamunit 0 0
Carnotit 0 0
UO2(OH)2(beta) 0 0
Zincocit 0 0

```

Använd Lösning 5

SPARA balanslägets\_faser 15

SPARA lösningen 15

slut

YTA 15

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 6,80 kg# använd sedimenterat ferrihydrit som reaktiv yta

Använd Yta 15

ANVÄND Lösning 15

SPARA Lösning 25 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 5

H2O -1

0 mol

ANVÄND Lösning 25

Slut

BALANSLÄGETS\_FASER 16

Silver 0 0

Alunit 0 10

Anglesit 0 0

Baryt 0 10

Be(OH)2(am) 0 0

Boehmit 0 10

Kalcit 0 10

Celestin 0 0

Cerussit 0 0

Co(OH)2 0 0

CoCO3 0 0

CO2(g) -2,5 10

Cr(OH)3(am) 0 10

Cu(OH)2 0 0

Dolomit(beställd) 0 0

Ferrihydrit 0 0

#Na-Jarosit 0 0

Manganit 0 10

# Fluorit 0 0

# Gibbsit 0 0

```
Gips      0 10
Kvicksilver(1) 0 0
Hydroxylapatit 0 0
Malakit   0 0
Ni(OH)2   0 0
O2(g)     -32 10
Otavit    0 0
Pb(OH)2   0 0
Pyromorfit 0 0
# Rodokrosit 0 0
SbO2      0 0
# Siderit  0 0
Kristobalit 0 10
Smithsonit 0 0
Strontianit 0 0
# Tyuyamunit 0 0
Carnotit  0 0
UO2(OH)2(beta) 0 0
Zincocit  0 0
PbMoO4    0 10
Sn(OH)4    0 10
```

Använd Lösning 6

SPARA balanslägets\_faser 16

SPARA lösningen 16

slut

YTA 16

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_fas 0.2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 7,26 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 16

ANVÄND Lösning 16

SPARA Lösning 26 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 6

H2O -1

0 mol

ANVÄND Lösning 26

Slut

**BILAGA E**

**PHREEQC- SKRIPT FÖR HANNUKAINENS DAGBROTTSJÖ**  
**(EXEMPEL)**

## KNOPPAR

```

-uppreppningar      10000
-konvergens_tolerans 1e-008
-tolerans            1e-015
-stegstorlek        10
-pe_stegstorlek     5

```

## VALD\_FUNKTION

```

-fil                  Hannukainen_Pit_V5.out
-vald_ut              ja
-hög_precision       ja
-simulation           ja
-läge                 ja
-lösning              ja
-avstånd              nej
-tid                  nej
-steg                 nej
-ph                   ja
-pe                   ja
-alkaliskhet          ja
-jonisk_styrka        ja
-vatten               ja
-laddningens_balans  ja
-sammanlagt           C(4)  Cl   F   P   S(6) Ag   Al   As
  B   Ba   N   Bi   Ca   Cd   Co   Cr   Cu   Fe   Hg   K
  Li   Mg   Mn   Mo   Na   Ni   Pb   Sb   Se   Si   Sn   Sr
  Ti   Tl   U   V   W   Zn

```

## SLUT

## FASER

## fixa\_pe

```

e- = e-
log_k    0

```

## fixa\_pH

```

H+ = H+
log_k    0

```

## Slut

## YT\_SORTER

```

2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2 + 2H+
log_k      -6,06
-ej_granskning
##-mol_balans (Hfo_wO)2UO2
Hfo_sOH + UO2+2 = Hfo_sOUO2 + H+
log_k      4,2
-ej_granskning
##-mol_balans (Hfo_sO)2UO2
H2CO3 + Hfo_wOH = Hfo_wOCO2H + H2O
log_k      2,9
H2CO3 + Hfo_wOH = Hfo_wOCO2- + H+ + H2O
log_k      -5,20
CO3-2 + 2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2CO3-2 + 2H+
log_k      2,7
-ej_granskning
##-mol_balans (Hfo_wO)2UO2CO3-2
CO3-2 + Hfo_sOH + UO2+2 = Hfo_sOUO2CO3-2 + H+
log_k      4,33
-ej_granskning
##-mol_balans (Hfo_sO)2UO2CO3-2

```

## Slut



	0	0	0	0
	0	0	0	0
	0	0	0	0
4,063704565	7,936295435		7	17,04690804
41,37973488	12,56657442	0,266798554		2108,89974
0,008711308	43,45843535	0,002350659		0,65964605
0,035905015	0,755865953	0,001281037		103,2408534
0,003550908	2,256722713	0,071585713		21,92555615
106,0753614	0,000732783	286,2388707		0,341150608
131,8305944	44,04685253	0,043836571		127,3575144
2,786095871	0,056876596	0,006054307		0,103313023
29,50198981	0,006157183	0,937863046		0,030827238
0,014137944	0,287650206	0,090030942		0,000296439
1,139796376				
6,083255325	5,916744675		7	26,9922703
2,333288437	0,090900305	0,085603001		7,675948168
0,000317736	0,25163535	0,001375333		0,001784069
0,007810796	0,021095194	0,00121276		4,920748491
05	0,00349994	0,001330724	0,013194523	0,527128491
	6,70026E-06	1,639205465	0,011996587	1,75188502
	0,045854858	0,002987964	7,692466928	0,003300518
	0,001814491	6,70056E-05	0,005984188	7,414753608
	2,29919E-05	0,022335307	0,009662133	0,002939386
	0,001787817	0,003633411	9,95182E-05	0,004759282

slut

## BALANSLÄGETS\_FASER 11

Silver		0 0
Alunit	0 0	
Anglesit	0 0	
Baryt	0 0	
Be(OH)2(am)	0 0	
Kalcit	0 0	
Celestin	0 0	
Cerussit	0 0	
Co(OH)2	0 0	
CO2(g)	-3,3 10	
Cr(OH)3(am)	0 0	
Cu(OH)2	0 0	
Dolomit(beställd)	0 0	
Ferrihydrit	0 0	
Cr(OH)3(am)	0 0	
Fluorit	0 0	
Gibbsit	0 0	
Gips	0 0	
Kvicksilver(1)		0 0
# Hydroxylapatit	0 0	
MnHPO4	0 0	
Malakit	0 0	
Ni(OH)2	0 0	
O2(g)	-32 10	
Otavit	0 0	
Pb(OH)2	0 0	
Pyromorfit	0 0	
Rodokrosit	0 0	
SbO2	0 0	
Siderit	0 0	
SiO2(am-ppt)	0 10	
Smithsonit	0 0	
Strontianit	0 0	
# Tyuyamunit	0 0	

```

UO2(OH)2(beta)      0 0
Carnotit           0 0
Hallosyit          0 0
  Zincocit         0 0

```

ANVÄND Lösning 1

SPARA balanslägets\_faser 11

SPARA lösningen 11

slut

YTA 11

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 11 ## använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 11

ANVÄND Lösning 11

SPARA Lösning 21 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 1

H2O -1

0 mol

ANVÄND Lösning 21

Slut

BALANSLÄGETS\_FASER 12

```

  Silver                0 0
  Alunit                0 0
  Anglesit              0 0
  Baryt                 0 0
  Be(OH)2(am)          0 0
  Kalцит                0 0
  Celestin              0 0
  Cerussit              0 0
  Co(OH)2               0 0
  CO2(g)                -3,3 10
  Cu(OH)2               0 0
  Dolomit(beställd)    0 0
  Ferrihydrit           0 0
  Cr(OH)3(am)           0 0
  O2(g)                 -32 10
  Fluorit               0 0
  Gibbsit              0 0
  Gips                  0 0
  Kvikksilver(1)       0 0
  # Hydroxylapatit     0 0
MnHPO4                 0 0
  Malakit               0 0
  Ni(OH)2               0 0
  Otavit                0 0
  Pb(OH)2               0 0
  Pyromorfit           0 0
  Rodokrosit           0 0
  SbO2                  0 0
  Siderit               0 0
  SiO2(am-ppt)         0 0
  Smithsonit           0 0
  Strontianit           0 0
  # Tyuyamunit         0 0

```

```

Zincocit          0 0
UO2(OH)2(beta)   0 0
Carnotit         0 0
Hallosyit        0 0
ANVÄND Lösning 2
SPARA balanslägets_faser 12
SPARA lösningen 12
slut
YTA 12
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 5,44 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 12
ANVÄND Lösning 12
SPARA Lösning 22 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 2
  H2O          -1
  0 mol

ANVÄND Lösning 22
Slut
BALANSLÄGETS_FASER 13

Silver          0 0
Alunit          0 0
Anglesit        0 0
Baryt           0 0
Be(OH)2(am)    0 0
Kalцит         0 0
Celestin        0 0
Cerussit        0 0
Co(OH)2         0 0
CO2(g)          -3,3 10
Cu(OH)2         0 0
Dolomit(beställd) 0 0
Ferrihydrit    0 0
Cr(OH)3(am)    0 0
O2(g)          -32 10
Fluorit         0 0
Gibbsit         0 0
Gips            0 0
Kvicksilver(1) 0 0
# Hydroxylapatit 0 0
MnHPO4         0 0
Malakit         0 0
Ni(OH)2         0 0
Otavit         0 0
Pb(OH)2         0 0
Pyromorfit     0 0
Rodokrosit     0 0
SbO2           0 0
Siderit        0 0
SiO2(am-ppt)   0 0
Smithsonit     0 0
Strontianit    0 0
# Tyuyamunit   0 0
Zincocit       0 0

```

```

UO2(OH)2(beta)          0 0
Carnotit                0 0
Hallosyit               0 0
#Fixa_pH -8.5 Ca(OH)2 10
Använd Lösning 3
SPARA balanslägets_faser 13
SPARA lösningen 13
slut
YTA 13
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 5,90 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 13
ANVÄND Lösning 13
SPARA Lösning 23 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 3
  H2O          -1
  0 mol

ANVÄND Lösning 23
SLUT
BALANSLÄGETS_FASER 14

  Silver                0 0
  Alunit                0 0
  Anglesit              0 0
  Baryt                 0 0
  Be(OH)2(am)          0 0
  Kalцит               0 0
  Celestin              0 0
  Cerussit              0 0
  Co(OH)2               0 0
  CO2(g)                -3,3 10
  Cu(OH)2               0 0
  Dolomit(beställd) 0 0
  Ferrihydrit          0 0
#Fixa_pH -8.5 Ca(OH)2 10
  O2(g)                 -32 10
  Fluorit               0 0
  Gibbsit               0 0
  Gips                  0 0
  Kvikksilver(1)       0 0
# Hydroxylapatit 0 0
  MnHPO4                0 0
  Malakit               0 0
  Ni(OH)2               0 0
  Otavit                0 0
  Pb(OH)2               0 0
  Pyromorfit           0 0
  Rodokrosit           0 0
  SbO2                  0 0
  Siderit               0 0
  SiO2(am-ppt)         0 0
  Smithsonit           0 0
  Strontianit           0 0
# Tyuyamunit 0 0
  Zincocit              0 0

```

```

Cr(OH)3(am)          0 0
UO2(OH)2(beta)      0 0
Carnotit             0 0
Hallosyt            0 0
Använd Lösning 4
SPARA balanslägets_faser 14
SPARA lösningen 14
slut
YTA 14
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 6,35 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 14
ANVÄND Lösning 14
SPARA Lösning 24 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 4
  H2O          -1
  0 mol

ANVÄND Lösning 24
Slut
BALANSLÄGETS_FASER 15
  Silver          0 0
  Alunit          0 0
  Anglesit        0 0
  Baryt           0 0
  Be(OH)2(am)    0 0
  Kalцит          0 0
  Celestin        0 0
  Cerussit        0 0
  Co(OH)2         0 0
  O2(g)           -3,3 10
  Cu(OH)2         0 0
  Dolomit(beställd) 0 0
  Ferrihydrit    0 0
  Cr(OH)3(am)    0 0
  O2(g)          -32 10
  Fluorit        0 0
  Gibbsit        0 0
  Gips           0 0
  Kvicksilver(1)          0 0
# Hydroxylapatit 0 0
  MnHPO4         0 0
  Malakit        0 0
  Ni(OH)2        0 0
  Otavit         0 0
  Pb(OH)2        0 0
  Pyromorfit     0 0
  Rodokrosit     0 0
  SbO2           0 0
  Siderit        0 0
  SiO2(am-ppt)  0 0
  Smithsonit     0 0
  Strontianit    0 0
# Tyuyamunit    0 0
  Zincocit       0 0
UO2(OH)2(beta)  0 0

```

```

Carnotit                0 0
Hallosyit                0 0
#Fixa_pH -8.5 Ca(OH)2 10
Använd Lösning 5
SPARA balanslägets_faser 15
SPARA lösningen 15
slut
YTA 15
  Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
  Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
  -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 6,80 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 15
ANVÄND Lösning 15
SPARA Lösning 25 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 5
  H2O          -1
  0 mol

ANVÄND Lösning 25
Slut
BALANSLÄGETS_FASER 16
  Silver                0 0
  Alunit                0 0
  Anglesit              0 0
  Baryt                 0 0
  Be(OH)2(am)          0 0
  Kalцит              0 0
  Celestin              0 0
  Cerussit              0 0
  Co(OH)2               0 0
  CO2(g)                -3,3 10
  NiS(Gamma)           0 0
  Cu(OH)2               0 0
  Dolomit(beställd) 0 0
  Ferrihydrit          0 0
  O2(g)                 -32 10
  Fluorit              0 0
  Gibbsit              0 0
  Gips                  0 0
  Kviksilver(1)        0 0
# Hydroxylapatit 0 0
  MnHPO4                0 0
  Malakit              0 0
  Ni(OH)2               0 0
  Otavit               0 0
  Pb(OH)2              0 0
  Pyromorfit           0 0
  Rodokrosit           0 0
  SbO2                  0 0
  Siderit              0 0
  SiO2(am-ppt)         0 0
  Smithsonit           0 0
  Strontianit          0 0
# Tyuyamunit          0 0
  Zincocit              0 0
Cr(OH)3(am)            0 0
UO2(OH)2(beta)        0 0

```

```
Carnotit          0 0
Hallosyit         0 0
Använd Lösning 6
SPARA balanslägets_faser 16
SPARA lösningen 16
slut
YTA 16
    Hfo_sOH Ferrihydrit balanslägets_fas 0.005 64200
    Hfo_wOH Ferrihydrit  balanslägets_faser 0,2
    -donnan 1e-008
ANVÄND BALANSLÄGETS_FASER 7,26 kg# använd sedimenterad ferrihydrit som
reaktiv yta
Använd Yta 16
ANVÄND Lösning 16
SPARA Lösning 26 #Gråbergets lakvatten efter mineralernas sedimentering och
sorptionsförlust.
SLUT
REAKTION 6
    H2O          -1
    0 mol

ANVÄND Lösning 26
Slut
```

**BILAGA F**

**BERÄKNINGAR FÖR RAUTUVAARAS MASSBALANS**





**BILAGA G**

**RAUTUVAARAS PHREEQC-SKRIPT (EXEMPEL)**

## KNOPPAR

```

-upprepningar      10000
-konvergens_tolerans 1e-008
-toleranss         1e-015
-stegstorlek       10
-pe_stegstorlek    5

```

## VALD\_FUNKTION

```

-fil                Hannukainen_Yleinen_V4.out
-vald_ut            ja
-hög_precision     ja
-simulering        ja
-läge              ja
-lösning           ja
-avstånd           nej
-tid               nej
-steg              nej
-pH                ja
-pe                ja
-alkaliskhet       ja
-jonisk_styrka     ja
-vatten            ja
-laddningens_balans ja
-sammanlagt        C(4)  N    P    Cl    F    S(6)  Ca    Fe
  K    Mg    Na    Si    Ag    Al    As    Ba    Cd    Co    Cr    Cu
  Hg    Mn    Mo    Ni    Pb    Sb    Se    Sr    Tl    U    Zn

```

## SLUT

## FASER

## Fixa\_pe

```

e- = e-
log_k    0

```

## Slut

## YT\_SORTER

```

2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2 + 2H+
log_k    -6,06
-ej_granskning
##-mol_balans (Hfo_wO)2UO2
Hfo_sOH + UO2+2 = Hfo_sOUO2 + H+
log_k    4,2
-ej_granskning
##-mol_balans (Hfo_sO)2UO2
H2CO3 + Hfo_wOH = Hfo_wOCO2H + H2O
log_k    2,9
H2CO3 + Hfo_wOH = Hfo_wOCO2- + H+ + H2O
log_k    -5,20
CO3-2 + 2Hfo_wOH + UO2+2 = (Hfo_wO)2UO2CO3-2 + 2H+
log_k    2,7
-ej_granskning
##-mol_balans (Hfo_wO)2UO2CO3-2
CO3-2 + Hfo_sOH + UO2+2 = Hfo_sOUO2CO3-2 + H+
log_k    4,33
-ej_granskning
##-mol_balans (Hfo_sO)2UO2CO3-2

```

## Slut

## LÖSNINGENS\_DISPERSION

```

-enheter    mg/kgw

```

N(5)	pH	Temperatur	pe	alkaliskhet	S(6)
		P	Cl	F	
		Ca	Fe	K	Mg
		Na	Si	Ag	Al
		As	Ba	Cd	Co
		Cr	Cu	Hg(0)	Mn
		Mo	Ni	Pb	Sb
Se		Sr	Tl	U	Zn
mg/kgw		mg/kgw	mg/kgw	mg/kgw	mg/kgw som SO4
laddning		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
mg/kgw		mg/kgw	mg/kgw	mg/kgw	
4,950549417			18	7,049450583	40,71121597
0,164621275	0,622522285			3,537193314	0,02851578
204,926476	108,1094207			2,40456336	37,00472201
17,6545667	13,11913464			7,614699317	3,21952E-07
0,840648613	0,001650973			0,162994046	0,000410661
0,031890478	0,001694449			0,545154734	0,000384609
0,547076004	0,016416558			0,045776506	0,001126612
06	9,46439E-06		0,347545682	1,81448E-06	0,241909446
	0,021358528				
4,9523659			7	7,0476341	34,04140623
0,137732709	0,610749366			3,222198436	0,02851578
191,8179035	104,069961			2,360225908	36,63730294
16,47951341	12,06859963			6,433563862	3,21952E-07
0,788059873	0,001630337			0,157383194	0,000407502
0,030407083	0,001596612			0,543509082	0,00038466
0,506712929	0,016357248			0,04234192	0,000989249
06	9,46439E-06		0,33133278	1,81448E-06	0,241922215
	0,020116798				
4,981683287			4	7,018316713	32,14142407
0,130008051	0,603592307			1,878211897	0,02851578
189,994112	103,0811456			2,33860593	36,22184391
16,19852411	11,10225989			6,184088678	3,21952E-07
0,771953571	0,001612644			0,155803781	0,00040423
0,030238746	0,001558892			0,539567383	0,000381757
0,501291777	0,016220529			0,042062916	0,000950548
06	9,46439E-06		0,327874298	1,81448E-06	0,240092939
	0,01984873				
5,149798817			18	6,850201183	97,36366582
0,369188632	0,485149298			8,807814553	0
102,0461831	66,11470949			1,457470867	24,53653054
11,4891492	18,76362423			11,66339093	0
0,828639856	0,001228681			0,114080893	0,000255346
0,009686444	0,001989282			0,320147601	0,000240893
0,27982478	0,010790889			0,012824815	0,001865179
0	0		0,228278127	0	0,151680172
	0,013615129				
5,134636036			7	6,865363964	72,79587794
0,259665581	0,439306594			8,788171488	0
94,59567728	62,15132262			1,307895314	23,93221534
10,20071043	15,56528644			8,092501619	0
0,616451816	0,001133873			0,104426543	0,0002509
0,009215687	0,001532347			0,318845025	0,000240893
0,222765242	0,010556472			0,011714055	0,001305639

0	0	0,209055786	0	0,151622642
	0,011073377			
	5,4617971	4	6,5382029	62,11665174
0,203493703	0,4140983	1,17255698		0
91,51501856	60,40301776	1,223879175		23,0388734
9,120730049	9,913734392	6,208546309		0
0,496989859	0,001082428	0,10002636		0,000248544
0,008990512	0,001278873	0,318130682		0,000240893
0,195852759	0,0104295	0,011148574		0,000991431
0	0	0,201391358	0	0,151592993
	0,009724603			

slut

## BALANSLÄGETS\_FASER 11

Silver		0 0	
Alunit		0 0	
Anglesit		0 0	
Baryt	0 0		
Be(OH)2(am)		0 0	
Kalcit	0 0		
Celestin		0 0	
Cerussit		0 0	
Co(OH)2		0 0	
CO2(g)		-2,5 10	
Cr(OH)3(am)		0 0	
Cu(OH)2		0 0	
Dolomit(beställd)		0 0	
Ferrihydrit	2 0,00106733		
Fluorit		0 0	
Gibbsit	0 0		
Gips		0 0	
Kvicksilver(1)			0 0
Hydroxylapatit	0 0		
Malakit	0 0		
Ni(OH)2		0 0	
O2(g)		-32 10	
Otavit	0 0		
Pb(OH)2		0 0	
Pyromorfit		0 0	
Rodokrosit		0 0	
SbO2		0 0	
Siderit		0 0	
SiO2(am-ppt)		0 10	
Smithsonit		0 0	
Strontianit	0 0		
Tyuyamunit		0 0	
Zincocit		0 0	

Använd Lösning 1

SPARA lösningen 11

SPARA lösningen 11

slut

YTA 11

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 11 ## använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 11

ANVÄND Lösning 11

SPARA Lösning 21 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 1

H2O -1  
0 mol

ANVÄND Lösning 21

Slut

BALANSLÄGETS\_FASER 12

Silver		0 0
Alunit	0 0	
Anglesit		0 0
Baryt	0 0	
Be(OH)2(am)		0 0
Kalcit	0 0	
Celestin		0 0
Cerussit		0 0
Co(OH)2		0 0
CO2(g)	-2,5 10	
Cu(OH)2		0 0
Cr(OH)3(am)		0 0
Dolomit(beställd)		0 0
Ferrihydrit	2 0,00099905	
Fluorit	0 0	
Gibbsit	0 0	
Gips		0 0
Kvicksilver(1)		0 0
Hydroxylapatit	0 0	
Malakit	0 0	
Ni(OH)2		0 0
NiS(Gamma)		0 0
O2(g)	-32 10	
Otavit	0 0	
Pb(OH)2		0 0
Pyromorfit		0 0
Rodokrosit		0 0
SbO2		0 0
Siderit	0 0	
SiO2(am-ppt)		0 0
Smithsonit		0 0
Strontianit	0 0	
Tyuyamunit		0 0
Zincocit		0 0

ANVÄND Lösning 2

SPARA lösningen 12

SPARA lösningen 12

slut

YTA 12

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200  
Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2  
-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 5,44 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 12

ANVÄND Lösning 12

SPARA Lösning 22 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 2

H2O -1  
0 mol

ANVÄND Lösning 22

Slut

BALANSLÄGETS\_FASER 13

Silver		0 0	
Alunit		0 0	
Anglesit		0 0	
Baryt	0 0		
Be(OH)2(am)		0 0	
Kalcit	0 0		
Celestin		0 0	
Cerussit		0 0	
Co(OH)2		0 0	
Cr(OH)3(am)		0 0	
CO2(g)		-2,5 10	
NiS(Gamma)		0 0	
Cu(OH)2		0 0	
Dolomit(beställd)	0 0		
Ferrihydrit	2 0,00098955		
O2(g)		-32 10	
Fluorit	0 0		
Gibbsit	0 0		
Gips		0 0	
Kvicksilver(1)			0 0
Hydroxylapatit	0 0		
Malakit	0 0		
Ni(OH)2		0 0	
Otavit	0 0		
Pb(OH)2		0 0	
Pyromorfit		0 0	
Rodokrosit		0 0	
SbO2		0 0	
Siderit	0 0		
SiO2(am-ppt)		0 0	
Smithsonit		0 0	
Strontianit	0 0		
Tyuyamunit		0 0	
Zincocit		0 0	

ANVÄND Lösning 3

SPARA lösningen 13

SPARA lösningen 13

slut

YTA 13

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 5,90 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 13

ANVÄND Lösning 13

SPARA Lösning 23 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 3

H2O -1  
0 mol

ANVÄND Lösning 23

Slut

BALANSLÄGETS\_FASER 14

Silver		0 0	
Alunit		0 0	
Anglesit		0 0	
Baryt	0 0		
Be(OH)2(am)		0 0	
Kalcit	0 0		
Celestin		0 0	
Cerussit		0 0	
Co(OH)2		0 0	
CO2(g)	-2,5 10		
NiS(Gamma)		0 0	
Cu(OH)2		0 0	
Cr(OH)3(am)		0 0	
Dolomit(beställd)		0 0	
Ferrihydrit	2 0,00053149		
O2(g)	-32 10		
Fluorit		0 0	
Gibbsit	0 0		
Gips		0 0	
Kvicksilver(1)			0 0
Hydroxylapatit	0 0		
Malakit	0 0		
Ni(OH)2		0 0	
Otavit	0 0		
Pb(OH)2		0 0	
Pyromorfit		0 0	
Rodokrosit		0 0	
SbO2		0 0	
Siderit	0 0		
SiO2(am-ppt)		0 0	
Smithsonit		0 0	
Strontianit	0 0		
Tyuyamunit		0 0	
Zincocit		0 0	

Använd Lösning 4

SPARA lösningen 14

SPARA lösningen 14

slut

YTA 14

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 6,35 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 14

ANVÄND Lösning 14

SPARA Lösning 24 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 4

H2O -1

0 mol

ANVÄND Lösning 24

Slut

BALANSLÄGETS\_FASER 15

Silver		0 0
Alunit	0 0	
Anglesit	0 0	
Baryt	0 0	
Be(OH)2(am)	0 0	
Kalcit	0 0	
Celestin	0 0	
Cerussit	0 0	
Co(OH)2	0 0	
CO2(g)	-2,5 10	
NiS(Gamma)	0 0	
Cu(OH)2	0 0	
Cr(OH)3(am)	0 0	
Dolomit(beställd)	0 0	
Ferrihydrit	2 0,00049269	
O2(g)	-32 10	
Fluorit	0 0	
Gibbsit	0 0	
Gips	0 0	
Kvicksilver(1)		0 0
Hydroxylapatit	0 0	
Malakit	0 0	
Ni(OH)2	0 0	
Otavit	0 0	
Pb(OH)2	0 0	
Pyromorfit	0 0	
Rodokrosit	0 0	
SbO2	0 0	
Siderit	0 0	
SiO2(am-ppt)	0 0	
Smithsonit	0 0	
Strontianit	0 0	
Tyuyamunit	0 0	
Zincocit	0 0	

Använd Lösning 5

SPARA lösningen 15

SPARA lösningen 15

slut

YTA 15

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 6,80 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 15

ANVÄND Lösning 15

SPARA Lösning 25 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 5

H2O -1

0 mol

ANVÄND Lösning 25

Slut

BALANSLÄGETS\_FASER 16

Silver		0 0
Alunit	0 0	

Anglesit		0 0
Baryt	0 0	
Be(OH)2(am)		0 0
Kalcit	0 0	
Celestin		0 0
Cerussit		0 0
Co(OH)2		0 0
CO2(g)	-2,5 10	
Cr(OH)3(am)		0 0
NiS(Gamma)		0 0
Cu(OH)2		0 0
Dolomit(beställd)		0 0
Ferrihydrit	2 0,00047664	
O2(g)	-32 10	
Fluorit	0 0	
Gibbsit	0 0	
Gips		0 0
Kvicksilver(1)		0 0
Hydroxylapatit	0 0	
Malakit	0 0	
Ni(OH)2		0 0
Otavit	0 0	
Pb(OH)2		0 0
Pyromorfit		0 0
Rodokrosit		0 0
SbO2		0 0
Siderit	0 0	
SiO2(am-ppt)		0 0
Smithsonit		0 0
Strontianit	0 0	
Tyuyamunit		0 0
Zincocit		0 0

Använd Lösning 6

SPARA lösningen 16

SPARA lösningen 16

slut

YTA 16

Hfo\_sOH Ferrihydrit balanslägets\_fas 0.005 64200

Hfo\_wOH Ferrihydrit balanslägets\_faser 0,2

-donnan 1e-008

ANVÄND BALANSLÄGETS\_FASER 7,26 kg# använd sedimenterad ferrihydrit som reaktiv yta

Använd Yta 16

ANVÄND Lösning 16

SPARA Lösning 26 #Gråbergets lakvatten efter mineralernas sedimentering och sorptionsförlust.

SLUT

REAKTION 6

H2O -1

0 mol

ANVÄND Lösning 26

Slut