Appendix VII

2022

PE:7008 Non-Compliance Report EMS ID: E218582 (DGI # 214321)

DGI # 214321

PE:7008

To: EnvironmentalNonCompliance@gov.bc.ca

Date: February 15, 2022

Subject: Permit non-compliance report for authorization number PE:7008, EMS # E218582, Settling Pond #1 (SPD), issued under Section 14 of the *Environmental Management Act*.

Attention: *Permit limit, non-compliance for iron - dissolved collected from the discharge of EMS # E218582. Permit limit for iron-dissolved is 0.50 mg/L applied to the discharge. Provincial Emergency Program (PEP) were notified, and a Dangerous Goods Incident (DGI) was generated (DGI# 214321).*

Date of Non-compliance: *2022-01-04 (24-hour period).*

Location of Non-compliance: [5800 Argonaut Main, Quinsam Coal Mine Site]

Nature of Non-compliance:

On January 4th, 2022, SPD discharge water was elevated in iron resulting in 1.19 mg/L. The permit limit for iron- dissolved (Fe-D) at SPD is 0.5 mg/L. Discharge from SPD on January 4th was 1.46 L/s.

The inflow waters pumped from the 3-South Pit (EMS ID: E292130) were below detection limits for Fe-D (<0.005 mg/L). The downstream result at a wetland leading into the outlet of Long Lake, site LLE (EMS ID: E292130) was also elevated in Fe-D (0.855mg/L). Discharge water quality at LLE is compared to B.C. Water Quality Guidelines - Aquatic Life with no specific permit limits existing for this site.

The Fe-D (Fe^{2+}) exceedance at SPD is thought to be attributed to ice cover on the ponds, limiting oxygen in the water. This causes anoxic conditions to occur where iron changes state from Ferric (Fe^{3+}) to Ferrous, (Fe^{2+}). Ferric and ferrous oxides are iron oxides. Ferric means the iron (III) ion Fe^{+3}, and ferrous means iron (II), which is Fe^{+2}. Both ions react with oxygen, but ferric oxide is more common.

In general, Fe^{2+} occurs at high concentrations in anoxic waters with lower pH. SPD had a field pH on surface recorded as 7.72 (neutral). A layer of ice was broken when the samples were collected from both SPD and the downstream location at a wetland area, LLE. Both locations were elevated in Fe^{2+}. The ice would have limited the oxygen circulation in the water causing anoxic conditions to occur increasing the concentration of Fe^{2+}.

Initial Response/Actions Taken & Monitoring Conducted:

On January 17, 2022, the analytical report for January 4th, 2022, sampling event was received through email and uploaded into Quinsam Coal' s database. A permit limit exceedance was flagged for site SPD. PEP was notified with a DGI number generated. Samples were collected for an analysis of general chemistry, total and dissolved metals at SPD and downstream at LLE. Field notes confirm ice did not have to be broken on the subsequent sampling event on January 17th at either location. Additionally, flow rates increased from 1.46 L/s to 46.22 L/s from January 4 to January 17, at SPD, respectively. LLE flow rates were 40.1 L/s and 127.2 L/s on January 4th and January 17th, respectively.

The analytical laboratory was notified and a request to rerun the sample was generated.

On January 18, 2022, a notification e-mail was sent to the following Ministries:

- Ministry of Environment and Climate Change Strategy (ENV) Compliance Reporting Mailbox ENV:EX EnvironmentalCompliance@gov.bc.ca
- Ministry of Energy, Mines and Low Carbon Innovation, Permitting and Reclamation (MEMLCI) EMPR:EX permrecl@gov.bc.ca

On January 21, 2022, the analytical laboratory, Bureau Veritas (BV Labs) had completed the re-analysis of sample SPD-4JAN22-P for under Job# C200857 as outlined in the re-analysis rework form. The results verified that there were no internal labeling errors, and that the client sample identifications matched BV Labs identifications. BV Labs confirmed there were no obvious errors with any of the analytical runs, internal quality control or data transcription on the tests ran. Upon re-analysis, the rework results confirmed the original values reported for dissolved iron.

Table 1 below displays the results from December 2021 to February 2022 sampling events at SPD and LLE. Appendix 1 displays the laboratory analytical details. Further sampling from these sites resulted in Fe-D below 0.50 mg/L and 0.35 mg/L for SPD and LLE, respectively. The February sampling event displayed moderately elevated iron at SPD once again, but results were below the permit limit of 0.5 mg/L. Downstream at LLE remained in low concentrations.

These results indicate the risk to aquatic receptors in the receiving environment is deemed as low.

Table 1: Results from Sampling Events December through February

Site	BV Lab Report No: / Date		C194653 07-Dec-2021	C200857 04-Jan-2022	C203243 17-Jan-2022	C206596 01-Feb-2022	Standard
	Parameter	Unit					Permit Limit
SPD	Fe-T	mg/L	0.517	1.44	0.142	0.767	
SPD	Fe-D	mg/L	0.343	1.19	0.0944	0.398	0.5
							BCWQG-FWAL-Acut
LLE	Fe-T	mg/L	0.317	0.899	0.099	0.226	1
LLE	Fe-D	mg/L	0.271	0.855	0.0764	0.195	0.35

The elevated iron indicates these sites may be experiencing the same type of anoxic conditions where iron changes state and is cycling out of the sediments. Figures 1 and 2 below display the seasonal changes in both Fe^{2+} and Fe^{3+} at both SPD and LLE over time. As observed Fe^{2+} has been elevated in the winter months previously in 2018 and 2020 at SPD and occurs more frequently at LLE due to this area being a natural wetland where iron is attenuated. Mechanisms of natural attenuation of iron by wetland plants and sediment may be classified by plant uptake and adsorption and/or co-precipitation by iron (oxy)hydroxide formed on the root surface of plants.

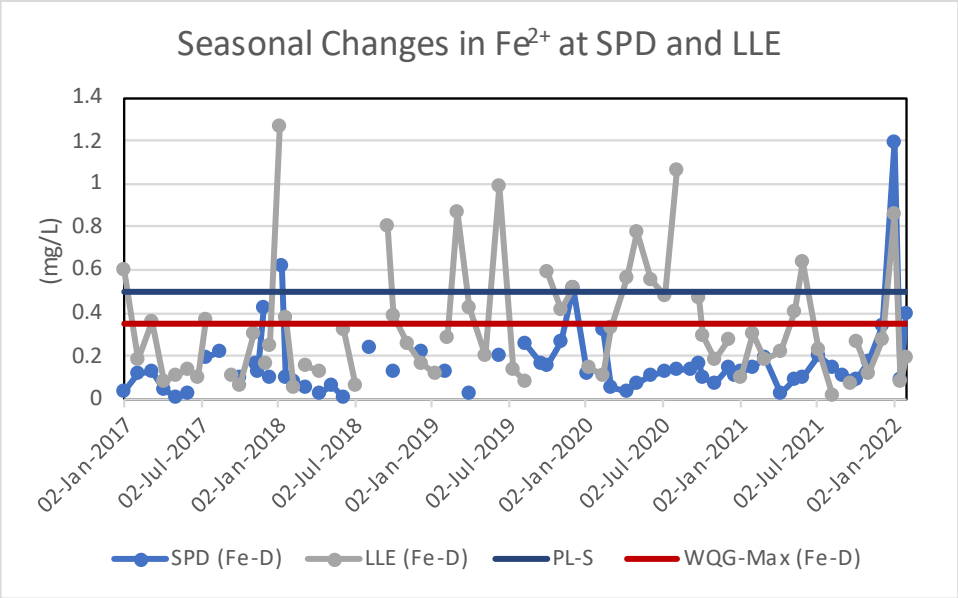

Figure 1: Season Changes in Fe^{2+} at SPD and LLE

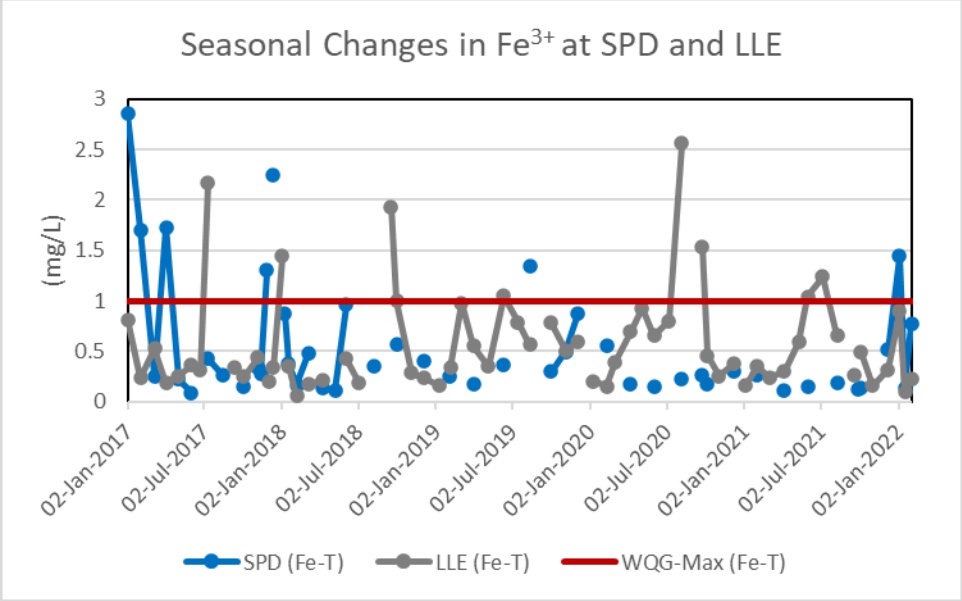

Figure 2: Season Changes in Fe^{3+} at SPD and LLE

SPD discharge flows through a serious of wetlands to the downstream monitoring station LLE prior to entering Long Lake near the outlet (LLO). As displayed in the Google earth image Figure 3 below, the flow path (red line) from SPD to Long Lake is approximately 1.88 km.

Figure 3: South Water Management Flow Path from SPD to LLO

Future Action Items:

Quinsam Environmental Department makes every attempt to lower the risk to aquatic receptors in the receiving environment from mine water and will continue to employ best practices to ensure compliance in the future. If there are any further inquiries into these events, please contact me at the below contact information.

Contact information:

Kathleen Russell BSc.
Environmental Coordinator
QUINSAM COAL
Quinsam Coal
Ph: (250) 286-3224 ext. 225
E-mail: kathleen.russell@quinsam.com

Appendix I

Table 1

EMS ID			E218582																				
Station Description			Settling Pond # 1																				
	Stn.Code		SPD																				
	BV Lab Rpt No		C194653	C194218	C196601	C197690	C200857	C202251	C203243	C204768	C206596												
Date			07-Dec-2021	13-Dec-2021	20-Dec-2021	27-Dec-2021	04-Jan-2022	11-Jan-2022	17-Jan-2022	24-Jan-2022	01-Feb-2022												
Parameter	Unit	Permit Limit										Count	Average	Minimum	Maximum	Geometric Mean	Count <DL	Standard Deviation	1st Quartile	Median	Count of Results Exceeding Standard	3rd Quartile	% of Results Exceeding Standard
pH	pH Units	6.0 - 8.5	7.11	7.18	7.29	7.12	7.72	7.34	6.90	7.20	7.45	9	7.22	6.90	7.45	7.22	0	0.17	7.12	7.20	0	7.34	0.0
Cond	uS/cm		430	310	380	290	550	160	90	120	680	9	334	90	680	276	0	198	160	310	0	430	0.0
SO4-D	mg/L		180	110	140	110	250	51	26	58	290	9	135	26	290	106	0	90	58	110	0	180	0.0
TSS	mg/L	25	1.2	2.4	<1.0	2.0	3.6	<1.0	2.4	<1.0	1.6	9	1.80	<1.0	3.6	1.63	3	0.89	<1.0	1.6	0	2.4	0.0
Alk-T	mg/L		49				72				83	3	68.0	49	83	66.4	0	17.3	60.5	72	0	77.5	0.0
Acidity83	mg/L		12.2				4.6				3.3	3	6.7	3.3	12.2	5.7	0	4.8	4.0	4.6	0	8.4	0.0
Al-T	mg/L		0.0526				0.0334		0.0389		0.0220	4	0.0367	0.0220	0.0526	0.0350	0	0.0127	0.0306	0.0362	0	0.0423	0.0
As-T	mg/L		0.00114				0.00136		0.00017		0.00108	4	0.00094	0.00017	0.00136	0.00073	0	0.00053	0.00085	0.00111	0	0.00119	0.0
Ba-T	mg/L		0.0096				0.0101		0.0019		0.0128	4	0.0086	0.0019	0.0128	0.0070	0	0.0047	0.0077	0.0098	0	0.0108	0.0
B-T	mg/L		0.093				0.108		<0.050		0.115	4	0.0915	<0.050	0.115	0.0872	1	0.0291	0.0822	0.1005	0	0.1098	0.0
Cd-T	mg/L		<0.000010				0.000020		<0.000010		<0.000010	4	0.0000125	<0.000010	0.000020	0.0000119	3	0.0000050	<0.000010	<0.000010	0	0.0000125	0.0
Ca-T	mg/L		49.6				84.8		7.03		69.5	4	52.73	7.03	84.8	37.86	0	33.70	38.96	59.55	0	73.32	0.0
Cr-T	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Co-T	mg/L		0.00045				0.00101		<0.00020		0.00053	4	0.000548	<0.00020	0.00101	0.000469	1	0.000339	0.000388	0.000490	0	0.000650	0.0
Cu-T	mg/L		0.00051				0.00063		0.00082		0.00060	4	0.00064	0.00051	0.00082	0.00063	0	0.00013	0.00058	0.00062	0	0.00068	0.0
Hard-T	mg/L		153				256		23.0		213	4	161.2	23.0	256	117.7	0	101.4	120.5	183.0	0	223.8	0.0
Fe-T	mg/L		0.517				1.44		0.142		0.767	4	0.716	0.142	1.44	0.534	0	0.546	0.423	0.642	0	0.935	0.0
Pb-T	mg/L		<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Mg-T	mg/L		7.05				10.7		1.33		9.45	4	7.13	1.33	10.7	5.55	0	4.15	5.62	8.25	0	9.76	0.0
Mn-T	mg/L		0.0662				0.332		0.0258		0.0955	4	0.1299	0.0258	0.332	0.0858	0	0.1377	0.0561	0.0808	0	0.1546	0.0
Hg-T	mg/L		<0.0000019				<0.0000019				<0.0000019	3	0.00000190	<0.0000019	<0.0000019	0.00000190	3	0.00000000	<0.0000019	<0.0000019	0	<0.0000019	0.0
Mo-T	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Ni-T	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
K-T	mg/L		0.552				0.751		0.100		0.736	4	0.535	0.100	0.751	0.418	0	0.304	0.439	0.644	0	0.740	0.0
S-T	mg/L		43.9				70.0		4.4		63.1	4	45.4	4.4	70.0	30.4	0	29.4	34.0	53.5	0	64.8	0.0
Se-T	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Si-T	mg/L		3.83				3.57		2.91		2.84	4	3.29	2.84	3.83	3.26	0	0.49	2.89	3.24	0	3.64	0.0
Ag-T	mg/L		<0.000020				<0.000020		<0.000020		<0.000020	4	0.0000200	<0.000020	<0.000020	0.0000200	4	0.0000000	<0.000020	<0.000020	0	<0.000020	0.0
Na-T	mg/L		12.8				12.7		1.90		16.6	4	11.00	1.90	16.6	8.46	0	6.33	10.00	12.75	0	13.75	0.0
Sr-T	mg/L		0.290				0.460		0.0351		0.420	4	0.3013	0.0351	0.460	0.2106	0	0.1917	0.2263	0.3550	0	0.4300	0.0
Zn-T	mg/L		<0.0050				0.0084		<0.0050		<0.0050	4	0.00585	<0.0050	0.0084	0.00569	3	0.00170	<0.0050	<0.0050	0	0.00585	0.0
Al-D	mg/L	0.5	0.0304				0.0179		0.0363		0.0088	4	0.0234	0.0088	0.0363	0.0204	0	0.0124	0.0156	0.0241	0	0.0319	0.0
As-D	mg/L		0.00094				0.00098		0.00020		0.00090	4	0.00076	0.00020	0.00098	0.00064	0	0.00037	0.00072	0.00092	0	0.00095	0.0
Ba-D	mg/L		0.0125				0.0119		0.0018		0.0144	4	0.0102	0.0018	0.0144	0.0079	0	0.0057	0.0094	0.0122	0	0.0130	0.0
B-D	mg/L		0.105				0.136		<0.050		0.157	4	0.1120	<0.050	0.157	0.1029	1	0.0465	0.0912	0.1205	0	0.1413	0.0
Be-D	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Cd-D	mg/L		<0.000010				0.000020		<0.000010		<0.000010	4	0.0000125	<0.000010	0.000020	0.0000119	3	0.0000050	<0.000010	<0.000010	0	0.0000125	0.0
Ca-D	mg/L		62.1				96.7		6.50		98.8	4	66.03	6.50	98.8	44.31	0	43.10	48.20	79.40	0	97.22	0.0
Cr-D	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Co-D	mg/L		0.00064				0.00108		<0.00020		0.00039	4	0.000578	<0.00020	0.00108	0.000482	1	0.000380	0.000343	0.000515	0	0.000750	0.0
Cu-D	mg/L	0.02	0.00038				0.00036		0.00022		0.00021	4	0.00029	0.00021	0.00038	0.00028	0	0.00009	0.00022	0.00029	0	0.00037	0.0
Hard-D	mg/L		191				294		21.5		298	4	201.1	21.5	298	137.7	0	129.6	148.6	242.5	0	295.0	0.0
Fe-D	mg/L	0.5	0.343				1.19		0.0944		0.398	4	0.5064	0.0944	1.19	0.3519	0	0.4745	0.2809	0.3705	1	0.5960	25.0
Pb-D	mg/L	0.05	<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Mg-D	mg/L		8.77				12.9		1.29		12.4	4	8.84	1.29	12.9	6.52	0	5.36	6.90	10.58	0	12.52	0.0
Mn-D	mg/L		0.0730				0.386		0.0233		0.0914	4	0.1434	0.0233	0.386	0.0880	0	0.1643	0.0606	0.0822	0	0.1650	0.0
Hg-D	mg/L		<0.0000019				<0.0000019				<0.0000019	3	0.00000190	<0.0000019	<0.0000019	0.00000190	3	0.00000000	<0.0000019	<0.0000019	0	<0.0000019	0.0
Mo-D	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Ni-D	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
K-D	mg/L		0.641				0.872		0.095		0.991	4	0.650	0.095	0.991	0.479	0	0.397	0.505	0.756	0	0.902	0.0
S-D	mg/L		57.9				84.9		4.1		90.3	4	59.3	4.1	90.3	36.7	0	39.4	44.4	71.4	0	86.2	0.0
Se-D	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Si-D	mg/L		3.43				3.49		2.67		2.86	4	3.11	2.67	3.49	3.09	0	0.41	2.81	3.14	0	3.44	0.0
Na-D	mg/L		15.8				15.3		1.80		22.8	4	13.92	1.80	22.8	9.98	0	8.78	11.92	15.55	0	17.55	0.0
Sr-D	mg/L		0.354				0.553		0.0324		0.615	4	0.3886	0.0324	0.615	0.2499	0	0.2623	0.2736	0.4535	0	0.5685	0.0
Zn-D	mg/L	0.2	0.0633				<0.0050		<0.0050		<0.0050	4	0.01958	<0.0050	0.0633	0.00943	3	0.02915	<0.0050	<0.0050	0	0.01957	0.0
O&G	mg/L	10	<1.0								<1.0	2	1.00	<1.0	<1.0	1.00	2	0.00	<1.0	<1.0	0	<1.0	0.0

Table 2

EMS ID			E292130																				
Station Description			Culvert into Long Lake																				
	Stn.Code		LLE																				
	BV Lab Rpt No		C194653	C194218	C196601	C197690	C200857	C202251	C203243	C204768	C206596												
Date			07-Dec-2021	13-Dec-2021	20-Dec-2021	27-Dec-2021	04-Jan-2022	11-Jan-2022	17-Jan-2022	24-Jan-2022	01-Feb-2022												
Parameter	Unit	BCWQG-FWAL-Acute*										Count	Average	Minimum	Maximum	Geometric Mean	Count <DL	Standard Deviation	1st Quartile	Median	Count of Results Exceeding Standard	3rd Quartile	% of Results Exceeding Standard
pH	pH Units	6.5 - 9.0	7.29	7.50	7.25	7.63	6.99	7.25	7.36	7.39	6.99	9	7.29	6.99	7.63	7.29	0	0.21	7.25	7.29	0	7.39	0.0
Cond	uS/cm		220	220	220	440	180	160	140	140	310	9	225	140	440	210	0	96	160	220	0	220	0.0
SO4-D	mg/L		86	82	73	190	62	53	45	43	130	9	84	43	190	75	0	47	53	73	0	86	0.0
TSS	mg/L	25	<1.0				<1.0				<1.0	3	1.00	<1.0	<1.0	1.00	3	0.00	<1.0	<1.0	0	<1.0	0.0
Alk-T	mg/L		29				26				37	3	30.7	26	37	30.3	0	5.7	27.5	29	0	33.0	0.0
Acidity83	mg/L		2.9				1.4				1.7	3	2.0	1.4	2.9	1.9	0	0.8	1.5	1.7	0	2.3	0.0
Al-T	mg/L		0.0833				0.131		0.0744		0.0663	4	0.0888	0.0663	0.131	0.0857	0	0.0290	0.0724	0.0788	0	0.0952	0.0
As-T	mg/L	0.005	0.00084				0.00093		0.00058		0.00067	4	0.00076	0.00058	0.00093	0.00074	0	0.00016	0.00065	0.00076	0	0.00086	0.0
Ba-T	mg/L		0.0078				0.0071		0.0058		0.0112	4	0.0080	0.0058	0.0112	0.0077	0	0.0023	0.0068	0.0074	0	0.0086	0.0
B-T	mg/L		0.051				<0.050		<0.050		0.065	4	0.0540	<0.050	0.065	0.0537	2	0.0073	<0.050	0.0505	0	0.0545	0.0
Cd-T	mg/L		<0.000010				<0.000010		<0.000010		<0.000010	4	0.0000100	<0.000010	<0.000010	0.0000100	4	0.0000000	<0.000010	<0.000010	0	<0.000010	0.0
Ca-T	mg/L		26.5				21.3		18.5		43.3	4	27.4	18.5	43.3	25.9	0	11.1	20.6	23.9	0	30.7	0.0
Cr-T	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Co-T	mg/L	0.11	<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Cu-T	mg/L		0.00050				0.00054		<0.00050		<0.00050	4	0.000510	<0.00050	0.00054	0.000510	2	0.000020	<0.00050	<0.00050	0	0.000510	0.0
Hard-T	mg/L		81.8				66.6		57.1		132	4	84.4	57.1	132	80.0	0	33.3	64.2	74.2	0	94.4	0.0
Fe-T	mg/L	1	0.317				0.899		0.099		0.226	4	0.385	0.099	0.899	0.283	0	0.354	0.194	0.272	0	0.462	0.0
Pb-T	mg/L	0.01763	<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Mg-T	mg/L		3.79				3.26		2.63		5.68	4	3.84	2.63	5.68	3.69	0	1.32	3.10	3.52	0	4.26	0.0
Mn-T	mg/L	0.8706	0.0414				0.0616		0.0066		0.0131	4	0.0307	0.0066	0.0616	0.0217	0	0.0256	0.0115	0.0272	0	0.0464	0.0
Hg-T	mg/L		0.0000019				0.0000023				<0.0000019	3	0.00000203	<0.0000019	0.0000023	0.00000202	1	0.00000023	<0.0000019	0.0000019	0	0.00000210	0.0
Mo-T	mg/L	2	<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Ni-T	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
K-T	mg/L		0.334				0.282		0.270		0.477	4	0.341	0.270	0.477	0.332	0	0.095	0.279	0.308	0	0.370	0.0
S-T	mg/L		22.1				18.2		14.4		38.9	4	23.4	14.4	38.9	21.8	0	10.8	17.2	20.2	0	26.3	0.0
Se-T	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Si-T	mg/L		3.44				3.30		3.16		3.39	4	3.32	3.16	3.44	3.32	0	0.12	3.26	3.34	0	3.40	0.0
Ag-T	mg/L	0.0001	<0.000020				<0.000020		<0.000020		<0.000020	4	0.0000200	<0.000020	<0.000020	0.0000200	4	0.0000000	<0.000020	<0.000020	0	<0.000020	0.0
Na-T	mg/L		6.47				5.68		4.96		10.5	4	6.90	4.96	10.5	6.61	0	2.48	5.50	6.07	0	7.48	0.0
Sr-T	mg/L		0.155				0.121		0.110		0.254	4	0.160	0.110	0.254	0.151	0	0.066	0.118	0.138	0	0.180	0.0
Zn-T	mg/L	0.033	<0.0050				<0.0050		<0.0050		<0.0050	4	0.00500	<0.0050	<0.0050	0.00500	4	0.00000	<0.0050	<0.0050	0	<0.0050	0.0
Al-D	mg/L	0.1	0.0508				0.0627		0.0458		0.0305	4	0.0474	0.0305	0.0627	0.0459	0	0.0133	0.0420	0.0483	0	0.0538	0.0
As-D	mg/L		0.00077				0.00084		0.00059		0.00055	4	0.00069	0.00055	0.00084	0.00068	0	0.00014	0.00058	0.00068	0	0.00079	0.0
Ba-D	mg/L		0.0078				0.0073		0.0060		0.0104	4	0.0079	0.0060	0.0104	0.0077	0	0.0018	0.0070	0.0076	0	0.0084	0.0
B-D	mg/L		<0.050				<0.050		<0.050		0.072	4	0.0555	<0.050	0.072	0.0548	3	0.0110	<0.050	<0.050	0	0.0555	0.0
Be-D	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Cd-D	mg/L	0.00017	<0.000010				0.000127		<0.000010		<0.000010	4	0.0000392	<0.000010	0.000127	0.0000189	3	0.0000585	<0.000010	<0.000010	0	0.0000392	0.0
Ca-D	mg/L		27.4				22.6		18.7		41.9	4	27.6	18.7	41.9	26.4	0	10.1	21.6	25.0	0	31.0	0.0
Cr-D	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
Co-D	mg/L		<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Cu-D	mg/L	0.00385	0.00045				0.00046		0.00030		0.00038	4	0.00040	0.00030	0.00046	0.00039	0	0.00007	0.00036	0.00042	0	0.00045	0.0
Hard-D	mg/L		84.2				70.4		57.7		128	4	85.1	57.7	128	81.3	0	30.6	67.2	77.3	0	95.2	0.0
Fe-D	mg/L	0.35	0.271				0.855		0.0764		0.195	4	0.3494	0.0764	0.855	0.2424	0	0.3465	0.1654	0.2330	1	0.4170	25.0
Pb-D	mg/L		<0.00020				<0.00020		<0.00020		<0.00020	4	0.000200	<0.00020	<0.00020	0.000200	4	0.000000	<0.00020	<0.00020	0	<0.00020	0.0
Mg-D	mg/L		3.84				3.40		2.70		5.65	4	3.90	2.70	5.65	3.76	0	1.26	3.22	3.62	0	4.29	0.0
Mn-D	mg/L		0.0378				0.0630		0.0065		0.0126	4	0.0300	0.0065	0.0630	0.0210	0	0.0259	0.0111	0.0252	0	0.0441	0.0
Hg-D	mg/L		0.0000020				<0.0000019				<0.0000019	3	0.00000193	<0.0000019	0.0000020	0.00000193	2	0.00000006	<0.0000019	<0.0000019	0	0.00000195	0.0
Mo-D	mg/L		<0.0010				<0.0010		<0.0010		0.0422	4	0.01130	<0.0010	0.0422	0.00255	3	0.02060	<0.0010	<0.0010	0	0.01130	0.0
Ni-D	mg/L		<0.0010				<0.0010		<0.0010		<0.0010	4	0.00100	<0.0010	<0.0010	0.00100	4	0.00000	<0.0010	<0.0010	0	<0.0010	0.0
K-D	mg/L		0.342				0.293		0.284		0.475	4	0.349	0.284	0.475	0.341	0	0.088	0.291	0.318	0	0.375	0.0
S-D	mg/L		22.6				19.1		15.0		39.3	4	24.0	15.0	39.3	22.5	0	10.7	18.1	20.8	0	26.8	0.0
Se-D	mg/L		<0.00010				<0.00010		<0.00010		<0.00010	4	0.000100	<0.00010	<0.00010	0.000100	4	0.000000	<0.00010	<0.00010	0	<0.00010	0.0
Si-D	mg/L		3.45				3.73		3.03		3.38	4	3.40	3.03	3.73	3.39	0	0.29	3.29	3.42	0	3.52	0.0
Na-D	mg/L		6.79				5.68		5.01		10.4	4	6.97	5.01	10.4	6.70	0	2.40	5.51	6.24	0	7.69	0.0
Sr-D	mg/L		0.164				0.128		0.108		0.246	4	0.162	0.108	0.246	0.154	0	0.061	0.123	0.146	0	0.184	0.0
Zn-D	mg/L		<0.0050				<0.0050		<0.0050		<0.0050	4	0.00500	<0.0050	<0.0050	0.00500	4	0.00000	<0.0050	<0.0050	0	<0.0050	0.0
* BC Water Quality Guidelines - Freshwater Aquatic Life-Acute																							

To: EnvironmentalCompliance@gov.bc.ca

This report represents one of several reports where the unauthorized discharge **DGIR 204584** has been presented and reported. Information presenting the information for this discharge includes the following:

- Provincial Emergency Line contacted and spill report number DGIR 204584 was generated on March 17, 2021
- PE7008 Unauthorized Discharge DGIR 204584 report submitted on March 19, 2021
- PE7008 Unauthorized Discharge DGIR 204584 follow up water chemistry submitted on March 22, 2021
- PE:7008 Q4 WQ Report and Data submitted on April 30, 2021
- 2020-2021 Annual Water Quality Monitoring Report (AWQMR) submitted June 30, 2021
- Annual Groundwater Monitoring Report (Appendix VIII of AWQMR) submitted June 30, 2021
- PE:7008 Q1 WQ Report and Data submitted July 31, 2021

This is a follow-up report presenting the information collected for the unauthorized discharge of mine water to the receiving environment (Quinsam River). Groundwater well accessing the mine pool discharged to the Quinsam River from sometime in January until March 18, 2021 (discovered on March 17, 2021) when the discharge was directed into a sump and contained. The well was capped on March 19, 2021 but continued to discharge minimally into the sump. The groundwater elevation in the well QU11-09 M decreased below surface elevation of 226 mASL by May 13, 2021. This stopped all discharge to surface from the well head. The shallow groundwater aquifer in the area was under pressure and continued to seep from the ground upward into the Quinsam river until approximately July 20, 2021. A final sample was collected on August 23, 2021 from the stagnant pooled water. Water quality and quantity was collected in order to characterize the seepage water.

Underground Pumping System:

At the time of the spill, the well pumps used to dewater 2-North Mine pool (5M#2 and 1M2N) were not operating and new pumps were on order. For contingency, the mine pool water levels

were being managed by the 3M2N pumping system operating at maintaining the mine pool at a higher elevation than normal. The 2-North mine pool water level rose to approximately 244 meters above sea level (mASL) by March 22, 2021. The 3M2N system was installed in order to maintain the mine pool below the known subsidence features in 3-North area, located at 280 mASL, where the mine pool has potential to become a groundwater discharge zone into the Quinsam River and to protect underground infrastructure. The 5M#2 and 1M2N were replaced on March 25 and April 6, 2021, respectively. The groundwater elevation is depicted in the figure below.

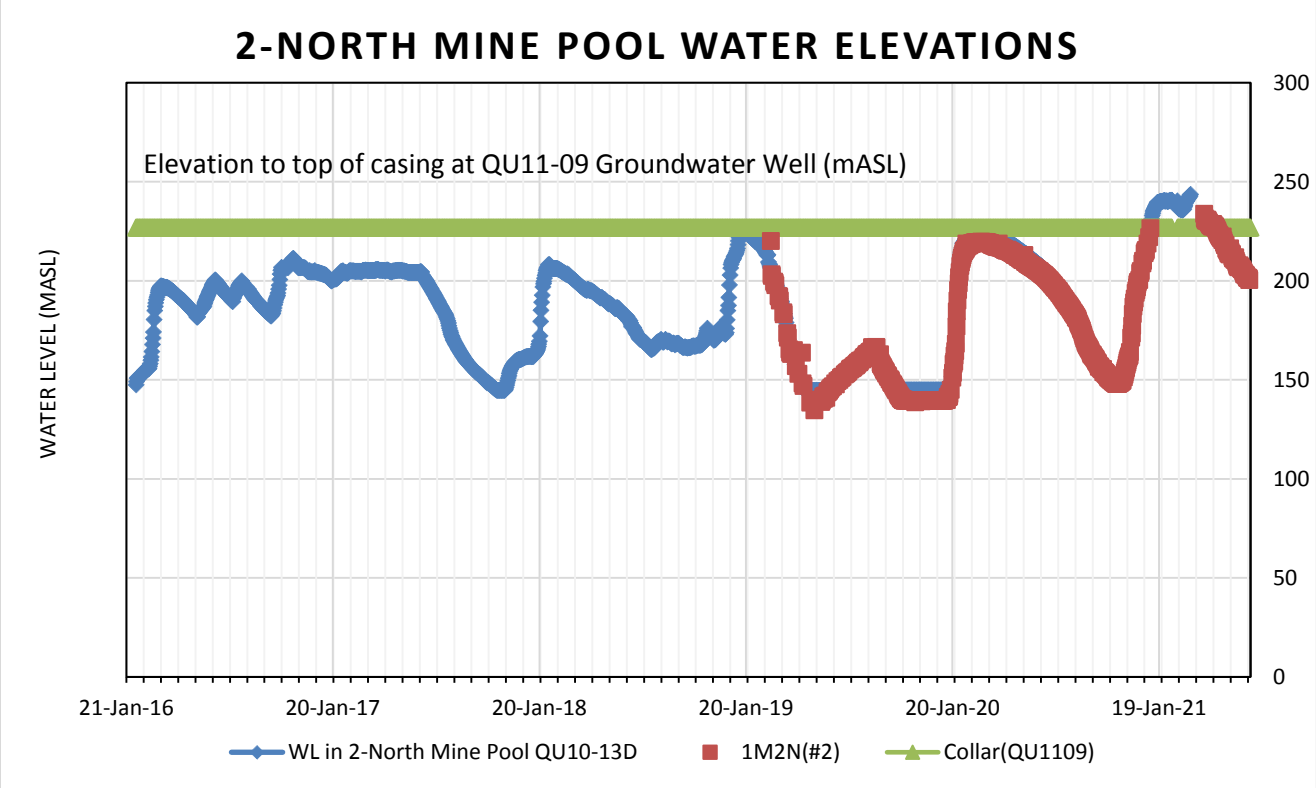

Figure 1: 2-North Mine Pool Elevations compared to QU11-09 elevation (mASL)

Nature of Non-compliance: Groundwater well (QU11-09) accessing the River Barrier Pillar mine pool, became artesian and discharged to the Quinsam River. The flow path from the well to the

river was 157 m. Iron was deposited and dropped out along the flow path. At the river, iron was deposited on the riverbed for about 5m.

QU11-09 is a nested well that accesses three zones, shallow groundwater, water cover over potentially acid generating (PAG) course coal refuse (CCR) in the No. 1 coal seam and water quality below the 1 seam located in the River Barrier Pillar (RBP) between the 2 North and 5-South Mine. The deep well is not used for sampling. The medium well has a dedicated bladder pump with tubing deployed to assess water quality in the mine pool of the RBP, and the shallow well has hydro lift tubing. Both wells expelled the tubing and pump. The elevation of the well head is 226 masl. The medium well diameter is a 2-inch PVC pipe with a depth 82 m or 142 masl below top of casing (mBTOC). The elevation of the CCR is 153.5 masl. The shallow well diameter is 1.25 inches with a depth of 24.8 mBTOC or 201 masl. Figure 2 below displays the cross section of the 2-North Mine, QU11-09, the Quinsam River and the 5-South Mine.

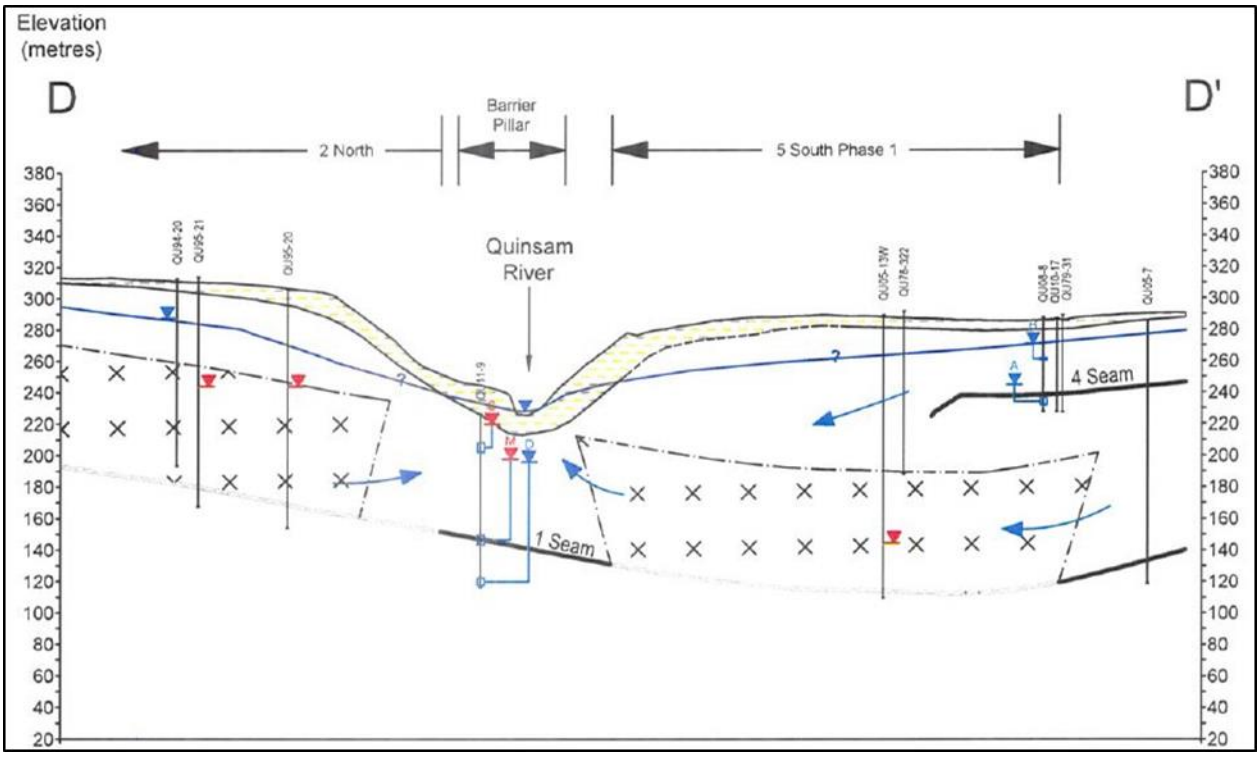

Figure 2: Cross section of 2-North Mine, River Barrier Pillar (QU11-09) and 5-South Mine

Response/Actions taken: On March 17, 2021 the well was scheduled to be sampled. Upon arrival the well was artisan and flowing into the river. The site was investigated and immediately sampled with a report made to Provincial Emergency Response Program (PEP).

Monitoring conducted: Refer to Appendix 1, Tables 1-39 and Graphs 1-13 for a full review of water chemistry and parameters of concern trending on the Quinsam River.

Initially water sampling was conducted at the well head (QU11-09M), where the spill entered the river (S), 87 m downstream on the Quinsam River (QRDS), and 80 m upstream of the well (QRUS).

Monitoring of the seepage area for water quality and quantity continued until the seep stopped or could not be collected and quantified any longer (July 20, 2021). In order to capture any impacts on the Quinsam River as a result of the seepage in this area, the spring and summer receiving environment monitoring on the Quinsam River included weekly sampling upstream at Middle Quinsam Lake outlet (WB), and downstream of the seepage area at three locations on the Quinsam River (QRDS, QRDS1 and 7SQR), as well as the seepage location (S) as it entered the river.

Most parameters remained in low concentrations (below WQG's) on the Quinsam River at QRDS and QRDS1. Indicating limited impact on water quality in the Quinsam River as a result of the seepage area.

Water quality was analyzed for metals, anions, cations, nutrients, turbidity and total suspended solids. A rush analysis was requested on the first set of samples. Field parameters indicated neutral pH and elevated conductivity. The water quality from the seepage area was consistently elevated above BC Water Quality Guidelines for Protection of Aquatic Life (WQG) in arsenic, boron and sulphate and occasionally elevated in copper and sulphide as H_2S.

Appendix I, presents water chemistry from the seepage water. Water quality and quantity was measured periodically from (March 19 through July 20) Table 1, below. The flow rate was measured at the entrance where the seepage flows into the Quinsam River.

Table 1:Water Quantity from Seepage into Quinsam River

Date	Flow rate L/s
Apr 21	1.1
Apr 26	1.00
May 5	1.9
May 10	1.3
May 20	0.50
May 25	0.37
May 31	0.30
Jun 7	0.20
Jun 10	0.18
Jun 14	0.14
Jun 21	0.11
Jul 5	0.07
Jul 19	0.03
August 19	0.001 (too low to measure)

In the Quinsam River elevated copper was found in both upstream and downstream locations throughout monitoring in both spring and summer. Dissolved copper is measured against the most conservative approach when applying the copper guideline (0.0003 mg/L for chronic and 0.002 mg/L for acute). The upstream location is above all mine influence at station WA and the furthest downstream displayed in the data set is represented by 7SQR.

There were 6 weeks of data collected for the sites WB (upstream of the spill location) and QRDS (downstream of the spill location) in order to capture any changes in water quality on the Quinsam River.

All other Quinsam River sites are compared to 5 weeks of sampling during spring and summer. The Graphs displayed an increase in sulphate over the spring and summer on the Quinsam river. This could be attributed to the cumulative load of dewatering the mine pool into Middle Quinsam lake and seepage from the mine areas.

Future action items: The elevation of the mine pool has been reduced to below the elevation of the groundwater well, 226 mASL. The closure plan for the mine will reflect this well being capped

and include monitoring of any seepage on the Quinsam River with increased mine pool elevations. Seepage is likely to occur and will be monitored. An updated water quality predictions and cumulative effects on the Quinsam River model is required.
During operations the area will be monitored for seepage and if identified, water quality and quantity will be further characterized. If there is potential for adverse impacts on aquatic life and reduced water quality, then a mitigation plan is required.

Currently the Environmental Department is conducting a sediment and benthic program on the Quinsam River using the Canadian Aquatic Biomonitoring Network (CABIN) wadable stream approach. This will provide a health assessment on the Quinsam River using physical, chemical and biological measures. The addition of the biological component will assist in providing the effect of the stressor on the biota in the Quinsam River. Aquatic biomonitoring reflects changes in river conditions for weeks or months prior to monitoring. Any impairment to aquatic biota due to pollution can be detected long after the cause of the impact using CABIN protocols. The results from this program will be presented in the Annual Water Quality Monitoring report for 2021-22.

Contact information:
Environmental Coordinator
Kathleen Russell BSc., EP
250-286-3224 EXT 225

Attachments: Appendix 1, Water Chemistry and Statics from the Seepage area (S) and Quinsam River upstream and downstream of mine impacts (WA to 7SQR).

Figure 3 below displays the well draining to the sump as initial efforts to contain the discharge. Figure 4 displays the capped well. Figures 5 and 6 display the location of the mine, underground workings and QU11-09. Figure 7 displays the location where the groundwater well drained into the Quinsam river and continuous flow path the seepage occurred on. Figure 8 displays the Google image of the Quinsam River and monitoring locations.

Figure 3: March 18, 2021 discharge contained and directed into a low-lying sump area next to the well away from the river.

Figure 4: March 19, 2021 well capped and discharge reduced to about 1 L/s. Discharge still directed to the sump area. No surface expression to the river from the well. Well stopped discharging on May 13, 2021 when mine pool was reduced below 226 mASL.

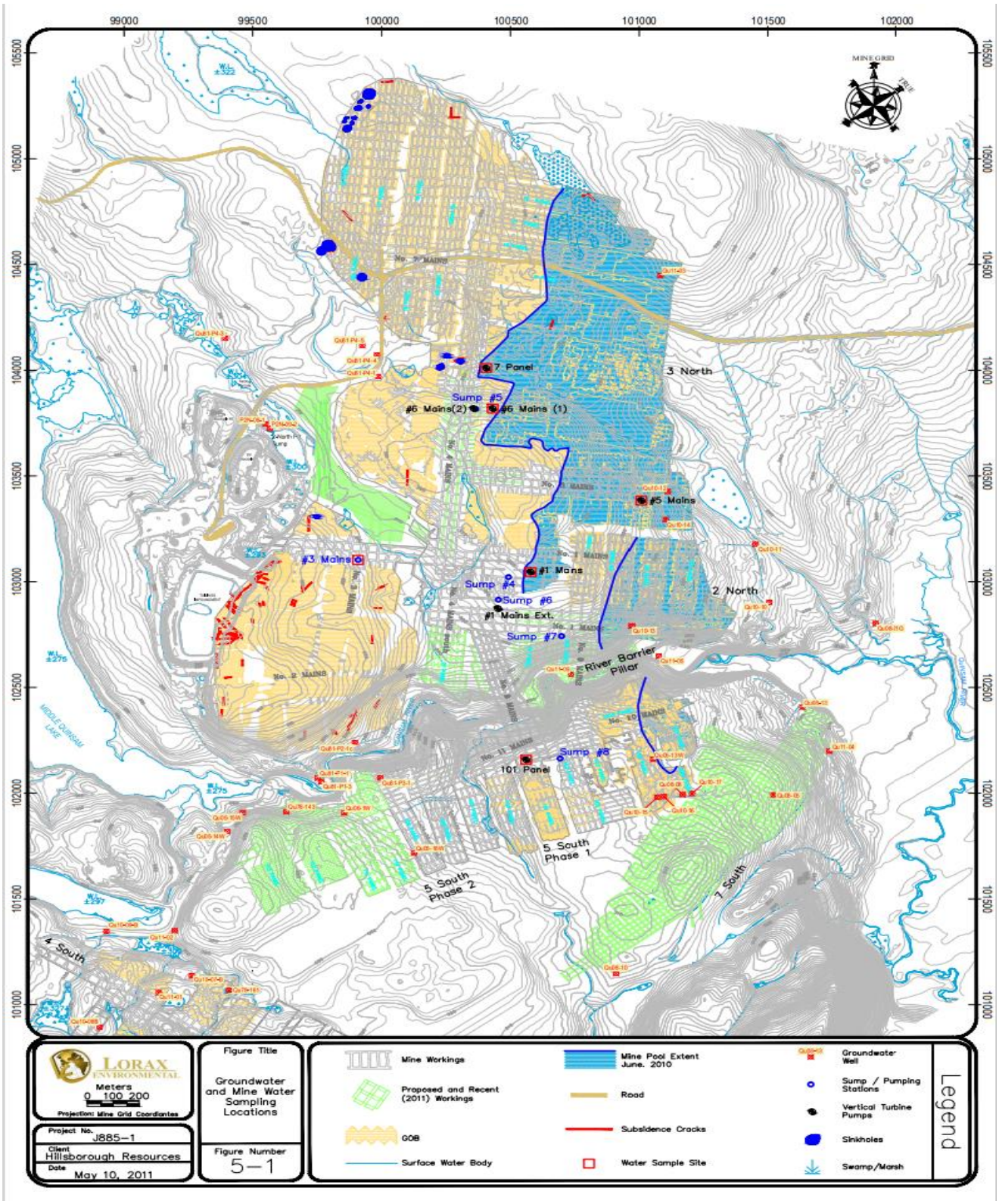

Figure 5: Underground workings and groundwater locations of the Quinsam Mine Site. QU11-09 in the River Barrier Pillar is the location of the artisan well.

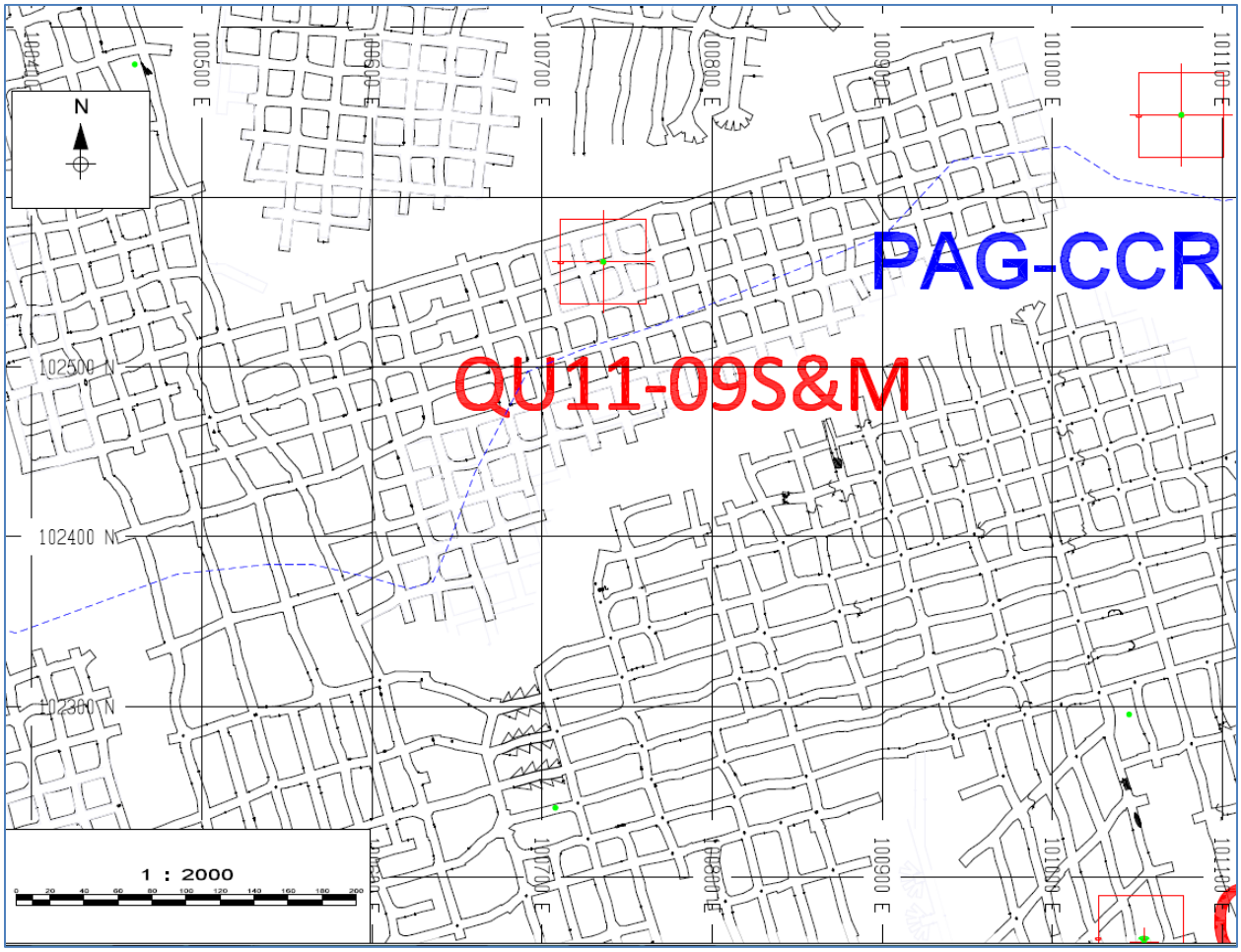

Figure 6: QU11-09 S&M blue dotted line represents the Quinsam River

Figure 7: Initial Flow Path into River

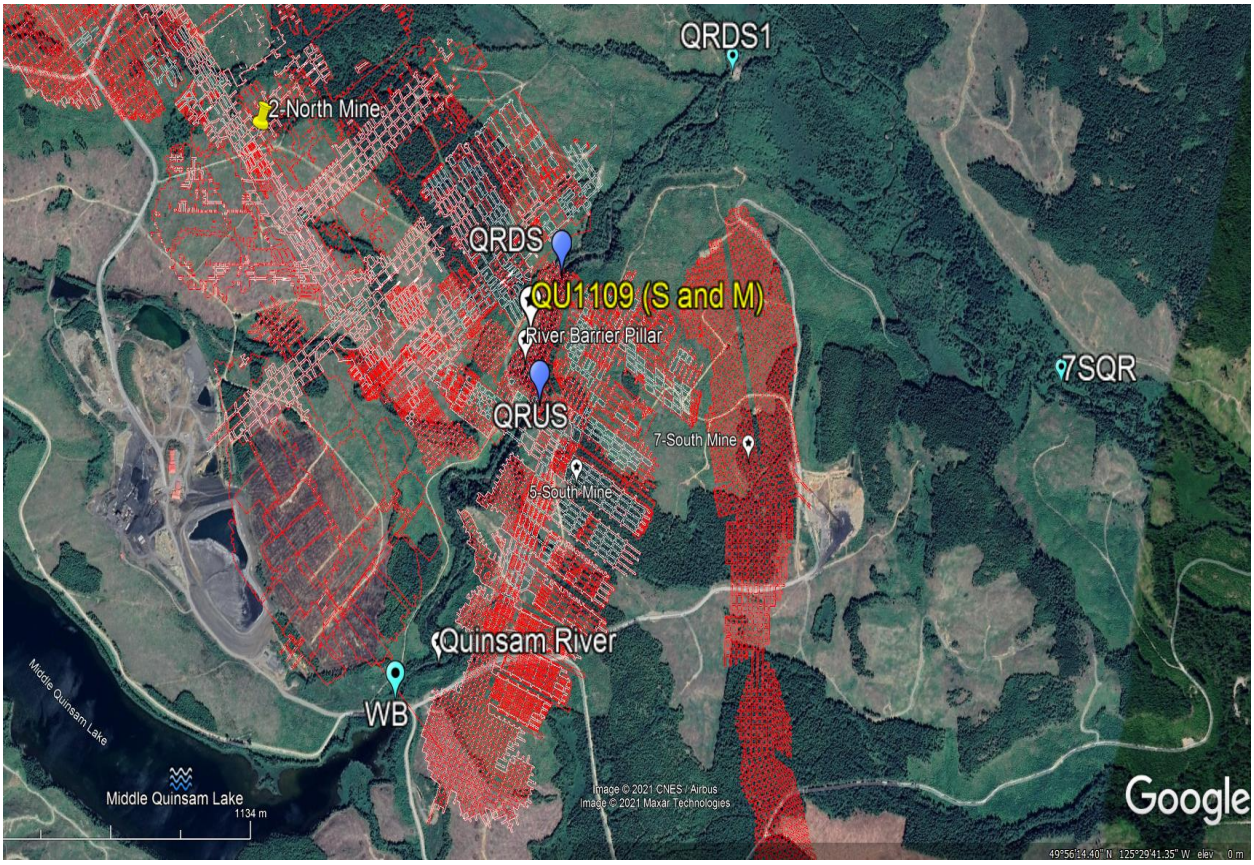

Figure 8: Quinsam River Monitoring Locations and Underground Workings. Spill occurred at QU1109 and discharged into the Quinsam River. Monitoring occurred upstream and downstream on the river at sites WB, QRUS, QRDS, QRDS1 and 7SQR. Seepage continued from shallow groundwater for several months.