Appendix E

Calibration of Mass-Balance Model for Embarrass River Watersheds for Surface Water Runoff Water Quality

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Silver

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.11	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.11	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.11	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.16	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	0.1	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	0.008	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.008	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	39	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	174	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	1	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	9	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	11	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	0	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	1	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	40	(µg/s)
	mass flux in river at PM-13	M_r13 =	236	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.10	(µg/l)
	concentration in river at PM-13	C_r13 =	0.10	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.2)	(µg/l)
	Observed concentration in river at PM-13		ND (0.2)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Aluminum

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.12	(mg/l)
	concentration of surface water into PM-13	C_s13 =	0.12	(mg/l)
	concentration of WWTP discharge	C_sBab =	0.12	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.01325	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.5788	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(mg/l)
	concentration of ground water flow into PM-12	C_g12 =	0.025	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.025	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	43	(mg/l)
	mass flux of surface water into PM-13	M_s13 =	190	(mg/l)
	mass flux of Babbitt WWTP	M_sBab =	1	(mg/l)
	concentration of Area 5 Pit NW discharge	M_spit =	1	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	179	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/l)
	mass flux of ground water into PM-12	M_g12 =	1	(mg/l)
	mass flux of ground water into PM-13	M_g13 =	3	(mg/l)

Mass Balance	mass flux in river at PM-12	M_r12 =	45	(mg/s)
	mass flux in river at PM-13	M_r13 =	417	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.114	(mg/l)
	concentration in river at PM-13	C_r13 =	0.184	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		0.099	(mg/l)
	Observed concentration in river at PM-13		0.192	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Arsenic

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.75	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.75	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.75	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	1.325	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	2.905	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	2.73	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	2.73	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	268	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	1189	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	7	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	75	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	329	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	66	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	325	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	341	(µg/s)
	mass flux in river at PM-13	M_r13 =	2258	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.87	(µg/l)
	concentration in river at PM-13	C_r13 =	1.00	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (2)	(µg/l)
	Observed concentration in river at PM-13		ND (2)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Boron

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	27	(µg/l)
	concentration of surface water into PM-13	C_s13 =	27	(µg/l)
	concentration of WWTP discharge	C_sBab =	27	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	131.5	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	330	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	21.2	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	21.2	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	9631	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	42794	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	252	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	7406	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	37356	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	516	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	2526	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	10399	(µg/s)
	mass flux in river at PM-13	M_r13 =	100481	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	26.64	(µg/l)
	concentration in river at PM-13	C_r13 =	44.38	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (35)	(µg/l)
	Observed concentration in river at PM-13		44.3	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Barium

Input Flow Data	surface water flow into PM-12	Q_s12 =	11.54	(cfs)
	surface water flow into PM-13	Q_s13 =	50.77	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	16	(µg/l)
	concentration of surface water into PM-13	C_s13 =	16	(µg/l)
	concentration of WWTP discharge	C_sBab =	16	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	4.4	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	92.98	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	68.1	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	68.1	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	12.73	(cfs)
	flow in river at PM-13	Q_r13 =	73.70	(cfs)
	flow check	Q_ck =	73.70	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	5225	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	22989	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	149	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	248	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	10525	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	1657	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	8114	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	7032	(µg/s)
	mass flux in river at PM-13	M_r13 =	48908	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	19.52	(µg/l)
	concentration in river at PM-13	C_r13 =	23.45	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		15.50	(µg/l)
	Observed concentration in river at PM-13		27.80	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Beryllium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.1	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.1	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.1	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.1	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	0.75	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	0.023	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.023	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	36	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	158	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	1	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	6	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	85	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	1	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	3	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	37	(µg/s)
	mass flux in river at PM-13	M_r13 =	289	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.10	(µg/l)
	concentration in river at PM-13	C_r13 =	0.13	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.2)	(µg/l)
	Observed concentration in river at PM-13		ND (0.2)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Calcium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	15	(mg/l)
	concentration of surface water into PM-13	C_s13 =	15	(mg/l)
	concentration of WWTP discharge	C_sBab =	15	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	95.35	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	59.78	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	19	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	19	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	5350	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	23774	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	140	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	5370	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	6767	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	462	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	2264	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	5953	(mg/s)
	mass flux in river at PM-13	M_r13 =	44128	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	15.25	(mg/l)
	concentration in river at PM-13	C_r13 =	19.49	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		13.4	(mg/l)
	Observed concentration in river at PM-13		19.9	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Cadmium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.08	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.08	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.08	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.1	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	0.188	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	0.3	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.3	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	29	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	127	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	1	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	6	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	21	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	7	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	36	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	37	(µg/s)
	mass flux in river at PM-13	M_r13 =	226	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.09	(µg/l)
	concentration in river at PM-13	C_r13 =	0.10	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.2)	(µg/l)
	Observed concentration in river at PM-13		ND (0.2)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Chloride

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	6.5	(mg/l)
	concentration of surface water into PM-13	C_s13 =	6.5	(mg/l)
	concentration of WWTP discharge	C_sBab =	6.5	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	5.95	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	21.54	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(mg/l)
	concentration of ground water flow into PM-12	C_g12 =	1.8	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	1.8	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	2319	(mg/l)
	mass flux of surface water into PM-13	M_s13 =	10302	(mg/l)
	mass flux of Babbitt WWTP	M_sBab =	61	(mg/l)
	concentration of Area 5 Pit NW discharge	M_spit =	335	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	2438	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/l)
	mass flux of ground water into PM-12	M_g12 =	44	(mg/l)
	mass flux of ground water into PM-13	M_g13 =	214	(mg/l)

Mass Balance	mass flux in river at PM-12	M_r12 =	2423	(mg/s)
	mass flux in river at PM-13	M_r13 =	15713	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	6.21	(mg/l)
	concentration in river at PM-13	C_r13 =	6.94	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		4.49	(mg/l)
	Observed concentration in river at PM-13		6.98	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Cobalt

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.6	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.6	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.6	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.5	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.556	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(µg/l)
	concentration of ground water flow into PM-12	C_g12 =	1.1	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	1.1	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	214	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	951	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	6	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	28	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	176	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	27	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	131	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	246	(µg/s)
	mass flux in river at PM-13	M_r13 =	1533	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.63	(µg/l)
	concentration in river at PM-13	C_r13 =	0.68	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		0.58	(µg/l)
	Observed concentration in river at PM-13		ND (1)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Copper

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	1.5	(µg/l)
	concentration of surface water into PM-13	C_s13 =	1.5	(µg/l)
	concentration of WWTP discharge	C_sBab =	1.5	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	3.45	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	4.555	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(µg/l)
	concentration of ground water flow into PM-12	C_g12 =	4	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	4	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	535	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	2377	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	14	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	194	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	516	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	97	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	477	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	646	(µg/s)
	mass flux in river at PM-13	M_r13 =	4210	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	1.66	(µg/l)
	concentration in river at PM-13	C_r13 =	1.86	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		1.53	(µg/l)
	Observed concentration in river at PM-13		2.00	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Fluoride

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.2	(mg/l)
	concentration of surface water into PM-13	C_s13 =	0.2	(mg/l)
	concentration of WWTP discharge	C_sBab =	0.2	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.125	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.55	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(mg/l)
	concentration of ground water flow into PM-12	C_g12 =	0.385	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.385	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	71	(mg/l)
	mass flux of surface water into PM-13	M_s13 =	317	(mg/l)
	mass flux of Babbitt WWTP	M_sBab =	2	(mg/l)
	concentration of Area 5 Pit NW discharge	M_spit =	7	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	175	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/l)
	mass flux of ground water into PM-12	M_g12 =	9	(mg/l)
	mass flux of ground water into PM-13	M_g13 =	46	(mg/l)

Mass Balance	mass flux in river at PM-12	M_r12 =	83	(mg/s)
	mass flux in river at PM-13	M_r13 =	628	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.21	(mg/l)
	concentration in river at PM-13	C_r13 =	0.28	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		0.10	(mg/l)
	Observed concentration in river at PM-13		0.39	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Iron

Input Flow Data	surface water flow into PM-12	Q_s12 =	1.01	(cfs)
	surface water flow into PM-13	Q_s13 =	0.72	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	0.26	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	2.9	(mg/l)
	concentration of surface water into PM-13	C_s13 =	2.9	(mg/l)
	concentration of WWTP discharge	C_sBab =	2.9	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.038	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	4.594	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(mg/l)
	concentration of ground water flow into PM-12	C_g12 =	0.035	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.035	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	2.20	(cfs)
	flow in river at PM-13	Q_r13 =	11.39	(cfs)
	flow check	Q_ck =	11.39	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	83	(mg/l)
	mass flux of surface water into PM-13	M_s13 =	59	(mg/l)
	mass flux of Babbitt WWTP	M_sBab =	27	(mg/l)
	concentration of Area 5 Pit NW discharge	M_spit =	0	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	520	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/l)
	mass flux of ground water into PM-12	M_g12 =	1	(mg/l)
	mass flux of ground water into PM-13	M_g13 =	4	(mg/l)

Mass Balance	mass flux in river at PM-12	M_r12 =	111	(mg/s)
	mass flux in river at PM-13	M_r13 =	694	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	1.78	(mg/l)
	concentration in river at PM-13	C_r13 =	2.15	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		2.26	(mg/l)
	Observed concentration in river at PM-13		1.70	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Hardness

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	70	(mg/l)
	concentration of surface water into PM-13	C_s13 =	70	(mg/l)
	concentration of WWTP discharge	C_sBab =	70	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	942.7	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	436.6	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(mg/l)
	concentration of ground water flow into PM-12	C_g12 =	87.5	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	87.5	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	24969	(mg/l)
	mass flux of surface water into PM-13	M_s13 =	110947	(mg/l)
	mass flux of Babbitt WWTP	M_sBab =	654	(mg/l)
	concentration of Area 5 Pit NW discharge	M_spit =	53090	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	49423	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/l)
	mass flux of ground water into PM-12	M_g12 =	2130	(mg/l)
	mass flux of ground water into PM-13	M_g13 =	10425	(mg/l)

Mass Balance	mass flux in river at PM-12	M_r12 =	27752	(mg/s)
	mass flux in river at PM-13	M_r13 =	251638	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	71.09	(mg/l)
	concentration in river at PM-13	C_r13 =	111.15	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		53.66	(mg/l)
	Observed concentration in river at PM-13		121.55	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Magnesium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	5.9	(mg/l)
	concentration of surface water into PM-13	C_s13 =	5.9	(mg/l)
	concentration of WWTP discharge	C_sBab =	5.9	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	271	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	69.97	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	10.65	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	10.65	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	2105	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	9351	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	55	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	15262	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	7921	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	259	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	1269	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	2419	(mg/s)
	mass flux in river at PM-13	M_r13 =	36221	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	6.20	(mg/l)
	concentration in river at PM-13	C_r13 =	16.00	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		6.2	(mg/l)
	Observed concentration in river at PM-13		15.9	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Manganese

Input Flow Data	surface water flow into PM-12	Q_s12 =	0.00	(cfs)
	surface water flow into PM-13	Q_s13 =	0.00	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	0.26	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.3	(mg/l)
	concentration of surface water into PM-13	C_s13 =	0.3	(mg/l)
	concentration of WWTP discharge	C_sBab =	0.3	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.65	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.183	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	0.188	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.188	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	1.91	(cfs)
	flow in river at PM-13	Q_r13 =	9.66	(cfs)
	flow check	Q_ck =	9.66	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	0	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	0	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	3	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	5	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	134	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	5	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	22	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	7	(mg/s)
	mass flux in river at PM-13	M_r13 =	168	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.14	(mg/l)
	concentration in river at PM-13	C_r13 =	0.62	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		0.34	(mg/l)
	Observed concentration in river at PM-13		0.20	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Sodium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	6.0	(mg/l)
	concentration of surface water into PM-13	C_s13 =	6.0	(mg/l)
	concentration of WWTP discharge	C_sBab =	6.0	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	119.5	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	44.31	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	4.9	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	4.9	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	2140	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	9510	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	56	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	6730	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	5016	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	119	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	584	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	2315	(mg/s)
	mass flux in river at PM-13	M_r13 =	24155	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	5.93	(mg/l)
	concentration in river at PM-13	C_r13 =	10.67	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		3.0	(mg/l)
	Observed concentration in river at PM-13		12.7	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Nickel

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	1.2	(µg/l)
	concentration of surface water into PM-13	C_s13 =	1.2	(µg/l)
	concentration of WWTP discharge	C_sBab =	1.2	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	5.2	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	6.88	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	(µg/l)
	concentration of ground water flow into PM-12	C_g12 =	7	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	7	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	428	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	1902	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	11	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	293	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	779	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	170	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	834	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	610	(µg/s)
	mass flux in river at PM-13	M_r13 =	4417	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	1.6	(µg/l)
	concentration in river at PM-13	C_r13 =	2.0	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		1.9	(µg/l)
	Observed concentration in river at PM-13		2.1	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Lead

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.15	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.15	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.15	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.3	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.2	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	1.2	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	1.2	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	54	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	238	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	1	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	17	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	136	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	29	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	143	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	84	(µg/s)
	mass flux in river at PM-13	M_r13 =	618	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.22	(µg/l)
	concentration in river at PM-13	C_r13 =	0.27	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.30)	(µg/l)
	Observed concentration in river at PM-13		0.27	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Antimony

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.04	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.04	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.04	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.25	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	0.25	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	1.5	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	1.5	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	14	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	63	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	0	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	14	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	28	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	37	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	179	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	51	(µg/s)
	mass flux in river at PM-13	M_r13 =	336	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.13	(µg/l)
	concentration in river at PM-13	C_r13 =	0.15	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.3)	(µg/l)
	Observed concentration in river at PM-13		ND (0.3)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Selenium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.3	(µg/l)
	concentration of surface water into PM-13	C_s13 =	0.3	(µg/l)
	concentration of WWTP discharge	C_sBab =	0.3	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	1.6	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	1.09	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	2.95	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	2.95	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	107	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	475	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	3	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	90	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	123	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	72	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	351	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	182	(µg/s)
	mass flux in river at PM-13	M_r13 =	1222	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.47	(µg/l)
	concentration in river at PM-13	C_r13 =	0.54	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (1)	(µg/l)
	Observed concentration in river at PM-13		ND (1)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Sulfate

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	4	(mg/l)
	concentration of surface water into PM-13	C_s13 =	4	(mg/l)
	concentration of WWTP discharge	C_sBab =	4	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	1046.3	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	152.4	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	8.5	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	8.5	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	1427	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	6340	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	37	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	58924	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	17252	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	207	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	1013	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	1671	(mg/s)
	mass flux in river at PM-13	M_r13 =	85200	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	4.3	(mg/l)
	concentration in river at PM-13	C_r13 =	37.6	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		4.7	(mg/l)
	Observed concentration in river at PM-13		36.1	(mg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Thallium

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	0.2	(mg/l)
	concentration of surface water into PM-13	C_s13 =	0.2	(mg/l)
	concentration of WWTP discharge	C_sBab =	0.2	(mg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	0.6	(mg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	0.2	(mg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	0.004	(mg/l)
	concentration of ground water flow into PM-13	C_g13 =	0.004	(mg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	71	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	317	(mg/s)
	mass flux of Babbitt WWTP	M_sBab =	2	(mg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	34	(mg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	23	(mg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(mg/s)
	mass flux of ground water into PM-12	M_g12 =	0	(mg/s)
	mass flux of ground water into PM-13	M_g13 =	0	(mg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	73	(mg/s)
	mass flux in river at PM-13	M_r13 =	447	(mg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	0.19	(mg/l)
	concentration in river at PM-13	C_r13 =	0.20	(mg/l)

Observed Concentration	Observed concentration in river at PM-12		ND (0.4)	(µg/l)
	Observed concentration in river at PM-13		ND (0.4)	(µg/l)

Embarrass River Model - Calibration to Baseline Water Quality Data

Parameter: Zinc

Input Flow Data	surface water flow into PM-12	Q_s12 =	12.60	(cfs)
	surface water flow into PM-13	Q_s13 =	56.01	(cfs)
	Babbitt WWTP discharge	Q_sBab =	0.33	(cfs)
	Area 5 Pit NW discharge	Q_spit =	1.99	(cfs)
	LTVSMC Tailings Basin seepage	Q_fs =	4.00	(cfs)
	Hydrometallurgical Residue Cells Liner Leakage	Q_rrs =	0.00	(cfs)
	ground water flow into PM-12	Q_g12 =	0.86	(cfs)
	ground water flow into PM-13	Q_g13 =	4.21	(cfs)

Input Concentration Data	concentration of surface water into PM-12	C_s12 =	16	(µg/l)
	concentration of surface water into PM-13	C_s13 =	16	(µg/l)
	concentration of WWTP discharge	C_sBab =	16	(µg/l)
	concentration of Area 5 Pit NW discharge	C_spit =	3	(µg/l)
	concentration of LTVSMC Tailings Basin seepage	C_fs =	14.35	(µg/l)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	C_rrs =	0	
	concentration of ground water flow into PM-12	C_g12 =	11.5	(µg/l)
	concentration of ground water flow into PM-13	C_g13 =	11.5	(µg/l)

Water Balance	flow in river at PM-12	Q_r12 =	13.79	(cfs)
	flow in river at PM-13	Q_r13 =	80.00	(cfs)
	flow check	Q_ck =	80.00	(cfs)

Calculation of Mass Flux	mass flux of surface water into PM-12	M_s12 =	5707	(µg/s)
	mass flux of surface water into PM-13	M_s13 =	25359	(µg/s)
	mass flux of Babbitt WWTP	M_sBab =	149	(µg/s)
	concentration of Area 5 Pit NW discharge	M_spit =	169	(µg/s)
	concentration of LTVSMC Tailings Basin seepage	M_fs =	1624	(µg/s)
	concentration of Hydrometallurgical Residue Cells Liner Leakage	M_rrs =	0	(µg/s)
	mass flux of ground water into PM-12	M_g12 =	280	(µg/s)
	mass flux of ground water into PM-13	M_g13 =	1370	(µg/s)

Mass Balance	mass flux in river at PM-12	M_r12 =	6137	(µg/s)
	mass flux in river at PM-13	M_r13 =	34659	(µg/s)

Calculated Concentration	concentration in river at PM-12	C_r12 =	15.72	(µg/l)
	concentration in river at PM-13	C_r13 =	15.31	(µg/l)

Observed Concentration	Observed concentration in river at PM-12		18.3	(µg/l)
	Observed concentration in river at PM-13		12.3	(µg/l)