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TECHNICAL MEMORANDUM

TO: Vicky Peacey, Resolution Copper

FROM: Ted Eary, Enchemica

DATE: July 17, 2018

SUBJECT: Alternative 3 - Near West Modified Proposed Action – Thin Lift/PAG Cell: Prediction of Operational Tailings Circuit Solute Chemistry

1 INTRODUCTION

The draft environmental impact statement (DEIS) for the Resolution Copper mine includes assessment of the following tailings storage facility alternatives:

- Alternative 1: No Action
- Alternative 2: Near West Modified Proposed Action
- Alternative 3: Near West Modified Proposed Action – Thin Lift/PAG Cell
- Alternative 4: Silver King Filtered
- Alternative 5: Peg Leg
- Alternative 6: Skunk Camp

Water balances models have been developed for each of these alternatives. These water balance models have been augmented by the addition of chemical balances. The purpose of this memo is to provide a description of the predictions of the chemical balance and resulting solute chemistry for Alternative 3.

2 MODEL SETUP

2.1 Software

The predictive model was developed with a combination of GoldSim (version 12.0) and PHREEQC (Parkhurst and Appelo, 2013; version 3.0). GoldSim was used for the water and chemical mass balance components of the model. PHREEQC was used to simulate reactive processes that affect water chemistry. The WATEQ4F.DAT thermodynamic database was used for the PHREEQC calculations. The chemical portions of the model included calculations for:

- Ca, Mg, Na, K, Cl, HCO_3, SO_4, Si, F, NO_3-N, Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag, Tl, Zn, and pH

The PHREEQC geochemical model was integrated directly into the GoldSim water balance model, so that changes to water chemistry resulting from reactive processes are made at each time step in the simulations and incorporated directly into the simulation results.

2.2 Input Data

A common set of inputs for water chemistry and flow rates from the block cave mine was used for all TSF alternatives. These inputs are described in Enchemica (2018).

2.3 Simulation Period

The simulation period was 41 years, which represents the life of mine per the mine plan of operations. A 3-day time step was used. Both the water balance and PHREEQC calculations are conducted at each time step. A 3-day timestep was found to be short enough prevent potential mass transfer warnings from GoldSim while being long enough to yield reasonably short model run times.

3 WATER BALANCE

A model of the water balance for Alternative 3 was developed by KCB. The boundaries of the KCB water balance model included the West Plant, tailings storage facility (TSF), and seepage collection systems. The details of the water balance relevant to the solute balance are provided in KCB (2018).

3.1 Makeup Water

The KCB water balance model provided calculations of the rate of reclaim water flow to the West Plant and the total demand for additional makeup water needed for ore processing at the West Plant. There are four sources of water for ore processing:

- **Reclaim water**: Excess water pumped from the Pyrite Pond – this flow is provided by the KCB water balance model.
- **Makeup water:**
  - **Ore moisture**: Ore entering the West Plant is estimated to contain 4% by weight of water.
  - **Block cave sump water**: The block cave mine is expected to have an excess amount of water that will be pumped to the surface providing a source of makeup water.
  - **Freshwater**: The demand for makeup water beyond the flow from the block cave mine will be comprised of a mixture of freshwater from the Central Arizona Project canal and well fields.

Figure 3-1 shows simulation results for process water sources. Freshwater makeup is generally the largest water source for ore processing followed by reclaim water, block cave sump water, and ore moisture. At certain times the model indicates low flows of overflow water, such as near the end of mining when the available water as reclaim water and block cave sump water are exceed what would be needed for ore processing at the West Plant.

Each of the makeup water sources has a different chemical composition. The details about the chemical compositions of makeup water are provided in Enchemica (2018).

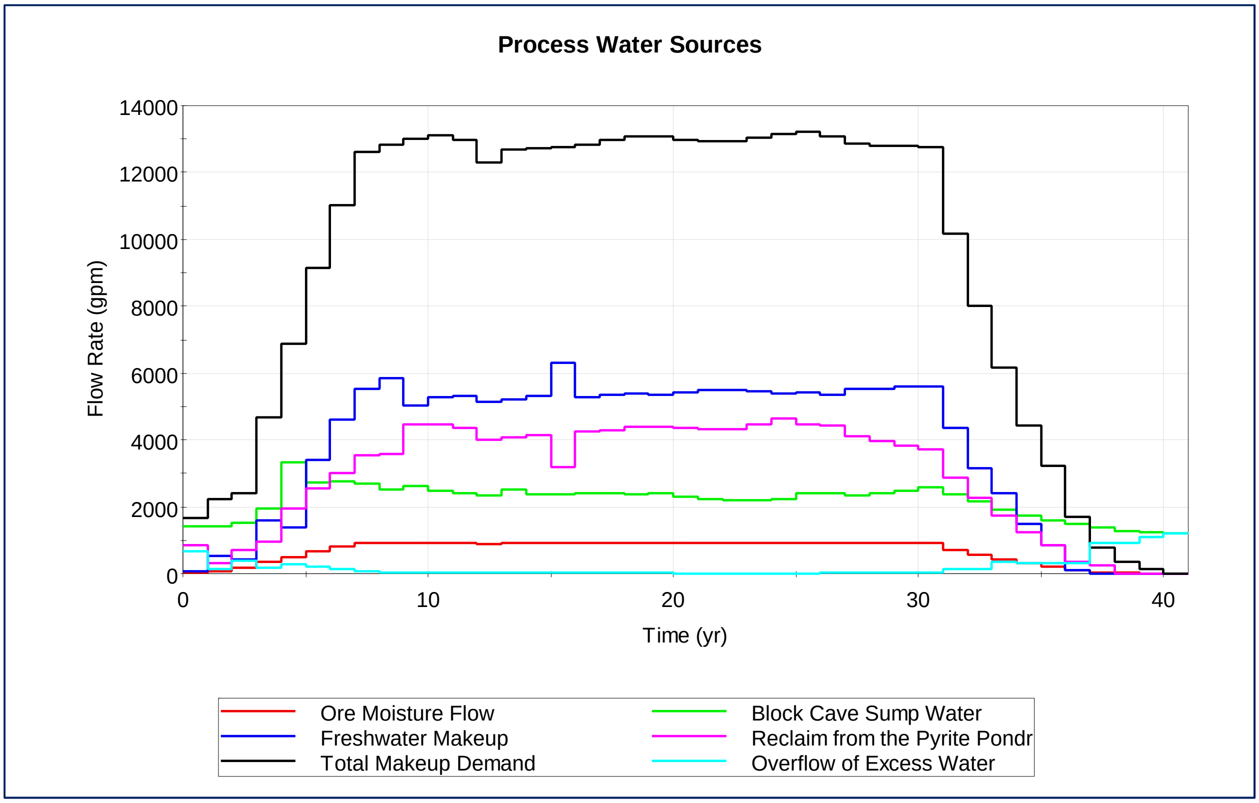

Figure 3-1. Simulation results for process water sources

4 Calculation Sequence for Solute Chemistry

The calculation sequence in the solute model is:

- Chemical loads are defined for all water sources entering the TSF system by multiplication of flow rates times concentrations. Descriptions of the source water chemistries are in Enchemica (2018).
- The chemical loads are converted to concentrations at locations of water mixing and storage.
- The concentrations are equilibrated with PHREEQC for aqueous speciation, solubility, and adsorption. The set of equilibria processes for PHREEQC are described in Enchemica (2018). There are four locations where PHREEQC is applied to produced equilibrated water chemistries:
  - **West Plant**: mixture of water entering the Plant
  - **Embankment**: water contained in the pore space of the embankment
  - **Seepage Collection Ponds**: The seepage collection ponds are lined and assumed to not leak. The water balance adds up all the seepage collections ponds into a single water reservoir. Predictions of water chemistry are made for this single reservoir.
  - **Pyrite Pond**: storage of water over the pyrite tailings used for reclaim to the West Plant. The Pyrite Pond and tailings comprise a single source of seepage in the water balance indicated to have the potential to bypass collection systems; hence, designated as Lost Seepage. In the solute balance model, the chemistry of Lost Seepage is assumed to be the same as the equilibrated chemistry determined for the Pyrite Pond. Reactions and mixing of Lost Seepage with groundwater in flow paths from the TSF are not included in the modeling logic. Transport of Lost Seepage along flow paths is the subject of associated modeling studies by Montgomery and Associates.

- Equilibrated water chemistries are multiplied by flow rates to move chemical loads through the water distribution system.

5 RESULTS

A full set of results from the model are provided in tables below as annual average concentrations. The tables are organized as follows:

- Table 5-1: Pyrite Pond and Lost Seepage
- Table 5-2: Seepage Collection Ponds
- Table 5-3: Embankment

5.1 Pyrite Pond and Lost Seepage

Examples of model results are shown in Figure 5-1 for the Pyrite Pond and Lost Seepage as average annual concentrations for the 41-year operational mine life. For this alternative, Lost Seepage represents seepage from the Pyrite Pond and that bypasses collection systems and enter the bedrock foundation. The Lost Seepage is assumed to have the same water chemistry as its source of the Pyrite Pond. The following observations for the Pyrite Pond-Lost Seepage water chemistry:

- Figure 5-1a - pH: The pH is predicted to range between about 7.8 and 7.9 for the entirety of the 41-year operational mine life.
- Figure 5-1b – major anions: Sulfate is the dominant anion at concentrations from 850 to 2000 mg/L. Chloride is next in importance with concentrations from 50 to 170 mg/L followed by HCO_3 at concentrations from 20 to 28 mg/L, nitrate-N at concentrations from 3.2 to 6.4 mg/L, and fluoride at concentrations from 2.2 to 2.8 mg/L.
- Figure 5-1c – divalent metals: Zinc is predicted to have the highest concentrations, ranging between 0.2 and 2 mg/L. Copper concentrations are predicted to be relatively constant at about 0.2 mg/L due to equilibrium with malachite. Concentrations of the other divalent metals are not limited by solubility. Nickel and cobalt are predicted to range from 0.02 to 0.2 mg/L. Concentrations of cadmium and lead are predicted to be less than 0.01 and 0.002 mg/L, respectively.
- Figure 5-1d: anionic metals and metalloids: Molybdenum concentrations are the highest for this group at concentrations from 0.2 to 0.7 mg/L. Selenium is next at concentrations from 0.04 to 0.27 mg/L. Arsenic concentrations lower but variable at concentrations from 0.0002 to 0.003 mg/L.

The trends shown in Figure 5-1 are due to the following factors:

- Concentrations of most solutes start out lowest during the early years due to low rates of ore production and a relatively higher amount of freshwater makeup during the initial period of operation.
- Concentrations of most solutes increase during the early years of operations due to evaporation and then tend to remain relatively constant (years 10 to 30) as the ratio of freshwater makeup balances the evaporative losses.
- Concentrations of most solutes reach maximums near the end of the operational period. This result is due to a decrease in the amount of freshwater makeup needed near the end of the operational period because most of the water requirement for ore processing can be satisfied by reclaim from the Pyrite Pond and water from the block cave. At about years 35 to 36, reclaim from the Pyrite Pond is the largest source of process water for the West Plant (Figure 3-1). The Pyrite Pond is subject to evaporation; hence, increases in concentrations occur due to evapoconcentration but without compensational dilution by freshwater makeup.

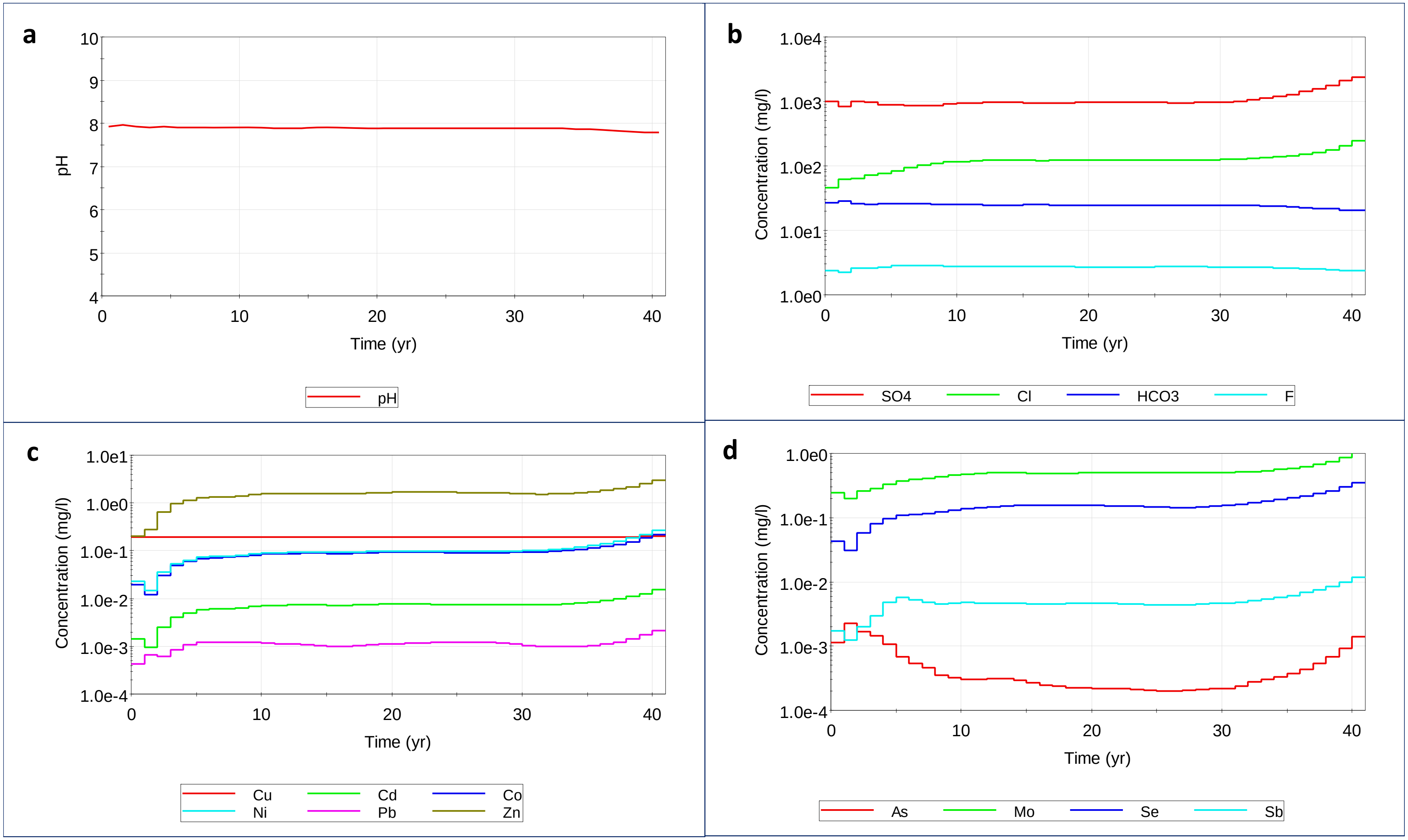

Figure 5-1. Predictions of average annual concentrations in Lost Seepage for a) pH, b) major anions, c) divalent metals, and d) anionic metals and metalloids

Table 5-1. Predictions of average annual concentrations for the Pyrite Pond and Lost Seepage

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	212	58	127	83	46	26	1002	8.5	2.4	3.9	0.94	0.0017	0.00115	0.017	0.00050	0.06	0.001	0.010	0.020	0.194	0.001718	0.0004	0.18	0.247	0.023	0.042	0.009	0.0007	0.20	7.92	1559
2	171	52	120	68	62	28	826	7.1	2.2	3.5	0.74	0.0013	0.00224	0.018	0.00023	0.08	0.001	0.007	0.012	0.193	0.00172	0.0007	0.11	0.199	0.015	0.031	0.006	0.0005	0.27	7.96	1329
3	223	58	132	84	64	26	1010	9.1	2.6	4.9	0.91	0.0020	0.00167	0.017	0.00027	0.09	0.002	0.016	0.031	0.194	0.001718	0.0006	0.30	0.260	0.035	0.058	0.013	0.0008	0.64	7.91	1603
4	226	52	124	85	72	26	969	12.0	2.6	4.9	0.97	0.0030	0.00144	0.017	0.00024	0.12	0.004	0.024	0.049	0.194	0.001717	0.0008	0.49	0.288	0.054	0.081	0.020	0.0015	0.97	7.91	1563
5	210	45	115	88	76	26	882	16.3	2.7	4.2	1.05	0.0048	0.00108	0.018	0.00019	0.14	0.005	0.028	0.060	0.194	0.001717	0.0011	0.59	0.327	0.064	0.095	0.024	0.0031	1.13	7.91	1456
6	213	42	113	97	83	26	880	18.5	2.8	3.8	1.06	0.0058	0.00068	0.018	0.00016	0.17	0.006	0.032	0.069	0.194	0.001717	0.0012	0.69	0.377	0.073	0.109	0.028	0.0040	1.28	7.91	1471
7	212	42	114	101	95	26	864	17.9	2.8	3.4	1.06	0.0052	0.00054	0.018	0.00014	0.18	0.006	0.033	0.071	0.194	0.001717	0.0012	0.72	0.398	0.075	0.114	0.029	0.0033	1.33	7.91	1469
8	211	41	114	103	103	26	856	17.0	2.8	3.2	1.06	0.0048	0.00046	0.018	0.00013	0.19	0.006	0.034	0.073	0.194	0.001717	0.0012	0.74	0.412	0.077	0.116	0.029	0.0028	1.36	7.91	1469
9	216	42	117	107	110	26	872	16.4	2.8	3.2	1.02	0.0046	0.00035	0.018	0.00012	0.20	0.006	0.035	0.076	0.194	0.001717	0.0012	0.77	0.431	0.080	0.122	0.030	0.0026	1.42	7.91	1503
10	227	43	121	114	115	25	913	16.7	2.8	3.3	0.95	0.0047	0.00032	0.018	0.00012	0.20	0.007	0.037	0.081	0.194	0.001717	0.0012	0.83	0.460	0.085	0.132	0.033	0.0025	1.52	7.90	1572
11	234	44	122	118	118	25	937	16.8	2.7	3.3	0.91	0.0047	0.00031	0.018	0.00012	0.21	0.007	0.038	0.085	0.195	0.001717	0.0012	0.86	0.478	0.089	0.139	0.034	0.0025	1.57	7.90	1613
12	237	44	124	121	120	25	951	16.7	2.7	3.4	0.89	0.0047	0.00030	0.018	0.00013	0.21	0.007	0.039	0.087	0.195	0.001717	0.0011	0.87	0.489	0.091	0.144	0.035	0.0024	1.60	7.89	1637
13	240	45	125	122	122	25	961	16.6	2.7	3.4	0.88	0.0047	0.00031	0.018	0.00013	0.21	0.007	0.039	0.088	0.195	0.001717	0.0011	0.88	0.496	0.093	0.149	0.035	0.0023	1.60	7.89	1654
14	241	45	126	123	122	25	965	16.7	2.7	3.5	0.87	0.0047	0.00031	0.018	0.00014	0.22	0.007	0.038	0.089	0.195	0.001717	0.0011	0.87	0.499	0.094	0.152	0.035	0.0023	1.59	7.89	1662
15	241	45	125	123	122	25	964	16.6	2.7	3.5	0.87	0.0047	0.00030	0.018	0.00014	0.22	0.007	0.038	0.089	0.195	0.001717	0.0010	0.87	0.500	0.094	0.155	0.036	0.0023	1.58	7.89	1661
16	237	44	124	120	122	25	948	16.1	2.7	3.4	0.89	0.0045	0.00027	0.018	0.00014	0.21	0.007	0.037	0.088	0.195	0.001717	0.0010	0.85	0.489	0.093	0.154	0.035	0.0022	1.55	7.89	1635
17	235	44	123	119	121	25	937	15.8	2.7	3.3	0.91	0.0045	0.00025	0.018	0.00014	0.21	0.007	0.037	0.088	0.195	0.001717	0.0010	0.84	0.482	0.093	0.154	0.035	0.0022	1.54	7.90	1618
18	238	44	123	120	122	25	947	15.9	2.7	3.3	0.89	0.0045	0.00024	0.018	0.00014	0.21	0.007	0.038	0.090	0.195	0.001717	0.0010	0.86	0.488	0.095	0.156	0.036	0.0022	1.59	7.89	1634
19	240	44	124	121	122	25	954	16.0	2.7	3.3	0.88	0.0046	0.00023	0.018	0.00014	0.22	0.008	0.038	0.091	0.195	0.001717	0.0011	0.88	0.493	0.096	0.157	0.036	0.0022	1.63	7.89	1644
20	241	44	124	122	123	25	958	16.1	2.7	3.3	0.88	0.0046	0.00022	0.018	0.00014	0.22	0.008	0.039	0.092	0.195	0.001717	0.0011	0.89	0.496	0.097	0.157	0.036	0.0022	1.66	7.89	1651
21	242	44	124	122	123	25	961	16.1	2.7	3.3	0.87	0.0046	0.00022	0.018	0.00015	0.22	0.008	0.039	0.092	0.195	0.001717	0.0011	0.90	0.499	0.098	0.155	0.037	0.0022	1.67	7.89	1656
22	242	45	125	123	124	25	964	15.9	2.7	3.3	0.87	0.0046	0.00022	0.018	0.00015	0.22	0.008	0.039	0.092	0.195	0.001717	0.0012	0.91	0.502	0.098	0.153	0.037	0.0022	1.68	7.89	1662
23	243	45	125	124	125	25	967	15.7	2.7	3.3	0.87	0.0045	0.00022	0.018	0.00016	0.22	0.008	0.039	0.092	0.195	0.001717	0.0012	0.92	0.504	0.098	0.151	0.036	0.0021	1.68	7.89	1667
24	243	45	125	124	125	25	966	15.5	2.7	3.3	0.87	0.0045	0.00021	0.018	0.00016	0.22	0.008	0.040	0.092	0.195	0.001717	0.0012	0.93	0.504	0.098	0.149	0.036	0.0020	1.68	7.89	1665
25	242	45	124	124	124	25	963	15.3	2.7	3.2	0.87	0.0044	0.00020	0.018	0.00016	0.22	0.008	0.040	0.092	0.195	0.001717	0.0012	0.94	0.503	0.098	0.147	0.036	0.0020	1.67	7.89	1660
26	241	44	124	123	123	25	958	15.1	2.7	3.2	0.88	0.0044	0.00020	0.018	0.00016	0.21	0.007	0.040	0.091	0.195	0.001717	0.0012	0.94	0.500	0.097	0.145	0.036	0.0020	1.66	7.89	1651
27	240	44	123	122	122	25	955	15.2	2.7	3.2	0.88	0.0044	0.00020	0.018	0.00016	0.21	0.007	0.040	0.090	0.195	0.001717	0.0012	0.94	0.497	0.097	0.143	0.036	0.0020	1.65	7.89	1644
28	240	44	123	122	122	25	956	15.4	2.7	3.2	0.88	0.0044	0.00020	0.018	0.00017	0.21	0.007	0.040	0.090	0.195	0.001717	0.0012	0.95	0.498	0.097	0.143	0.036	0.0021	1.63	7.89	1646
29	241	45	124	123	123	25	960	15.6	2.7	3.2	0.88	0.0045	0.00021	0.018	0.00018	0.21	0.007	0.040	0.091	0.195	0.001717	0.0012	0.95	0.500	0.098	0.146	0.036	0.0021	1.61	7.89	1654
30	244	45	126	124	125	25	971	16.0	2.7	3.2	0.86	0.0046	0.00022	0.018	0.00019	0.22	0.007	0.040	0.092	0.195	0.001717	0.0011	0.96	0.504	0.099	0.151	0.036	0.0022	1.59	7.89	1673
31	246	46	128	125	126	25	983	16.3	2.7	3.2	0.85	0.0047	0.00022	0.018	0.00019	0.22	0.007	0.040	0.093	0.195	0.001717	0.0010	0.96	0.507	0.100	0.157	0.037	0.0023	1.56	7.89	1692
32	251	47	131	126	128	25	1006	16.9	2.7	3.2	0.83	0.0048	0.00024	0.017	0.00021	0.22	0.007	0.040	0.094	0.195	0.001717	0.0010	0.96	0.512	0.102	0.162	0.037	0.0024	1.54	7.89	1728
33	260	50	137	130	131	24	1052	17.9	2.7	3.4	0.79	0.0051	0.00027	0.017	0.00025	0.23	0.007	0.040	0.096	0.195	0.001717	0.0010	0.97	0.524	0.106	0.170	0.038	0.0025	1.54	7.88	1801
34	274	53	144	135	135	24	1112	18.9	2.7	3.7	0.74	0.0053	0.00031	0.017	0.00030	0.24	0.008	0.041	0.101	0.195	0.001718	0.0010	1.00	0.539	0.111	0.179	0.039	0.0027	1.57	7.88	1894
35	292	57	153	140	139	24	1190	19.3	2.6	4.0	0.69	0.0057	0.00034	0.017	0.00037	0.24	0.008	0.043	0.106	0.195	0.001718	0.0010	1.05	0.559	0.119	0.190	0.040	0.0030	1.62	7.87	2014
36	315	62	164	148	144	23	1288	19.3	2.6	4.3	0.63	0.0062	0.00037	0.017	0.00046	0.25	0.008	0.045	0.114	0.196	0.001719	0.0010	1.12	0.584	0.129	0.202	0.042	0.0033	1.69	7.86	2163
37	345	68	178	158	151	23	1421	19.3	2.5	4.6	0.56	0.0068	0.00044	0.016	0.00058	0.27	0.009	0.048	0.125	0.196	0.00172	0.0011	1.22	0.622	0.143	0.218	0.045	0.0037	1.82	7.84	2366
38	382	76	197	172	162	22	1583	19.3	2.5	5.0	0.49	0.0076	0.00054	0.016	0.00075	0.29	0.010	0.052	0.137	0.197	0.001721	0.0012	1.35	0.668	0.160	0.234	0.049	0.0042	1.97	7.83	2615
39	430	87	222	191	179	21	1790	19.3	2.4	5.6	0.43	0.0085	0.00069	0.015	0.00098	0.32	0.011	0.057	0.155	0.197	0.001723	0.0014	1.53	0.738	0.184	0.257	0.054	0.0047	2.19	7.81	2942
40	504	102	259	222	207	21	2104	19.2	2.4	6.7	0.35	0.0100	0.00092	0.015	0.00133	0.37	0.013	0.066	0.184	0.198	0.001726	0.0017	1.83	0.855	0.222	0.297	0.062	0.0055	2.56	7.79	3444
41	559	122	307	262	247	20	2408	19.2	2.4	8.1	0.30	0.0118	0.00141	0.015	0.00179	0.44	0.015	0.078	0.222	0.199	0.001727	0.0021	2.23	1.007	0.272	0.349	0.073	0.0065	3.03	7.78	3952

Table 5-2. Predictions of average annual concentrations for the Seepage Collection Ponds

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	195	57	127	79	44	24	961	6.9	2.4	2.8	0.59	0.0014	0.00083	0.016	0.00015	0.05	0.001	0.006	0.010	0.194	0.001715	0.00038	0.08	0.227	0.012	0.030	0.006	0.0006	0.22	7.87	1488
2	184	53	123	75	58	25	883	6.7	2.5	3.5	0.80	0.0014	0.00085	0.016	0.00012	0.07	0.001	0.009	0.013	0.195	0.001716	0.00043	0.11	0.226	0.015	0.037	0.007	0.0005	0.35	7.89	1404
3	226	54	123	81	59	23	990	8.4	2.4	4.6	0.72	0.0022	0.00074	0.016	0.00012	0.08	0.003	0.020	0.038	0.196	0.001717	0.00058	0.37	0.260	0.041	0.069	0.017	0.0009	0.81	7.85	1561
4	203	44	110	79	68	24	856	11.8	2.5	4.1	0.87	0.0031	0.00064	0.017	0.00011	0.11	0.004	0.025	0.050	0.195	0.001716	0.00079	0.50	0.280	0.052	0.082	0.021	0.0017	0.99	7.88	1393
5	189	38	101	83	68	24	787	16.1	2.6	3.5	1.00	0.0051	0.00046	0.017	0.00009	0.14	0.005	0.027	0.058	0.195	0.001715	0.00104	0.56	0.316	0.060	0.092	0.023	0.0036	1.09	7.89	1304
6	188	37	100	88	77	25	770	16.3	2.7	3.1	1.04	0.0051	0.00033	0.018	0.00008	0.15	0.005	0.029	0.062	0.195	0.001715	0.00107	0.61	0.344	0.065	0.099	0.025	0.0035	1.16	7.89	1298
7	185	36	99	89	86	25	749	15.3	2.7	2.8	1.07	0.0044	0.00027	0.018	0.00008	0.16	0.005	0.030	0.062	0.195	0.001715	0.00103	0.63	0.354	0.065	0.101	0.025	0.0027	1.18	7.89	1281
8	183	35	99	90	91	24	736	14.3	2.7	2.6	1.07	0.0040	0.00023	0.018	0.00007	0.16	0.005	0.030	0.063	0.195	0.001715	0.00101	0.64	0.361	0.065	0.102	0.026	0.0023	1.19	7.89	1270
9	182	35	98	90	93	24	727	13.4	2.7	2.6	1.04	0.0037	0.00021	0.018	0.00007	0.16	0.005	0.030	0.063	0.195	0.001715	0.00098	0.64	0.364	0.066	0.103	0.026	0.0020	1.19	7.89	1260
10	189	36	100	95	95	24	755	13.7	2.6	2.6	0.96	0.0038	0.00022	0.017	0.00008	0.17	0.006	0.031	0.067	0.195	0.001715	0.00097	0.68	0.384	0.070	0.110	0.027	0.0020	1.26	7.87	1304
11	195	36	101	98	97	23	775	13.8	2.6	2.7	0.93	0.0039	0.00022	0.017	0.00008	0.17	0.006	0.032	0.070	0.195	0.001715	0.00096	0.71	0.397	0.073	0.116	0.028	0.0020	1.31	7.87	1338
12	197	36	102	100	99	23	783	13.7	2.6	2.7	0.92	0.0039	0.00021	0.017	0.00008	0.18	0.006	0.032	0.071	0.195	0.001715	0.00093	0.71	0.404	0.074	0.119	0.029	0.0020	1.32	7.87	1352
13	196	36	102	100	99	23	781	13.5	2.6	2.7	0.90	0.0038	0.00021	0.017	0.00008	0.17	0.006	0.031	0.071	0.195	0.001715	0.00089	0.71	0.404	0.074	0.121	0.029	0.0019	1.30	7.87	1348
14	195	36	102	100	99	23	777	13.4	2.6	2.7	0.89	0.0038	0.00020	0.017	0.00008	0.17	0.006	0.031	0.071	0.195	0.001715	0.00085	0.70	0.404	0.074	0.123	0.029	0.0019	1.28	7.86	1343
15	195	36	101	99	99	23	774	13.3	2.6	2.7	0.88	0.0038	0.00019	0.017	0.00008	0.17	0.006	0.031	0.071	0.195	0.001715	0.00082	0.69	0.403	0.074	0.125	0.029	0.0019	1.27	7.86	1338
16	191	35	100	97	98	23	758	12.9	2.5	2.6	0.89	0.0036	0.00019	0.017	0.00008	0.17	0.006	0.030	0.070	0.195	0.001715	0.00079	0.67	0.393	0.073	0.124	0.028	0.0018	1.24	7.86	1312
17	189	35	99	95	97	23	748	12.6	2.5	2.6	0.90	0.0036	0.00019	0.017	0.00008	0.17	0.006	0.030	0.069	0.195	0.001715	0.00080	0.66	0.387	0.073	0.123	0.028	0.0017	1.23	7.86	1296
18	192	35	99	97	98	23	759	12.8	2.5	2.6	0.89	0.0036	0.00019	0.017	0.00009	0.17	0.006	0.030	0.071	0.195	0.001715	0.00082	0.68	0.393	0.075	0.125	0.029	0.0018	1.27	7.86	1313
19	194	36	100	98	99	23	768	12.9	2.6	2.6	0.88	0.0037	0.00019	0.017	0.00009	0.17	0.006	0.031	0.073	0.195	0.001715	0.00086	0.70	0.398	0.076	0.127	0.029	0.0018	1.31	7.86	1328
20	196	36	101	99	100	23	774	13.0	2.6	2.6	0.87	0.0037	0.00018	0.017	0.00009	0.18	0.006	0.031	0.074	0.195	0.001715	0.00089	0.71	0.402	0.077	0.127	0.029	0.0018	1.34	7.86	1338
21	196	36	101	99	100	23	775	13.0	2.6	2.7	0.86	0.0037	0.00017	0.017	0.00009	0.18	0.006	0.031	0.074	0.195	0.001716	0.00091	0.72	0.404	0.078	0.126	0.030	0.0018	1.35	7.86	1340
22	195	36	100	99	99	22	772	12.8	2.5	2.6	0.85	0.0037	0.00017	0.017	0.00010	0.17	0.006	0.031	0.074	0.195	0.001716	0.00092	0.72	0.403	0.077	0.124	0.029	0.0018	1.35	7.85	1334
23	193	35	99	98	99	22	765	12.5	2.5	2.6	0.84	0.0036	0.00017	0.017	0.00010	0.17	0.006	0.031	0.073	0.196	0.001716	0.00093	0.72	0.400	0.077	0.121	0.029	0.0017	1.33	7.85	1322
24	192	35	99	98	98	22	760	12.3	2.5	2.5	0.83	0.0035	0.00017	0.017	0.00010	0.17	0.006	0.031	0.072	0.196	0.001716	0.00093	0.72	0.398	0.076	0.119	0.029	0.0016	1.32	7.84	1314
25	191	35	98	97	98	22	757	12.1	2.5	2.5	0.82	0.0035	0.00016	0.017	0.00010	0.17	0.006	0.031	0.072	0.196	0.001716	0.00094	0.73	0.396	0.076	0.117	0.029	0.0016	1.32	7.84	1308
26	190	35	97	97	97	22	753	12.0	2.5	2.5	0.81	0.0035	0.00015	0.017	0.00010	0.17	0.006	0.031	0.071	0.196	0.001716	0.00094	0.73	0.394	0.076	0.115	0.028	0.0016	1.31	7.84	1301
27	189	35	97	96	96	22	750	12.0	2.4	2.4	0.80	0.0035	0.00015	0.016	0.00011	0.17	0.006	0.031	0.071	0.196	0.001716	0.00094	0.73	0.391	0.075	0.113	0.028	0.0016	1.30	7.84	1295
28	189	35	97	96	96	22	751	12.0	2.5	2.5	0.81	0.0035	0.00015	0.017	0.00011	0.17	0.006	0.031	0.071	0.196	0.001716	0.00094	0.74	0.392	0.075	0.113	0.028	0.0016	1.29	7.84	1296
29	189	35	97	96	96	22	751	12.1	2.5	2.5	0.81	0.0035	0.00015	0.017	0.00012	0.17	0.006	0.031	0.071	0.196	0.001716	0.00092	0.74	0.392	0.076	0.114	0.028	0.0016	1.28	7.84	1297
30	188	35	96	95	96	22	745	12.1	2.5	2.4	0.81	0.0035	0.00017	0.017	0.00013	0.17	0.006	0.031	0.070	0.196	0.001716	0.00088	0.74	0.387	0.076	0.114	0.028	0.0016	1.24	7.84	1287
31	185	34	95	93	94	21	734	12.1	2.4	2.4	0.80	0.0035	0.00021	0.017	0.00016	0.16	0.006	0.030	0.070	0.196	0.001717	0.00084	0.73	0.379	0.076	0.114	0.027	0.0016	1.20	7.83	1266
32	181	34	92	91	91	21	719	11.9	2.3	2.3	0.76	0.0034	0.00027	0.017	0.00021	0.16	0.005	0.029	0.069	0.196	0.001718	0.00080	0.71	0.368	0.076	0.112	0.026	0.0016	1.15	7.82	1238
33	178	33	91	88	89	20	707	11.8	2.3	2.3	0.73	0.0033	0.00031	0.016	0.00024	0.16	0.005	0.028	0.068	0.197	0.001719	0.00076	0.70	0.358	0.075	0.110	0.026	0.0016	1.11	7.80	1216
34	176	33	89	87	87	19	698	11.7	2.2	2.3	0.70	0.0033	0.00034	0.016	0.00025	0.15	0.005	0.027	0.066	0.197	0.00172	0.00073	0.69	0.349	0.074	0.109	0.025	0.0016	1.08	7.79	1199
35	173	32	88	84	84	19	690	11.6	2.1	2.3	0.66	0.0033	0.00037	0.016	0.00028	0.15	0.005	0.026	0.066	0.198	0.001722	0.00071	0.67	0.340	0.074	0.107	0.024	0.0016	1.04	7.78	1180
36	172	32	87	83	82	18	686	11.3	2.0	2.3	0.62	0.0032	0.00039	0.015	0.00030	0.14	0.005	0.026	0.065	0.198	0.001725	0.00068	0.66	0.332	0.074	0.106	0.024	0.0016	1.02	7.76	1170
37	172	33	86	82	80	17	688	11.1	2.0	2.3	0.57	0.0033	0.00043	0.015	0.00034	0.14	0.005	0.025	0.065	0.199	0.001729	0.00067	0.66	0.326	0.075	0.105	0.024	0.0016	1.00	7.74	1169
38	173	33	87	81	79	17	696	10.9	1.9	2.3	0.52	0.0033	0.00047	0.014	0.00038	0.14	0.005	0.025	0.065	0.200	0.001733	0.00066	0.67	0.322	0.076	0.105	0.023	0.0017	0.99	7.72	1176
39	166	32	81	76	73	15	666	10.2	1.7	2.3	0.44	0.0031	0.00066	0.014	0.00052	0.13	0.004	0.023	0.064	0.202	0.001748	0.00064	0.66	0.297	0.078	0.097	0.021	0.0016	0.92	7.67	1117
40	164	32	79	73	70	13	658	9.6	1.5	2.3	0.36	0.0031	0.00082	0.014	0.00064	0.13	0.004	0.022	0.065	0.205	0.001766	0.00063	0.67	0.285	0.081	0.093	0.020	0.0015	0.89	7.62	1098
41	165	33	81	74	70	13	668	9.3	1.4	2.4	0.32	0.0031	0.00096	0.014	0.00074	0.13	0.004	0.022	0.068	0.206	0.001776	0.00066	0.70	0.288	0.086	0.095	0.021	0.0016	0.90	7.60	1113

Table 5-3. Predictions of average annual concentrations for the Embankment

	Ca	Mg	Na	K	Cl	HCO_3	SO_4	Si	F	NO_3-N	Al	Sb	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Se	Ag	Tl	Zn	pH	TDS
Year	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
1	215	64	142	88	49	23	1068	6.8	2.7	2.7	0.62	0.0015	0.000150	0.015	0.000068	0.048	0.001	0.006	0.010	0.181	0.0016	0.0004	0.0734	0.252	0.012	0.034	0.006	0.0007	0.24	7.86	1649
2	204	59	136	83	65	24	981	6.5	2.7	3.5	0.85	0.0015	0.000194	0.016	0.000039	0.074	0.001	0.010	0.014	0.185	0.001638	0.0005	0.1192	0.253	0.016	0.041	0.008	0.0006	0.39	7.88	1555
3	247	59	135	88	64	22	1088	8.4	2.6	4.7	0.75	0.0024	0.000141	0.016	0.000044	0.088	0.004	0.022	0.042	0.185	0.00163	0.0006	0.4046	0.287	0.044	0.076	0.019	0.0010	0.90	7.85	1711
4	221	48	120	86	75	24	935	12.3	2.7	4.1	0.93	0.0034	0.000125	0.017	0.000047	0.121	0.005	0.027	0.054	0.188	0.001659	0.0009	0.5382	0.307	0.056	0.090	0.023	0.0018	1.09	7.88	1519
5	200	40	108	88	72	25	836	16.7	2.8	3.4	1.05	0.0054	0.000098	0.018	0.000045	0.144	0.005	0.029	0.061	0.190	0.001677	0.0011	0.5962	0.338	0.063	0.099	0.025	0.0039	1.16	7.90	1384
6	196	38	105	92	81	25	805	16.7	2.8	3.0	1.08	0.0053	0.000067	0.018	0.000044	0.157	0.006	0.031	0.064	0.190	0.001683	0.0011	0.6395	0.361	0.067	0.104	0.026	0.0036	1.22	7.90	1356
7	191	37	103	93	89	25	776	15.6	2.8	2.8	1.11	0.0045	0.000051	0.018	0.000042	0.164	0.005	0.031	0.064	0.189	0.001675	0.0011	0.6489	0.368	0.067	0.105	0.026	0.0028	1.23	7.91	1327
8	188	36	102	93	94	25	759	14.5	2.8	2.6	1.10	0.0041	0.000043	0.018	0.000040	0.168	0.005	0.031	0.064	0.187	0.001659	0.0010	0.6548	0.374	0.067	0.105	0.026	0.0024	1.23	7.90	1308
9	187	36	101	93	96	25	748	13.6	2.8	2.5	1.08	0.0038	0.000035	0.018	0.000039	0.169	0.005	0.031	0.064	0.185	0.001637	0.0010	0.6583	0.375	0.067	0.106	0.027	0.0021	1.23	7.90	1295
10	195	37	103	98	99	24	780	13.9	2.7	2.6	1.00	0.0040	0.000030	0.018	0.000039	0.174	0.006	0.032	0.069	0.185	0.001634	0.0010	0.7019	0.397	0.072	0.114	0.028	0.0021	1.31	7.89	1347
11	201	37	105	102	101	24	801	14.1	2.7	2.7	0.97	0.0040	0.000028	0.018	0.000039	0.179	0.006	0.033	0.072	0.186	0.001646	0.0010	0.7280	0.412	0.075	0.120	0.030	0.0021	1.36	7.89	1383
12	203	38	106	103	103	24	808	13.9	2.7	2.7	0.96	0.0040	0.000027	0.018	0.000038	0.181	0.006	0.033	0.073	0.186	0.001647	0.0010	0.7327	0.419	0.076	0.124	0.030	0.0020	1.36	7.89	1395
13	202	37	106	103	103	24	805	13.7	2.7	2.7	0.95	0.0039	0.000027	0.017	0.000037	0.180	0.006	0.033	0.073	0.185	0.001635	0.0009	0.7224	0.419	0.076	0.126	0.030	0.0020	1.34	7.88	1391
14	201	37	105	103	102	24	800	13.6	2.7	2.7	0.94	0.0039	0.000027	0.017	0.000037	0.179	0.006	0.032	0.073	0.184	0.001622	0.0009	0.7100	0.417	0.075	0.127	0.030	0.0020	1.32	7.88	1383
15	200	37	104	102	102	24	796	13.5	2.6	2.7	0.93	0.0039	0.000026	0.017	0.000036	0.179	0.006	0.032	0.073	0.182	0.001611	0.0008	0.7028	0.417	0.075	0.129	0.030	0.0019	1.31	7.88	1377
16	196	36	103	100	101	24	780	13.1	2.6	2.6	0.94	0.0037	0.000025	0.017	0.000036	0.176	0.006	0.031	0.071	0.181	0.0016	0.0008	0.6844	0.406	0.074	0.128	0.029	0.0018	1.28	7.88	1350
17	194	36	102	98	101	24	771	12.8	2.6	2.6	0.96	0.0037	0.000024	0.017	0.000036	0.176	0.006	0.031	0.071	0.181	0.001599	0.0008	0.6777	0.400	0.073	0.127	0.029	0.0018	1.27	7.88	1336
18	198	36	103	100	102	24	783	13.0	2.6	2.6	0.95	0.0038	0.000023	0.017	0.000036	0.178	0.006	0.031	0.073	0.182	0.001608	0.0008	0.6959	0.407	0.076	0.130	0.030	0.0018	1.32	7.88	1356
19	200	37	104	101	103	24	793	13.2	2.7	2.6	0.94	0.0038	0.000022	0.017	0.000037	0.180	0.006	0.032	0.075	0.183	0.001619	0.0009	0.7132	0.413	0.077	0.132	0.030	0.0019	1.36	7.88	1373
20	202	37	104	102	103	24	798	13.3	2.7	2.7	0.94	0.0039	0.000021	0.017	0.000038	0.181	0.006	0.032	0.076	0.184	0.001622	0.0009	0.7253	0.417	0.078	0.132	0.031	0.0019	1.39	7.88	1381
21	202	37	104	102	103	24	797	13.2	2.6	2.7	0.93	0.0039	0.000021	0.017	0.000038	0.181	0.006	0.033	0.076	0.183	0.001616	0.0009	0.7314	0.418	0.078	0.130	0.031	0.0019	1.39	7.88	1380
22	201	37	104	102	103	24	794	13.0	2.6	2.6	0.92	0.0038	0.000020	0.017	0.000039	0.180	0.006	0.033	0.075	0.182	0.001606	0.0009	0.7342	0.417	0.078	0.128	0.030	0.0018	1.39	7.87	1374
23	199	36	103	102	102	23	788	12.8	2.6	2.6	0.91	0.0037	0.000018	0.017	0.000038	0.178	0.006	0.032	0.074	0.180	0.001593	0.0010	0.7334	0.415	0.077	0.125	0.030	0.0018	1.38	7.87	1364
24	197	36	102	101	102	23	783	12.5	2.6	2.5	0.91	0.0037	0.000017	0.017	0.000038	0.177	0.006	0.032	0.073	0.179	0.001581	0.0010	0.7339	0.413	0.076	0.123	0.030	0.0017	1.37	7.87	1355
25	196	36	102	101	101	23	779	12.3	2.6	2.5	0.90	0.0036	0.000015	0.017	0.000038	0.176	0.006	0.032	0.073	0.178	0.001569	0.0010	0.7368	0.411	0.076	0.121	0.030	0.0017	1.36	7.87	1348
26	195	36	101	100	101	23	774	12.2	2.6	2.5	0.89	0.0036	0.000015	0.017	0.000038	0.174	0.006	0.032	0.072	0.176	0.001559	0.0010	0.7389	0.408	0.075	0.119	0.030	0.0016	1.35	7.86	1340
27	195	36	101	100	100	23	773	12.2	2.5	2.5	0.89	0.0036	0.000014	0.017	0.000038	0.174	0.006	0.032	0.072	0.176	0.001556	0.0010	0.7425	0.407	0.075	0.118	0.029	0.0017	1.35	7.86	1336
28	195	36	101	100	100	23	774	12.3	2.6	2.5	0.90	0.0036	0.000014	0.017	0.000038	0.174	0.006	0.032	0.072	0.177	0.001565	0.0010	0.7482	0.408	0.075	0.118	0.030	0.0017	1.34	7.87	1340
29	196	36	101	100	101	23	776	12.4	2.6	2.5	0.91	0.0036	0.000013	0.017	0.000038	0.175	0.006	0.032	0.072	0.178	0.001576	0.0010	0.7509	0.409	0.075	0.119	0.030	0.0017	1.33	7.87	1344
30	196	36	102	100	101	23	776	12.5	2.6	2.5	0.92	0.0037	0.000012	0.017	0.000036	0.175	0.006	0.032	0.072	0.179	0.001583	0.0009	0.7489	0.409	0.075	0.121	0.030	0.0017	1.31	7.87	1344
31	195	36	101	100	101	23	774	12.6	2.6	2.4	0.93	0.0037	0.000010	0.017	0.000035	0.175	0.006	0.032	0.072	0.179	0.001583	0.0009	0.7414	0.406	0.075	0.122	0.029	0.0017	1.28	7.87	1339
32	193	36	101	99	100	23	767	12.5	2.6	2.4	0.92	0.0036	0.000009	0.017	0.000033	0.173	0.006	0.032	0.071	0.178	0.001572	0.0009	0.7279	0.401	0.074	0.121	0.029	0.0017	1.25	7.87	1327
33	189	35	99	97	98	23	753	12.4	2.5	2.3	0.91	0.0036	0.000009	0.016	0.000032	0.170	0.006	0.031	0.069	0.175	0.001544	0.0008	0.7084	0.393	0.072	0.120	0.028	0.0017	1.22	7.86	1303
34	185	34	97	94	95	22	737	12.1	2.5	2.3	0.89	0.0035	0.000008	0.016	0.000031	0.165	0.005	0.030	0.067	0.170	0.001506	0.0008	0.6857	0.382	0.070	0.117	0.028	0.0017	1.18	7.85	1273
35	180	34	94	91	92	22	718	11.8	2.4	2.2	0.86	0.0034	0.000008	0.016	0.000029	0.160	0.005	0.029	0.065	0.165	0.001463	0.0008	0.6615	0.369	0.068	0.115	0.027	0.0017	1.13	7.84	1239
36	175	33	92	88	88	21	698	11.5	2.3	2.2	0.83	0.0033	0.000007	0.015	0.000028	0.154	0.005	0.028	0.063	0.160	0.001415	0.0007	0.6364	0.356	0.066	0.111	0.026	0.0017	1.09	7.83	1203
37	169	32	89	85	85	20	676	11.1	2.2	2.1	0.80	0.0032	0.000007	0.015	0.000027	0.148	0.005	0.027	0.060	0.154	0.001364	0.0007	0.6108	0.342	0.063	0.108	0.025	0.0016	1.04	7.82	1164
38	163	31	85	81	81	20	651	10.7	2.2	2.0	0.77	0.0031	0.000007	0.014	0.000026	0.141	0.0047	0.0256	0.0577	0.148	0.00131	0.0007	0.5837	0.327	0.061	0.103	0.024	0.0016	1.00	7.80	1120
39	157	30	83	78	78	19	629	10.4	2.1	1.9	0.74	0.0030	0.000007	0.013	0.000025	0.136	0.0045	0.0247	0.0556	0.143	0.001266	0.00063	0.56155	0.315	0.058	0.099	0.023	0.0015	0.96	7.79	1082
40	153	29	81	76	76	19	615	10.2	2.0	1.9	0.72	0.0029	0.000007	0.013	0.000024	0.132	4.4E-03	2.4E-02	5.4E-02	1.4E-01	1.2E-03	6.2E-04	5.5E-01	3.1E-01	5.7E-02	9.7E-02	2.2E-02	1.5E-03	9.4E-01	7.78	1056
41	150	28.4	79.2	74.7	74.6	18.4	603	10.0	1.9969	1.8387	0.7081	0.0029	0.000007	0.0129	0.0000237	0.1299	4.3E-03	2.4E-02	5.3E-02	1.4E-01	1.2E-03	6.1E-04	5.4E-01	3.0E-01	5.6E-02	9.5E-02	2.2E-02	1.5E-03	9.2E-01	7.77	1036

6 References

Enchemica (2018) Water Chemistry Inputs for Operational Models of Tailings Circuit Solute Chemistry. Technical Memo from T. Eary (Enchemica) to V. Peacey (Resolution Copper), July 18, 2018.

KCB (2018) DEIS Design Alternative 3B – Near West Modified Proposed Action (High-Density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell), Draft Technical Memorandum, Klohn Crippen Berger, May 4, 2018.

Parkhurst, D.L. and Appelo, C.A.J. (2013) Description of Input and Examples for PHREEQC Version 3 – A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations. U.S. Geological Survey Techniques and Methods, Book 6, Chapter A43, 497 p, available only at http://pubs.usgs.gov/tm/06/a43.

RESOLUTION
COPPER

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July 20, 2018

Ms. Mary Rasmussen
US Forest Service
Supervisor's Office
2324 East McDowell Road
Phoenix, AZ 85006-2496

Subject: Response to Analysis Data Request #1 – Request for Analysis of Tailings Seepage – Item #2 Tailings Solute Modeling.

Dear Ms. Rasmussen,

In partial response to your letter dated March 8, 2018, the following documents are attached as requested:

2. **Tailings Solute Modeling**: It is our understanding that the water balance and geochemical modeling for tailings solute is being updated, specific to each alternative tailings storage facility, and including specific analysis of oxidation potential of the embankment. There is an expectation that modeling would cover both operational and post-closure time frames.

Request: RCM to provide USFS with block cave geochemical modeling.

RCM Response: As requested, please see the attached technical memorandums by Enchemica dated July 17, 2018 for the following tailing storage facilities (TSF):

- *Alternative 2 - Near West Modified Proposed Action: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 3 - Near West Modified Proposed Action – Thin Lift/PAG Cell: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 4 - Silver King Filtered: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 5 - Peg Leg: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Alternative 6 - Skunk Camp: Prediction of Operational Tailings Circuit Solute Chemistry*
- *Common Inputs Common to All Operational Models of Tailings Circuit Solute Chemistry*

Overall, there are no substantive differences in predictive solute chemistry for the alternative TSF sites with the exception of Alternative 4 (Silver King). The solute balances are useful tools for TSF alternatives comparison, but it is also worth noting that the model likely over predicts solute chemistry due to several conservative assumptions:

1. No mitigations have been applied to the water chemistry
2. Water from the block cave mine, which has the poorest water quality and highest solute load, has first priority to meet the water demand at the West Plant (concentrator).
3. Makeup water needed at the end of the operational period are sourced from the Pyrite Pond and water from the block cave. The decrease in the amount of freshwater makeup results in less dilution of the combined effects of evaporation and inflow of chemical loads from the block cave.

Once a selected TSF has been identified, additional mitigation approaches may be incorporated as needed.

Sincerely,

Vicky Peacey,

Senior Manager, Environment, Permitting and Approvals; Resolution Copper Company, as Manager of Resolution Copper Mining, LLC

Cc: Ms. Mary Morissette; Senior Environmental Specialist; Resolution Copper Company

Enclosure(s)

Technical Memorandum by Enchemica (2018), *Alternative 2 - Near West Modified Proposed Action: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 3 - Near West Modified Proposed Action – Thin Lift/PAG Cell: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 4 - Silver King Filtered: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 5 - Peg Leg: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Alternative 6 - Skunk Camp: Prediction of Operational Tailings Circuit Solute Chemistry*

Technical Memorandum by Enchemica (2018), *Common Inputs Common to All Operational Models of Tailings Circuit Solute Chemistry*