

March 17, 2020

Project: 666768

BC Ministry of Transportation & Infrastructure
Geotechnical Engineering Section – Victoria
4C – 940 Blanshard Street
Victoria, BC V8W 3E6

ATTENTION: Julie Sandusky, P.Geo.

REFERENCE: ML/ARD Assessment to Support Selkirk Mountain 4-Laning Project

As requested by the BC Ministry of Transportation & Infrastructure (MoTI), SNC-Lavalin Inc. (SNC-Lavalin) has completed this report to document the findings of a metal leaching/acid rock drainage assessment (the “ML/ARD assessment”) for bedrock (i.e., Type A) excavation materials along a segment of the Trans-Canada Highway (TCH) approximately 31 km northwest of Golden, BC (the “Project”). The Project is 3.86 km long; the general location is shown in Drawing 666768-100, attached.

SNC-Lavalin’s original scope of work was presented in our work plan entitled “*Proposed Scope of Work and Cost Estimate for ML/ARD Assessment to Support Selkirk Mountain 4-Laning Project*” dated August 14, 2019. A revised scope of work was approved by MoTI via email on October 15, 2019 including subsurface investigation tasks to be conducted by SNC-Lavalin. This work was conducted according to the terms and conditions of As & When Contract 860 CS 5040.

1 Background

A limited ML/ARD assessment was previously conducted in 2018 to support preliminary design (Lorax, 2018). Nine samples were collected from bedrock outcrop and/or road cuts within the Project and submitted for static test work including Acid-Base Accounting (ABA), Total Solid Phase Elemental Analysis, Shake Flask Extraction (SFE) and X-Ray Diffraction (XRD). Key observations included the following:

- › Samples of PELITE and QUARTZITE were collected from rocks identified within the Lower Cambrian Hamill Group.
- › Four of nine samples of QUARTZITE were classified as potential acid-generating (i.e., PAG) rock based on ABA results and calculated neutralization potential ratio (NPR) less than 2. This was attributed to a relative lack of neutralization potential (NP) in the material rather than elevated acid potential (AP).
- › NPR was conservatively based upon the non-sulphate content, and there appeared to be a significant amount of insoluble sulphur, which suggested the presence of either iron/aluminium sulfate minerals (e.g., jarosite) or organically-bound sulphur (i.e., non-sulphide sulphur).
- › The PAG rock was identified within existing rock cuts, including from: station (STA) 160+140 to 16+310 (“Outcrop A”); STA 16+650 to 16+870 (“Outcrop B”); and, STA 18+040 to 18+200 (“Outcrop C”).





- › One sample of PELITE was classified as non-PAG based on relatively low NP and non-detectable sulphide sulphur.
- › Further assessment including sampling from unweathered Type A material (e.g., rock core) was recommended upon completion of preliminary and functional design.

Review of functional design drawings provided by MoTI (dated April 17, 2019) suggest approximately 5,200 m³ of Type A material will be excavated from the south side of the existing alignment including Outcrops A, B, and C.

2 Objective

SNC-Lavalin's mandate was to conduct further ML/ARD assessment to support detailed design. Results from static testing upon unweathered Type A material were used to characterize samples according to inferred ML/ARD potential.

3 Scope of Work and Methods

To achieve MoTI's objective an ML/ARD assessment was conducted that included the following tasks:

- › Task 1 - Planning and Information Review;
- › Task 2 - Field Assessment;
- › Task 3 - Opportunistic Surface Water Sampling;
- › Task 4 - Laboratory Analysis;
- › Task 5 - Data Analysis and Reporting; and
- › Task 6 - Project Management.

Methodology for each task is summarized in the sections below.

3.1 Planning and Information Review

Available information was reviewed for the area of the Site including geological data; mineral occurrences and/or prospects; known bedrock type(s); and, nearby water resources. Information sources included: bedrock mapping, exploration, quaternary geology and/or geochemical records available from iMap¹; available geological reports from the BC Geological Survey (BCGS), Natural Resources Canada, and/or the Geological Survey of Canada; exploration and/or development records from the BC MINFILE² inventory; and, information on water resources from the BC Ministry of Environment & Climate Change Strategy (ENV).

¹ Available at: <https://www2.gov.bc.ca/gov/content/data/geographic-data-services/web-based-mapping/imapbc>

² Available at: <https://minfile.gov.bc.ca/>





3.2 Field Assessment

Site visits were conducted on August 8, 2019 and October 2, 2019 for confirmation of the 2018 sample locations for insight on potential structural/mineralogical controls on PAG materials. Potential ecological receptors and relevant drainage features were also assessed and rig access for borehole drilling was reviewed. Locations and prominent site features were documented in field notes and locations were recorded using a hand-held GPS unit with assumed accuracy in the range of +/- 6 m.

Information review suggested similar rock types were observed in a geotechnical borehole (BH19-39) that was advanced by Golder Associates Ltd. (Golder) on June 5, 2019 to support MoTI's adjacent Quartz Creek project (located immediately to the west). SNC-Lavalin reviewed a draft borehole log on July 24, 2019 and it was inferred that samples from BH19-39 could be used to assess the geochemical properties of unweathered Type A material within a planned rock cut for the Selkirk Mountain 4-Laning Project between STA 16+150 and STA 16+310. HQ-3 diameter rock core was available for review at Golder's geotechnical laboratory in Burnaby, BC and, as such, SNC-Lavalin visited the laboratory on August 27, 2019 to review and collect samples for ML/ARD testing.

Diamond drilling was completed in November 2019 to obtain samples of unweathered bedrock from two locations (BH19-SM4L-01 and -02) south of the highway near STA 18+080 and STA 18+180. Road access and two drill pads were roughed in by Golder in September 2019 for a geotechnical test pit investigation. SNC-Lavalin retained Mackay Contracting (Mackay) to make improvements for drill rig access on November 4, 2019 using a 300-series excavator. Mackay were also retained to provide traffic management and first aid services for the duration of the ML/ARD drilling program. HQ diameter coring was conducted between November 4 and 9, 2019 using a track-mounted Mobile Drill B47 provided by Blue Max Drilling Inc. SNC-Lavalin supervised all site activities, interpreted subsurface conditions, logged the rock core, and collected samples for laboratory testing.

HQ-3 core from Golder's geotechnical borehole TH18-118 was stored near the site at the time of the ML/ARD drilling investigation. Material from this location was inferred to represent bedrock near STA 18+235 and, as such, SNC-Lavalin reviewed and sampled from this material on November 9, 2019.

3.3 Opportunistic Surface Water Sampling

Pre-construction surface water sampling was completed to inform the ML/ARD assessment and management/mitigation for problematic materials (if present). Representative surface water samples were collected from accessible locations on relevant surface water receptors to assess chemistry in water bodies that may be affected by construction activities. Field measurements of pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), and oxidation-reduction potential (ORP) were recorded for each location using a hand-held multi-parameter instrument. Water samples were collected in bottles provided by the analytical laboratory. Dedicated sampling equipment (e.g., bottles, syringes, and 0.45 µm disc filters) were used for each location to prevent cross-contamination. Observations were documented in field notes and locations were recorded using a hand-held GPS.





Surface water sampling was completed to document water chemistry in the vicinity of the Project prior to commencing construction. If needed, results can be compared to data from subsequent sampling events to assess potential changes and (if required) to identify additional controls for mitigation of adverse drainage water.

3.4 Laboratory Testing and Quality Assurance/Quality Control

Eleven rock samples were submitted to Global ARD Testing Services Inc. of Burnaby, BC for ML/ARD tests including: Acid-Base Accounting (ABA); Strong Acid Leachable Metals (SALM); Shake Flask Extraction (SFE); single addition Net Acid Generation (NAG) test; and/or X-ray Diffraction (XRD, Rietveld Method). Petrographic analysis was conducted on three rock samples by Vancouver Petrographics of Langley, BC to confirm mineralogy and rock types. Finally, five surface water samples were submitted to CARO Analytical of Kelowna, BC for analysis of total and dissolved metals, dissolved organic carbon (DOC), alkalinity, total dissolved solids (TDS), total suspended solids (TSS), hardness, and anions including nitrate, nitrite, chloride, fluoride and sulphate.

A Quality Assurance/Quality Control (QA/QC) program was implemented during the collection and laboratory analysis of rock and surface water samples. The program included: the use of trained field staff; adherence to laboratory sampling and analytical protocols (including use of chain-of-custody documentation and submission within recommended hold times); use of qualified laboratories for ML/ARD, mineralogy, and water testing; review of laboratory QA/QC performance to confirm results were within their internal data quality objectives (DQO); and, evaluation of analytical precision by calculating the relative percent difference (RPD) between results for laboratory duplicate samples.

The DQO for RPD calculations was less than 20%; RPD values greater than 20% warranted further assessment before the analytical results were considered acceptable. Key staff responsible for design and execution of this ML/ARD assessment are Qualified Professionals as defined in the Technical Circular.

4 Screening Criteria

Laboratory analytical results were tabulated and compared to the adopted screening criteria in Table A below.





Table A: Adopted Screening Criteria for ML/ARD Assessment

Method	Screening Criteria/Classification			Reference	
ABA	Neutralization Potential Ratio (NPR)	NPR < 1	PAG	PAG unless sulphide minerals are non-reactive	MEND, 2009
		$1 \leq \text{NPR} \leq 2$	Uncertain	Potentially PAG if neutralization potential (NP) is insufficiently reactive or is depleted at a faster rate than sulphide mineralization	
		NPR > 2	Non-PAG	Non-acid generating unless sulphide mineralization is exposed along unidentified structural discontinuities (e.g., joints, fractures and/or faults) or extremely reactive sulphides occur in combination with insufficiently reactive NP	
Net Acid Generation (NAG)		pH < 4.5	PAG	PAG if NAG pH < 4.5 and maximum potential acidity (MPA) > Sobek NP.	INAP, 2014
		pH < 4.5	Uncertain	Potentially PAG if NAG pH < 4.5 and MPA < Sobek NP.	
		pH > 4.5		Potentially PAG if NAG pH > 4.5 and MPA > Sobek NP.	
		pH ≥ 4.5	Non-PAG	Non-PAG if NAG pH > 4.5 and MPA < Sobek NP.	
Elemental Composition (SALM)	Potential enrichment suggested by elevated sample concentrations	Schedule 3.1 Standards for Industrial (IL) and Reverted Wild Lands (WLR) Use		BC Contaminated Sites Regulation ³ (CSR)	
		Average crustal abundance values for comparable rock types		Price, 1997	
Leachate Testing (SFE)	Potential for problematic drainage suggested by elevated metal concentrations in leachate	BC Approved and Working Guidelines for Protection of Freshwater Aquatic Life and Drinking Water ⁴ (BCWQG AW and/or DW)		BC ENV. ⁵	
Surface Water	Existing water chemistry				

It is noted that adopted screening criteria in Table A include conservative comparisons and/or modified criteria as follows:

Elemental Composition:

- › Numerical standards from the BC CSR were adopted for comparison to SALM results from rock samples. These are considered useful criteria for assessing potential enrichment, but it is noted that significant mechanical processing of rock samples is required to reduce the sample to the

³ Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, including amendments up to B.C. Reg. 13/2019, January 24, 2019.
⁴ British Columbia Approved Water Quality Guidelines, includes Working Water Quality Guidelines for BC (BCWQG). British Columbia Ministry of Environment & Climate Change Strategy, updated September 2019.
⁵ British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture. BC Ministry of Environment and Climate Change Strategy, June 2017.





particle size required for the SALM test (< 2 mm, ENV 2015). As such, the comparison is not direct as the physical (and associated chemical) properties of *in situ* materials and/or the materials used for road/highway construction are expected to be significantly different than the processed media that was required for SALM testing (i.e., exceedance of the CSR criteria does not imply that the material is contaminated).

- › A 10-times multiplier was included with the comparison to average crustal abundance values to identify elements that are significantly enriched and should be considered for further examination in terms of leaching behaviour.

SFE Leachate Testing:

- › A 10-times multiplier was included with the comparison of leachate results to the adopted ENV BCWQG based on an assumed order of magnitude dilution along the flow path from the source to the nearest surface water receptor. The 10-times multiplier assumes dilution is likely to occur between the source and environmental receptor from mixing with water that is not in contact with the excavation materials (e.g., precipitation and/or overland flow from other areas of the catchment). This assumption does not apply for material placed directly into a water body (e.g., rip rap).
- › It is noted that BCWQG are intended for direct application to surface water (AW) and drinking water (DW) sources. Any leachate test does not represent field conditions and thus comparison against the BCWQG is only intended to identify drainage water constituents that may be problematic in the watershed and require further investigation (e.g., other leachate testing, risk assessment, water quality modelling).

5 Results

5.1 Information Review

Results of the information review are summarized in the sections below. Relevant GIS data are shown on Drawing 666786-101, attached.

5.1.1 Climate Data

The Project is located in the Dry Cool, Montane Spruce Zone which is characterized by extensive lodgepole pine forest situated in the rain shadow of the Coast and Selkirk mountains⁶. Summer months are typically cool and dry while winters are typically cold. The nearest Environment Canada (EC) climate station with historical data is “Glacier NP Rogers Pass” (Climate ID 1173191), located about 23 km towards the southwest. EC Climate Normals⁷ for Glacier NP Rogers Pass are summarized in **Table B** below.

⁶ Available at: <https://www.for.gov.bc.ca/hfd/pubs/docs/Bro/bro62.pdf>, accessed June 26, 2019.

⁷ Available at: http://climate.weather.gc.ca/climate_normals/index_e.html; accessed June 26, 2019.





Table B: 1981 to 2010 Canadian Climate Normals for the GLACIER NP ROGERS PASS Weather Station

Parameter	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average	°C	-8.3	-6.6	-2.1	2.1	5.8	10.3	13.1	12.8	8	1.8	-4.5	-9.1	1.9
Daily Maximum	°C	-6.1	-3.5	1.9	6.6	11.1	16.4	19.8	19.7	13.5	4.9	-2.6	-7	6.2
Daily Minimum	°C	-10.5	-9.7	-6.1	-2.5	0.4	4.2	6.3	5.8	2.5	-1.3	-6.3	-11.2	-2.4
Rainfall	mm	10.1	4.7	20.9	40.2	67.6	89.7	94.7	87.8	89	89.3	32.6	3.4	630.0
Snowfall	cm	210.1	128.8	88.6	40.9	7.8	0.2	0	0	1.9	48.9	164.2	173.4	864.7
Precipitation	mm	220.2	133.6	109.5	81.1	75.4	89.9	94.7	87.8	90.9	138.1	196.8	176.8	1494.6

Notes: °C = degrees Celsius; mm = millimetre; cm = centimetre; total precipitation assumes a 10:1 snow water equivalent.

Based on the above, average daily temperature for the area ranges from -9.1°C in December to 13.1°C in July and the total annual precipitation was 1,494.6 mm including 630.0 mm of rainfall and 864.7 mm of snowfall at 1,330 m elevation.

Rain shadow effects are supported by EC Climate Normals for the “Golden A” 8 weather station (Climate ID: 1173) located in Golden, BC and approximately 30 km southeast of the Project. Golden A recorded total annual precipitation of 466.8 mm which is approximately 1,028 mm less than the total for Glacier NP Rogers Pass. The Project is located approximately mid-way between these weather stations suggesting total annual precipitation may be less than Glacier NP Rogers Pass but greater than the total for Golden A. Nevertheless, it is inferred that the Project receives abundant precipitation throughout the year suggesting frequent contact of bedrock materials with rain and/or snow melt.

5.1.2 MINFILE Records

A review of the MINFILE database indicated three occurrences within 20 kilometres of the site. Approximate locations are shown on Drawing 661705-101 (attached) and summarized in Table C below.

Table C: Summary of MINFILE Records within 20 km of the Site

INFILE Number	Name	Mineral Occurrence	Host Rock	Group	Status
082N 096	Goldie 2	Travertine	Tufa	Unknown	Showing
082N 018	Quartz Creek Placer	Gold, Lead, Copper, Silver	Limestone/ Quartzite	Hadrynian Horsethief Creek Group	Past Producer
082N 056	Seward	Silver, Lead, Copper	Limestone	Unknown	Showing

Based on results in Table C, bedrock in the area may be locally enriched in base and/or precious metals including copper, lead, silver, and gold. Sulphide mineralization may be associated with the MINFILE records including chalcopyrite (CuFeS₂); galena (PbS); pyrite (FeS₂); sphalerite ((Zn,Fe)S); and/or

⁸ Available at: http://climate.weather.gc.ca/climate_normals/index_e.html; accessed June 26, 2019.





tetrahedrite ($\text{Cu}_6[\text{Cu}_4(\text{Fe},\text{Zn})_2]\text{Sb}_4\text{S}_{13}$). Descriptions of host rock in the MINFILE records also suggest a relative abundance of net-neutralizing carbonate minerals in the area including limestone and/or carbonaceous mudstones.

5.1.3 Water Resources

The Columbia River flows southeast to northwest in the area. The Project is set back from the river approximately 1,600 m at the east extent to approximately 1,900 m at the west extent. Flowing surface water was observed at one location during the ML/ARD drilling program, comprising a small unnamed creek flowing north near STA 18+260. A small swamp is located approximately 300 m north of the TCH near STA 17+500. No creeks were observed flowing into the swamp and it is inferred that recharge is via overland flow and/or seepage from shallow groundwater. Wiseman Creek is located approximately 1.4 km west of the Project; surface water at this location was not assessed as it is considered part of MoTI's Quartz Creek project.

Potential receptors of runoff from the Selkirk Mountain 4-Laning project include the unnamed creek, the swamp, regional groundwater, and the Columbia River. Runoff near the western extent of the Project may interact with Wiseman Creek; however, based on the distance between the creek and the Project it is inferred that the overall effect would be minimal (i.e., water quantity and quality is likely more dependant on inputs from higher elevations in the watershed and/or runoff from the Quartz Creek highway segment).

Mapping information in the BC Water Resources Atlas (WRA)⁹ suggests the nearest domestic groundwater wells were approximately 10 km east of the Project and across the Columbia River. These wells are considered hydraulically disconnected from the Project and are not likely to be influenced by construction activities.

5.2 Field Assessment

Investigation locations are shown on Drawing 666768-102 and -103, attached. Field observations of rock core at BH19-SM4L-01 and -02 are summarized in borehole logs (Attachment 1). Samples selected for laboratory analysis are described in Table D, below. Field descriptions of samples from Golder geotechnical boreholes BH19-39 and TH19-118 are also summarized in Table D. Photographs of chip samples are provided in Attachment 2.

⁹ Available at: <http://maps.gov.bc.ca/ess/sv/wrbc/>





Table D: Summary of Rock Core Samples

Borehole ID	Final Borehole Depth (m bgs)	Sample ID	Sample Interval (m bgs)	Description	Coordinates ¹	
					North (m)	East (m)
TH19-118	28.83	SA1	22.9 – 23.5	ARKOSE, fresh, pink, with disseminated sulphide mineralization, moderately strong to very strong.	5704709	479787
BH19-SM4L-01	14.63	SA2	5.64 – 5.99		5704741	479602
		SA4	13.28 – 13.64			
BH19-SM4L-02	18.29	SA1	2.59 – 3.05	ARKOSE, fresh, orange-pink, no visible sulphide mineralization, strong.	5704702	479692
		SA2	4.78 – 5.05	Interbedded PELITE and ARKOSE, fresh, pink-grey, no visible sulphide mineralization, strong.		
		SA3	9.40 – 9.70	Interbedded PELITE and ARKOSE, fresh, green-grey, no visible sulphide mineralization, strong.		
		SA4	13.36 – 13.72	Fresh, pink, ARKOSE, disseminated sulphide mineralization, iron staining on fracture surfaces, strong.		
BH19-39	15.24	RC01	2.75 – 3.25	Interbedded PELITE and ARKOSE, slightly weathered to fresh, green-grey, no visible sulphide mineralization, strong.	5704176	477816
		RC02	8.63 – 9.00	QUARTZITE, fresh, pink to grey to light brown, with disseminated sulphide mineralization, strong.		
		RC03	10.97 – 11.40			
		RC04	13.06 – 13.50			

Notes: 1) Hand-held GPS data with assumed accuracy in the range of +/- 6 m.





5.3 Laboratory Analytical Results

Eleven rock samples were submitted for laboratory analysis. A copy of laboratory analytical reports for the requested test methods is presented in Attachment 3; results are summarized in the sections below.

5.3.1 Petrographic Analysis

Three rock samples were selected for polished thin section preparation and petrographic analysis to confirm mineralogy and rock identifications. Key observations from the petrographic analysis include:

- › **BH19-SM4L-01-SA2** - Metamorphosed pebbly arkose that contained scattered pebbles of quartz and of K-feldspar set in a groundmass of fine to medium grained quartz with much less abundant K-feldspar and plagioclase (altered slightly to sericite), with interstitial patches of sericite and minor muscovite, and minor calcite and pyrite.
- › **BH19-SM4L-02-SA2** - Metamorphosed arkose dominated by equant, very fine detrital grains of quartz, with much less abundant similar grains of plagioclase (some altered slightly to sericite) and of K-feldspar, and two pebbles of quartz. These were set in a groundmass of sericite and biotite/chlorite(?), with minor ilmenite, leucoxene, kaolinite, and rutile. A diffuse vein of quartz was observed, and a veinlet of limonite was also observed having an alteration envelope containing patches of limonite, mainly associated with sericite.
- › **BH19-SM4L-SA3** - Metamorphosed pebbly arkose that contained scattered coarser equant to moderately elongate grains of quartz and lesser ones of K-feldspar that were interpreted as original pebbles. These were set in a groundmass of finer grained detrital quartz with much less abundant detrital K-feldspar and muscovite that were enclosed in much finer grained sericite, in part with minor to abundant limonite.

5.3.2 XRD

Four samples were selected for semi-quantitative XRD mineralogy testing. Materials selected for analysis were inferred to represent the different types of Type A material that will be encountered during construction. It is noted that no samples from geotechnical borehole BH19-39 were submitted for XRD testing. However, based on visual assessment it is expected that mineralogy for the collected samples of QUARTZITE was comparable to the analyzed samples of ARKOSE.

A list of samples and the associated analytical results are summarized in Table E below.



**Table E: Summary of XRD Test Results**

Mineral/Compound	Ideal Formula	Sample Results (weight %)			
		TH19-118-SA1	BH19-SM4L-01-SA2	BH19-SM4L-02-SA2	BH19-SM4L-02-SA3
Clinocllore	$(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$	-	-	0.6	1.0
Illite-Muscovite 1M	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2 - KAl_2AlSi_3O_{10}(OH)_2$	-	-	2.5	7.0
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2 - KAl_2AlSi_3O_{10}(OH)_2$	17.5	6.4	18.4	38.5
Kaolinite	$Al_2Si_2O_5(OH)_4$	-	0.6	0.7	1.6
K-feldspar (Microcline)	$KAlSi_3O_8$	10.2	17.0	15.5	13.3
Plagioclase (Albite)	$NaAlSi_3O_8 - CaAl_2Si_2O_8$	-	4.8	3.6	-
Pyrite	FeS_2	0.4	0.4	-	-
Quartz	SiO_2	71.9	70.8	58.2	37.5
Rutile	TiO_2	-	-	0.5	1.1
Total		100	100	100	100
Inferred Rock Type		ARKOSE		Interbedded PELITE and ARKOSE	

The following aspects are inferred from the XRD data:

ARKOSE:

- › Significant quartz/feldspar content (82.1 – 92.6%), these minerals are associated with negligible neutralization potential.
- › Abundant illite-muscovite (6.4 – 17.5%) which may contribute low to moderate neutralization potential, albeit in acidic conditions where pH is well below 6. Such an abundance of these minerals may also contribute to moderately alkaline paste pH and SFE pH results (Table 2 and 3, attached) as inferred by expected abrasion pH (Stevens and Carron 1948).
- › Minor amounts of kaolinite (0.6% in one sample).
- › Reportable pyrite content (0.4%).
- › No detectable reactive net-neutralizing carbonate minerals.

Interbedded PELITE and ARKOSE:

- › Significant quartz/feldspar content (50.8 – 77.8%).
- › Abundant illite-muscovite (20.9 – 45.5%). As discussed above, these minerals may contribute low to moderate neutralization potential in lower pH conditions and may also contribute to moderately alkaline paste pH and SFE pH results.
- › Reportable clinocllore (0.6 – 1.0%) and kaolinite (0.7 – 1.6%).
- › No detectable pyrite.
- › No detectable reactive net-neutralizing carbonate minerals.





5.3.3 Elemental Composition (SALM)

Elemental composition was determined by aqua-regia digest (Strong Acid Leachable Metals) on eleven rock samples. Analytical results compared to the applicable screening criteria are provided in Table 1 (attached); results greater than one or more of the adopted reference criteria are summarized in Table F below.

Table F: Summary of Metal and/or Metalloid Concentrations Greater than Reference Criteria

Rock Type	Parameter	Sample ID	Sample Concentration (µg/g)	Reference Value (µg/g)		
				10x Average Crustal Abundance	CSR WL _R	CSR IL
ARKOSE	Antimony	TH19-118-SA2	0.2	0.1	500	40,000
	Arsenic	BH19-SM4L-01-SA2	39.0	10	10	10
	Barium	BH19-SM4L-02-SA3	298.0	100	350	350
	Cobalt	TH19-118-SA2	9.2	3	25	25
		BH19-SM4L-02-SA3	6.4			
Interbedded PELITE and ARKOSE	Antimony	BH19-39-RC01	0.2	0.1	500	40,000
	Cobalt	BH19-39-RC01	23.6	3	25	25
	Manganese	BH19-39-RC01	296	100	2,000	2,000
QUARTZITE	Antimony	BH19-39-RC02	0.2	0.1	500	40,000
	Cobalt	BH19-39-RC02	7.8	3	25	25
		BH19-39-RC03	5.0			
	Manganese	BH19-39-RC02	390	100	2,000	2,000

SALM testing results suggest the following in relation to detectable metal/metalloid concentrations in the analyzed rock samples:

- › The reported SALM concentrations were less than the CSR reverted wildlands (WL_R) and industrial land use (IL) standards except arsenic in one sample (SA2) of ARKOSE from BH19-SM4L-01. The elevated arsenic in BH19-SM4L-01-SA2 was also greater than the 10x average crustal abundance value.
- › One sample of ARKOSE from TH19-118 reported slightly elevated antimony and cobalt when compared to the 10x average crustal abundance values for SANDSTONE.





- › Barium and cobalt in one sample (SA3) of interbedded PELITE and ARKOSE from BH19-SM4L-02 were greater than the 10x average crustal abundance values for SANDSTONE.
- › Barium, cobalt and manganese in one sample (RC01) of interbedded PELITE and ARKOSE from BH19-39 were greater than the 10x average crustal abundance values for SANDSTONE.
- › Barium, cobalt and/or manganese in two samples (RC02 and RC03) of QUARTZITE from BH19-39 were greater than the 10x average crustal abundance values for SANDSTONE.

Overall, results of the SALM testing on samples of ARKOSE, interbedded PELITE and ARKOSE, and QUARTZITE suggest the sampled materials were not significantly enriched with respect to most metals and/or metalloids. The source of elevated arsenic in BH19-SM4L-01-SA2 was likely a trace constituent with pyrite (Kolker and Nordstrom 1997) based upon the trace amounts of pyrite identified in the petrographic and XRD analysis (refer to Sections 5.3.1 and 5.3.2). However, the leachability upon short term contact as suggested by SFE results (Refer to Section 5.3.6) is relatively low.

5.3.4 ABA

Acid-Base Accounting parameters were tested for eleven rock samples. Analytical results compared against the adopted screening criteria are provided in Table 2, attached. The following aspects are inferred from the ABA results:

ARKOSE:

- › Circumneutral to alkaline pH paste in the range of 7.6 to 8.5, which was likely associated with an abundance of illite-muscovite as suggested by the mineralogy testing.
- › Low to moderate sulphide sulphur content, ranging from 0.01 to 0.27% by weight. The only sample containing detectable sulphate was BH19-SM4L-02-SA4 (0.01%) which suggests the samples were not subject to significant sulphide oxidation prior to analysis. The calculated AP was low to moderate and ranged from 0.3 to 8.4 kilograms CaCO₃ per tonne (kg CaCO₃/tonne). It should be noted that three out five samples reported below what can be considered the threshold for low capacity AP [4.9 kg CaCO₃/tonne (AMIRA 2002)].
- › Negligible Modified Sobek NP from 0.6 to 2.2 kg CaCO₃/tonne and net neutralization potential (NNP) between -7.5 and 2.0 kg CaCO₃/tonne (average -2.9 kg CaCO₃/tonne). This suggests an absence of net-neutralizing reactive Ca/Mg carbonate minerals and that the only minerals providing NP were silicates, which is supported by the mineralogy and petrographic analysis.
- › Calculated NPR from 0.1 to 8.8, with only one sample reporting an NPR greater than 1 (BH19-SM4L-02-SA1 that reported NPR of 8.8).
- › Overall the ARKOSE rock material was characterized as PAG with low to moderate acid-potential.

Interbedded PELITE and ARKOSE:

- › Circumneutral to alkaline pH paste between 7.8 and 8.5, which was likely associated with an abundance of illite-muscovite as suggested by the mineralogy testing.
- › Low to moderate sulphide sulphur content, ranging from <0.01 to 0.52% by weight. The only sample containing detectable sulphate was BH19-SM4L-02-SA3 (0.01%) which suggests the samples were





not subject to significant sulphide oxidation prior to analysis. The calculated AP was low to moderate and ranged from <0.3 to 16.3 kg CaCO₃/tonne. It should be noted that two out of three samples reported below what can be considered the threshold for low capacity AP [4.9 kg CaCO₃/tonne (AMIRA 2002)]. In fact, the two samples (BH19-SM4L-02-SA2 and BH19-SM4L-02-SA3) had AP values below the laboratory reporting limit (0.3 kg CaCO₃/tonne) which concurs with the absence of sulphides noted by the mineralogy and petrographic analysis.

- › Low to moderate Modified Sobek NP ranging from 2.6 to 48.8 kg CaCO₃/tonne and NNP from 2.6 to 32.5 kg CaCO₃/tonne. This suggests NP was provided by both silicate minerals (in terms of low NP values) and net-neutralizing reactive Ca/Mg carbonate minerals (in terms of sample BH19-39-RC01 reporting the upper NP value of 48.8 kg CaCO₃/tonne and an equivalent inorganic carbon content as well as a moderate fizz rating).
- › NPR from 3.0 to 13.7 (assuming AP = 0.3 kg CaCO₃/tonne for samples with non-detectable sulphide sulphur). It should be noted that the lowest NPR value of 3 (associated with sample BH19-39-RC01 had an abundance of net-neutralizing reactive Ca/Mg carbonate mineral content.
- › Overall the Interbedded PELITE and ARKOSE rock material was characterized as non-PAG.

QUARTZITE:

- › Alkaline pH paste between 8.4 and 8.7.
- › Moderate sulphide sulphur content, ranging from 0.28 to 0.88% by weight. The only sample containing detectable sulphate was BH19-39-RC02 (0.02%) which suggests the samples were not subject to significant sulphide oxidation prior to analysis. The calculated AP was low to moderate and ranged from 8.8 to 27.5 kilograms CaCO₃ per tonne (kg CaCO₃/tonne). It should be noted that only one of three samples reported below what can be considered the threshold for low capacity AP [4.9 kg CaCO₃/tonne (AMIRA 2002)].
- › Low to moderate Modified Sobek NP ranging from 7.2 to 42.8 kg CaCO₃/tonne and NNP from -20.3 to 34.0 kg CaCO₃/tonne. This suggests NP is provided by both silicate minerals (in terms of low NP values) and net-neutralizing reactive Ca/Mg carbonate minerals (in terms of sample BH19-39-RC02 reporting the upper NP value of 42.8 kg CaCO₃/tonne and a moderate fizz rating).
- › NPR from 0.3 to 4.9, with two samples reporting an NPR below 1.
- › Overall the QUARTZITE rock material was characterized as PAG with moderate acid-potential.





5.3.5 Net Acid Generation Test

Sample BH19-39-RC04 was selected for single addition NAG testing to assess potential worst-case acid generating potential of the sampled materials. NAG pH for the sample was 2.8 pH units which confirmed this material as PAG based on the screening threshold of < 4.5 pH units.

5.3.6 Shake Flask Extraction

Shake Flask Extraction was completed for eleven samples. Analytical results compared against the adopted screening criteria are provided in Table 3 (attached); leachate concentrations that were greater than one or more of the referenced BCWQG AW are summarized in Table G below.

Table G: Summary of SFE Leachate Concentrations Greater than Reference Criteria

Rock Type	Parameters	Sample ID	Leachate Concentration (mg/L)	Reference Value (mg/L)	
				BCWQG Aquatic Life (AW)	10x BCWQG Aquatic Life (AW)
ARKOSE	pH	BH19-SM4L-02-SA4	6.2	6.5 – 9.0	6.5 – 9.0
	Copper ^a	BH19-SM4L-01-SA2	0.0005	0.0002	0.002
BH19-SM4L-02-SA4		0.0009			
Interbedded PELITE and ARKOSE	Aluminium	BH19-39-RC01	0.181	0.1	1
		BH19-SM4L-02-SA2	0.136		
QUARTZITE	Aluminium	BH19-39-RC03	0.181	0.1	1
		BH19-39-RC04	0.234		
	Arsenic	BH19-39-RC04	0.0059	0.005	0.05
	Copper	BH19-39-RC02	0.0009	0.0002	0.002
		BH19-39-RC03	0.001		
BH19-39-RC04		0.0011			

Notes: a) Guideline is temperature, pH, DOC and hardness dependent.

Dissolved copper in leachate from two samples of ARKOSE (BH19-SM4L-01-SA2 and BH19-SM4L-02-SA4) and three samples of QUARTZITE (BH19-39-RC02, -RC03 and -RC04) were slightly above the BCWQG AW and below the 10-times BCWQG AW. The BCWQG AW for dissolved copper in surface water depends on site-specific and temporal data including temperature, pH, hardness, and dissolved organic carbon. These parameters are not applicable to assessment of SFE leachate and, as such, the comparison of leachate concentrations to BCWQ AW is considered conservative. It is noted that the reported leachate concentrations were below the Canadian Council of Ministers of the Environment (CCME) aquatic water quality guideline of 0.002 mg/L for copper, suggesting the risk of elevated copper in drainage water is low.





Dissolved aluminum in leachate from two samples of interbedded PELITE and ARKOSE (BH19-39-RC01 and BH19-SM4L-02-SA2) and two samples of QUARTZITE (BH19-39-RC03, BH19-39-RC04) were greater than the BCWQG AW and below the 10-times BCWQG AW. These results do not necessarily indicate that elevated aluminum may be problematic in drainage water as MEND, 2009 has shown that this parameter may be associated with fine particulate passing through the 0.45 micron glass filter that is used as part of the test method prior to analysis by ICP-MS (MEND, 2009). This inference is supported by mineralogical results that confirm the presence of aluminum-containing feldspars, sheet silicate minerals, and clay (e.g., microcline, albite, clinocllore, illite-muscovite and kaolinite).

Dissolved arsenic in leachate from one sample of QUARTZITE (BH19-39-RC04) was slightly above the BCWQG AW but below the 10-times BCWQG AW. Risk of elevated arsenic in drainage water is considered low as most samples had SFE leachate concentrations below the BCWQG AW and SALM results for all but one sample were below the CSR WL_R.

RPDs were calculated for BH19-39-RC04 and a duplicate prepared by the laboratory; the RPDs for all parameters were below the DQO of 20% except arsenic which had an RPD of 57%. Reasons for the high arsenic RPD are not clear. However, the result may be associated with the presence/absence of arsenic-containing minerals (e.g., disseminated arsenopyrite) in the solids that were used for the SFE test.

Overall the SFE results suggest that short-term contact of rainfall and/or snowmelt with the tested materials is not likely to generate significant loadings of the above mentioned slightly elevated leachate parameters to drainage water. However, it is noted that the SFE test only provides a preliminary indication of probable water quality upon short-term contact of the bedrock materials with surface water.

5.3.7 Surface Water

Surface water sample locations are shown on drawing 666768-104 and described in Table H below:





Table H: Surface Water Sampling Locations

Location ID	Description	GPS Coordinates		Comments
		Northing	Easting	
CRUS-20191104	Columbia River	5707085	480475	Upstream from the Project and approximately 2.5 km to the north.
CRDS-20191104		5706425	478404	Downstream from the Project and approximately 2 km to the northwest.
SWMP-20191104/SM DUPA	Wetland Area	5704974	478956	Down slope from the Project and up slope from the Columbia River. Located approximately 300 m north of the Project.
GULLY-20191107	Unnamed Creek	5704690	479766	A small creek that flows north through the Project towards the Columbia River. The creek flows under the TCH at approximately Stn. 18+250. The sample was collected south and up slope from the highway.

Analytical results for the pre-construction surface water samples were summarized and compared to the BCWQG AW and DW in Table 4 (attached). Data from each location suggests circumneutral conditions and oxygen saturation as indicated by field measurements of pH and DO. The sample collected from the wetland area had a lower DO concentration which is expected for low-flowing wetland environments. Samples collected from each location had low total suspended solids; this is likely an effect of seasonal low flow conditions (i.e., low energy) during fall months which result in lower suspended sediment loads.

Total and dissolved metal concentrations in each sample were less than the BCWQG AW and DW. It is noted that samples collected from the Columbia River in June 2019 during an ML/ARD assessment to support construction of the Donald Hill descending lane (SNC-Lavalin, 2019) contained slightly elevated total chromium, iron, and zinc. The Donald Hill samples were collected approximately 5.4 km and 11.9 km upstream from CRUS-20191104 and the elevated metals were attributed to higher sediment load in the river during higher freshet flows. These results suggest water chemistry in the area is seasonally affected, and this should be considered for interpretation of future surface water sampling results in the vicinity of the Project.

RPDs for the duplicate pair SWMP/DUPA were below the DQO of 20% except for total and dissolved iron which had RPDs of 21% and 65%, respectively. Water depth was less than 5 cm at the SWMP location and, as such, this sample had to be collected using a syringe. Iron precipitate and/or iron-reducing bacteria was observed on the substrate at this location and it is inferred that the difference in iron concentrations is associated with entrainment of particulate in the duplicate sample. Nevertheless, the surface water data are considered acceptable as the sample and duplicate results were at least one order of magnitude below the BCWQG AW and the other RPD results were less than the DQO.





No data qualifiers were reported by CARO for any of the samples submitted for this assessment and no qualifiers were reported for any of their own Quality Control testing. Given the results of the quality assurance and quality control, the analytical results for surface water are considered acceptable with good reproducibility.

6 Conclusions and Recommendations

Results of the ML/ARD Assessment for the Selkirk Mountain 4-Laning Project on the TCH near Golden, BC suggest the construction will contact Type A materials between STA 16+150 and STA 16+310, and from STA 18+040 and STA 18+200.

Results and field observations suggest prominent rock types between STA 16+150 and STA 16+310 include QUARTZITE and interbedded ARKOSE and PELITE. Results from geochemical testing of QUARTZITE samples suggest this material is PAG with moderate acid potential. Undiluted drainage from this material may contain acidity and sulphate salinity; however, the risk of significant loadings of metals or metalloids is considered low. Laboratory results suggest the interbedded ARKOSE and PELITE was non-PAG material with low risk of generating significant loadings of acidity, sulphate salinity and/or metals and metalloids. Existing data were not sufficient to estimate the relative volumes of each material; however, visual assessment of existing outcrop and road cuts suggest the volume of QUARTZITE between STA 16+150 and STA 16+310 is greater than the volume of interbedded ARKOSE and PELITE.

Prominent rock types observed between STA 18+040 and STA 18+200 include ARKOSE and interbedded ARKOSE and PELITE. ML/ARD testing of ARKOSE samples suggests this material is PAG with low to moderate acid potential. Similar to the QUARTZITE, undiluted drainage from this material may contain acidity and sulphate but the risk of significant loadings of metals and metalloids is considered low. Results suggest that interbedded ARKOSE and PELITE within this road segment is also non-PAG material and, as such, the risk of acid generation and/or metal leaching is considered low. Field observations from existing road cuts suggest the volume of ARKOSE between STA 18+040 and STA 18+200 is greater than the volume of interbedded ARKOSE and PELITE.

Interpretations above suggest that the greatest proportion of Type A material to be excavated for the Selkirk Mountain 4-Laning project is PAG with low potential for metal leaching. The total volume to be excavated is relatively low (5,200 m³) suggesting acidity from the Type A materials may be diluted/buffered along the flow path before drainage water interacts with a surface water receptor.

Based on possible moderate acid potential, it is recommended that QUARTZITE and ARKOSE are not used as fill within a natural watercourse (e.g., rip rap or culvert backfill). MoTI may wish to consider importing material that is demonstrated non-PAG with a negligible potential for metal leaching for locations where fill must be placed in an existing natural watercourse.

Loadings of acidity from other Type A fill locations could be reduced by limiting infiltration of precipitation and runoff through the identified PAG materials. Depending on geotechnical suitability, design elements





could be incorporated within the road embankment or encapsulation could be designed for on- or off-site wasting of the material.

Results from this assessment are not sufficient to predict actual drainage water chemistry. However, SFE results suggest a relative lack of readily soluble metals and/or metalloids. Supplemental test work (e.g., kinetic humidity cell testing) could be considered for the PAG materials to assess more probable drainage water quality and potential effects on surface water receptors (where required).

Short-term effects on surface water may be associated with disturbance and / or placement of Type A material for construction. However, it is expected that these effects can be mitigated through development and proper implementation of a Construction Environmental Management Plan (CEMP) for the Project as per MoTI's Standard Specifications for Highway Construction (MoTI, 2016).

7 Notice to Reader

This report has been prepared and the work referred to in this report have been undertaken by SNC-Lavalin Inc. (SNC-Lavalin) for the exclusive use of the Ministry of Transportation and Infrastructure (MoTI), which has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report. Should this report be submitted to the BC Ministry of Environment & Climate Change Strategy (ENV) by MoTI, the ENV is authorized to rely on the results in the report, subject to the limitations set out herein, for the sole purpose of determining whether MoTI has fulfilled its obligations with respect to meeting the regulatory requirements of the ENV.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made with respect to the professional services provided to MoTI or the findings, conclusions and recommendations contained in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered or project parameters change, modifications to this report may be necessary.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

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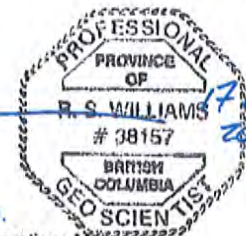


9 Closing

We trust this provides you with the information you currently require. If you have any questions, please contact the undersigned at your earliest convenience.

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- 1: Borehole Logs
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Tables

- 1: Summary of Analytical Results for Metals in Solids
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TABLE 1: Summary of Analytical Results for Metals in Solids

Sample ID Sample Date (yyyy mm dd)	Rock Types	TH19-118-SA2	BH19-SM4L-01-SA2	BH19-SM4L-01-SA4	BH19-SM4L-02-SA1	BH19-SM4L-02-SA2	BH19-SM4L-02-SA3	BH19-SM4L-02-SA4	BH19-39-RC01	BH19-39-RC02	BH19-39-RC03	BH19-39-RC04	Average Crustal Abundance Values 10x ^b Sandstones	CSR Natural Wildlands Reverted Land Use ^a (WLR)	CSR Industrial Land Use ^a (IL)
		2019 11 09	2019 11 05	2019 11 05	2019 11 07	2019 11 07	2019 11 07	2019 11 07	2019 08 27	2019 08 27	2019 08 27	2019 08 27			
Parameter		Analytical Results													
Physical Parameters															
Particle Size Used	mm	< 2	< 2	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	n/a	n/a	n/a
pH 1:2	pH	8.01	8.69	8.68	8.22	8.22	7.56	6.94	8.86	8.83	9.02	9.16	n/a	n/a	n/a
Metals															
Aluminum	µg/g	1,730	1,800	827	1,330	4,390	7,910	748	5,200	3,940	4,300	2,690	250,000	40,000	250,000
Antimony	µg/g	0.2	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	0.2	0.2	0.1	<0.1	0.1	500	40,000
Arsenic	µg/g	0.8	39.0	6.6	0.2	0.1	0.3	6.5	0.8	5.0	5.0	1.9	10	10	10
Barium	µg/g	92.8	12.7	11.1	88.6	46.7	298.0	23.7	46.9	23.5	16.2	11.1	100	350	350
Beryllium	µg/g	0.2	<0.1	<0.1	0.1	0.3	0.9	<0.1	0.4	0.1	0.2	0.1	1	150	350
Bismuth	µg/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	D	n/a	n/a
Boron	µg/g	0.8	0.7	<0.5	0.6	1.3	1.6	<0.5	0.6	0.6	<0.5	0.5	350	15,000	1,000,000
Cadmium	µg/g	0.03	<0.01	<0.01	<0.01	0.02	0.02	<0.01	0.08	0.03	0.03	0.02	0.1	30	3-50 ^c
Chromium	µg/g	10	23	27	11	8	4	5	4	13	8	6	350	60 ^d	60 ^d
Cobalt	µg/g	9.2	1.0	1.7	0.8	1.7	6.4	0.9	23.6	7.8	5.0	2.3	3	25	25
Copper	µg/g	1.4	0.9	1.5	1.4	0.6	0.4	0.5	0.5	0.7	0.6	0.6	10	150	300
Iron	µg/g	3,470	4,850	5,420	3,370	7,410	22,700	3,740	25,400	32,700	14,900	10,800	98,000	35,000	150,000
Lead	µg/g	2.0	1.7	1.1	0.6	1.1	2.8	2.4	3.1	2.9	4.1	1.6	70	550	1,000
Lithium	µg/g	<0.5	<0.5	0.6	0.6	1.7	3.7	<0.5	4.2	5.0	3.9	1.1	150	65	450
Manganese	µg/g	4	28	39	50	51	77	4	296	390	77	53	100	2,000	2,000
Mercury	µg/g	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.3	25	75
Molybdenum	µg/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	2	15	15
Nickel	µg/g	2.9	1.9	2.0	1.0	1.7	6.6	0.9	16.1	5.7	5.5	2.2	20	250	250
Selenium	µg/g	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	0.1	0.2	0.5	1	1
Silver	µg/g	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	<0.5 ^e	0.1	400	35,000
Strontium	µg/g	5	3	4	4	4	7	1	36	41	18	13	200	20,000	150,000
Thallium	µg/g	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	8.2	n/a	n/a
Tin	µg/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1	50,000	1,000,000
Tungsten	µg/g	0.05	<0.05	0.10	<0.05	<0.05	0.07	<0.05	0.08	<0.05	<0.05	<0.05	16	25	200
Uranium	µg/g	<0.2	<0.2	<0.2	<0.2	0.2	0.3	<0.2	1.8	1.8	0.3	1.1	4.5	30	30
Vanadium	µg/g	1	<1	<1	<1	<1	2	<1	2	<1	<1	<1	200	100	100
Zinc	µg/g	3	1	1	2	3	7	<1	9	4	1	<1	160	450	450
Zirconium	µg/g	0.9	0.4	0.2	0.2	0.9	0.6	0.2	3.8	0.8	1.1	1.1	2,200	n/a	n/a

Associated Global file: 1964.

All terms defined within the body of SNC-Lavalin's report.

< Denotes concentration less than indicated detection limit.

n/a Denotes no applicable standard/guideline.

D Denotes data for this element is not available.

^a The site-specific factors used for determining the matrix standards for this site include: intake of contaminated soil, groundwater used for drinking water, toxicity to soil invertebrates and plants, and groundwater flow to surface water used by freshwater aquatic life (whichever is most stringent).

^b Average abundance in Sandstones (Price, A.W. 1997).

^c Standard varies with pH.

^d Individual standards exist for Cr +3 and Cr +6. Reported value represents more stringent standard.

^e Laboratory detection limit exceeds reference criteria

BOLD	Sample concentration greater than land use screening criteria.
SHADOW	Sample concentration greater than average crustal abundance values.

TABLE 2: Summary of Acid-Base Accounting (ABA) Results

Sample ID	Sample Date (yyyy mm dd)	Rock Types	Paste pH pH Units	Fizz Rating -	Total Inorganic C wt %	CaCO ₃ Equivalents kg CaCO ₃ /tonne	Total Sulphur wt %	Sulphate Sulphur wt %	Sulphide Sulphur ¹ wt %	AP ² kg CaCO ₃ / tonne	Mod. ABA NP kg CaCO ₃ / tonne	NNP ³ kg CaCO ₃ / tonne	NPR ⁴ -	Material Characterization ⁵
TH19-118-SA2	2019 11 9	ARKOSE	8.3	None	-	-	0.270	<0.01	0.27	8.4	0.9	-7.5	0.1	PAG
BH19-SM4L-01-SA2	2019 11 05		8.5	None	-	-	0.169	<0.01	0.17	5.3	1.4	-3.9	0.3	PAG
BH19-SM4L-01-SA4	2019 11 05		8.5	None	-	-	0.088	<0.01	0.09	2.8	1.6	-1.2	0.6	PAG
BH19-SM4L-02-SA1	2019 11 07		8.3	None	-	-	0.008	<0.01	0.01	0.3	2.2	2.0	8.8	non-PAG
BH19-SM4L-02-SA2	2019 11 07	Interbedded PELITE and ARKOSE	8.2	None	-	-	<0.005	<0.01	<0.01	<0.3	2.6	2.6	8.6	non-PAG
BH19-SM4L-02-SA3	2019 11 07		7.8	None	<0.02	<1.7	0.007	0.01	<0.01	<0.3	4.1	4.1	13.7	non-PAG
BH19-SM4L-02-SA4	2019 11 07	ARKOSE	7.6	None	-	-	0.156	0.01	0.15	4.6	0.6	-4.0	0.1	PAG
BH19-39-RC01	2019 08 27	Interbedded PELITE and ARKOSE	8.5	Moderate	0.57	47.5	0.523	<0.01	0.52	16.3	48.8	32.5	3.0	non-PAG
BH19-39-RC02	2019 08 27	QUARTZITE	8.4	Moderate	-	-	0.302	0.02	0.28	8.8	42.8	34.0	4.9	non-PAG
BH19-39-RC03	2019 08 27		8.5	None	-	-	0.712	<0.01	0.71	22.3	9.2	-13.1	0.4	PAG
BH19-39-RC04	2019 08 27		8.7	None	-	-	0.879	<0.01	0.88	27.5	7.2	-20.3	0.3	PAG

Associated Global File: 1964.

¹ Sulphide-Sulphur: Total-sulphur - sulphate-sulphur

² AP (Acid Potential): Sulphide-sulphur x 31.25

³ NNP (Net Neutralization Potential): NP - AP

⁴ NPR (Neutralization Potential Ratio): NP/AP. The reporting limit of AP was used for sample results below the reporting limit.

⁵ Refer to in-text Table A of report for adopted reference criteria

TABLE 3: Summary of Shake Flask Extraction (SFE) Results - Aquatic Life Comparison

Sample ID	TH19-118-SA2	BH19-SM4L-01-SA2	BH19-SM4L-01-SA4	BH19-SM4L-02-SA1	BH19-SM4L-02-SA2	BH19-SM4L-02-SA3	BH19-SM4L-02-SA4	BH19-39-RC01	BH19-39-RC02	BH19-39-RC03	BH19-39-RC04	BH19-39-RC04	QA/QC	BCWQG	BCWQG		
Sample Date (yyyy mm dd)	2019 11 09	2019 11 05	2019 11 05	2019 11 07	2019 11 07	2019 11 07	2019 11 07	2019 08 27	2019 08 27	2019 08 27	2019 08 27	Lab duplicate	RPD	Aquatic Life (AW) ^{a,b}	Aquatic Life (AW) ^a (10x)		
Rock Types	ARKOSE				Interbedded PELITE and ARKOSE		ARKOSE		Interbedded PELITE and ARKOSE		QUARTZITE				%		
Parameter	Units	Analytical Results															
Physical Parameters																	
Weight of dry sample used	g	250	250	250	250	250	250	250	250	250	250	250	250	*	n/a	n/a	
Volume of DI water used	mL	750	750	750	750	750	750	750	750	750	750	750	750	*	n/a	n/a	
pH	pH	6.8	7.0	7.0	7.0	6.7	6.5	6.2	8.4	8.0	7.7	8.8	8.8	*	6.5-9.0	6.5-9.0	
Hardness, Total (as CaCO3)	mg/L	2.9	3.3	4.5	4.2	1.4	6.2	0.9	35.1	31.5	27.7	27.1	26.7	1	n/a	n/a	
EC	µS/cm	28	17	25	30	17	23	17	86	79	75	75	77	3	n/a	n/a	
ORP	mV	224	210	183	208	221	247	246	155	144	131	120	123	2	n/a	n/a	
Acidity (to pH 8.3)	mg CaCO ₃ /L	5.6	4.4	5.0	8.1	5.0	7.5	5.6	<0.5	2.8	2.5	<0.5	<0.5	*	n/a	n/a	
Alkalinity (to pH 4.5)	mg CaCO ₃ /L	7.5	6.3	9.0	9.4	6.3	5.0	4.4	31.3	28.8	25.0	25.6	25.0	2	n/a	n/a	
Dissolved Sulphate (SO4)	mg/L	4.6	0.5	<0.5	3.7	1.2	4.9	3.2	4.6	4.6	6.9	6.3	6.0	5	128-218 ^c (LT)	1,280-2,180 ^c (LT)	
Ion Balance																	
Major Anions	meq/L	0.25	0.14	0.18	0.26	0.15	0.20	0.15	0.72	0.67	0.64	0.64	0.63	3	n/a	n/a	
Major Cations	meq/L	0.21	0.15	0.21	0.25	0.14	0.19	0.11	0.80	0.72	0.68	0.69	0.68	1	n/a	n/a	
Difference	meq/L	-0.04	0.01	0.03	-0.02	-0.01	-0.01	-0.04	0.08	0.05	0.04	0.05	0.06	20	n/a	n/a	
Balance (%)	%	-8.4%	4.8%	7.7%	-3.6%	-2.2%	-3.1%	-14.6%	5.2%	3.6%	2.7%	3.6%	4.5%	22	n/a	n/a	
Dissolved Metals																	
Aluminum	mg/L	0.056	0.09	0.068	0.081	0.136	0.024	0.017	0.181	0.082	0.181	0.234	0.241	3	0.1	1	
Antimony	mg/L	0.0007	0.0004	0.0004	0.0007	0.0006	0.0005	0.0002	0.0003	0.0002	0.0003	0.0007	0.0007	0	0.009 (LT)	0.09 (LT)	
Arsenic	mg/L	0.0017	0.0037	0.0024	0.0002	0.0004	0.0004	0.0002	0.0004	0.0004	0.0015	0.0059	0.0033	57	0.005	0.05	
Barium	mg/L	0.0395	0.0013	0.0033	0.0333	0.0029	0.0388	0.0031	0.0057	0.0024	0.003	0.0019	0.0019	*	1 (LT)	10 (LT)	
Beryllium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*	0.00013 (LT)	0.0013 (LT)	
Bismuth	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*	n/a	n/a	
Boron	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	*	1.2 (LT)	12 (LT)	
Cadmium	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	*	0.00004-0.0002 ^c	0.0004-0.002 ^c	
Calcium	mg/L	0.78	0.81	1.16	1.02	0.28	1.15	0.25	8.32	8.42	5.15	4.83	4.75	2	n/a	n/a	
Chromium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	*	0.001 (Cr(+6)) (LT)	0.01 (Cr(+6)) (LT)	
Cobalt	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*	0.11	1.1	
Copper	mg/L	<0.0005 ^f	0.0005	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	0.0009	<0.0005 ^f	0.0009	0.001	0.0011	0.0011	*	0.0002 ^e	0.002 ^e	
Iron	mg/L	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	*	1 (max)	10 (max)	
Lead	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	*	0.003-0.0215 ^c	0.03-0.215 ^c	
Lithium	mg/L	0.0012	0.0014	0.002	0.0022	0.002	0.0008	0.0013	0.0077	0.0023	0.0029	0.001	0.0011	10	n/a	n/a	
Magnesium	mg/L	0.22	0.3	0.4	0.4	0.169	0.81	0.065	3.47	2.54	3.61	3.66	3.61	1	n/a	n/a	
Manganese	mg/L	0.0012	0.0011	0.0024	0.004	0.0008	0.0037	0.0032	0.0019	0.0011	0.008	0.0056	0.0058	4	0.815-0.927 ^c	8.15-9.27 ^c	
Mercury	mg/L	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	<0.0005 ^f	*	0.00002 ^d	0.0002 ^d	
Molybdenum	mg/L	<0.0001	<0.0001	0.0001	0.0002	0.0001	<0.0001	<0.0001	0.0002	0.0005	0.0001	0.0001	0.0001	*	2	20	
Nickel	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	*	0.025 (LT)	0.25 (LT)	
Phosphorus	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	*	n/a	n/a	
Potassium	mg/L	4.36	1.93	2.72	4.36	2.89	1.81	2.61	2.65	2.37	3.3	3.61	3.61	0	n/a	n/a	
Selenium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	0.0005	*	0.002 (LT)	0.02 (LT)	
Silicon	mg/L	0.99	1.07	1.77	1.23	1.35	0.73	1.4	0.88	1.1	1.31	1.45	1.44	1	n/a	n/a	
Silver	mg/L	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	*	100	1,000	
Sodium	mg/L	0.73	0.56	0.96	0.94	0.61	0.37	0.65	0.24	0.49	0.44	0.7	0.69	1	n/a	n/a	
Strontium	mg/L	0.0158	0.0037	0.0075	0.0108	0.0012	0.0099	0.0021	0.0511	0.0394	0.0376	0.0288	0.03	4	n/a	n/a	
Sulphur	mg/L	1.2	<0.5	<0.5	0.7	<0.5	1.4	1	1.4	1.4	3.6	4.4	4.8	9	n/a	n/a	
Tellurium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*	n/a	n/a	
Thallium	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	*	0.0008 (LT)	0.008 (LT)	
Thorium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*	n/a	n/a	
Tin	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	*	n/a	n/a	
Titanium	mg/L	0.0007	<0.0005	0.0007	0.0005	0.0013	0.0008	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0005	*	n/a	n/a	
Tungsten	ug/L	0.0014	0.0002	0.0039	0.0008	0.0003	0.0004	<0.0001	0.0022	0.0003	0.0006	0.0016	0.0016	*	n/a	n/a	
Uranium	mg/L	<0.00005	<0.00005	0.00007	0.00006	<0.00005	<0.00005	<0.00005	0.00022	0.00032	0.00032	0.00043	0.00044	2	0.0085 (LT)	0.085 (LT)	
Vanadium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*	n/a	n/a	
Zinc	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*	0.033	0.33	
Zirconium	mg/L	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	*	n/a	n/a	

Associated Global file: 1964.
 All terms defined within the body of SNC-Lavalin's report.
 < Denotes concentration less than indicated detection limit.
 n/a Denotes no applicable standard/guideline.

^a Guideline to protect freshwater aquatic life.
^b Long-term Average guideline applied (LT) where no Short-term Maximum guideline available.
^c Guideline varies with Hardness.
^d Total Mercury guideline is based on the % of MethylMercury present. WQG = 0.0001 / (MeHg/total Hg), where MeHg is mass (or concentration) of methyl mercury and THg. Guideline shown assumes MeHg<0.5% of Total Hg.
^e Guideline is temperature, pH, DOC and hardness dependent.
^f Laboratory detection limit exceeds reference criteria.

BOLD	Exceedance of B Exceedance of BCWQG AW value.
SHADOW	Exceedance of B Exceedance of BCWQG AW 10x value.

TABLE 4: Summary of Analytical Results for Dissolved Inorganics and Metals in Surface Water

Sample Location	Sample ID	CRDS				CRUS		SWMP		QA/QC RPD %	GULLY	BC Guideline		
		CRDS-20191104	CRUS-20191104	SWMP-20191104	SM-DUPA-20191104	GULLY-20191107		BCWQG	BCWQG			BCWQG		
		Sample Date (yyyy mm dd)	2019 11 04	2019 11 04	2019 11 04	Duplicate	2019 11 04	Aquatic Life Short-term Maximum (AW) ^b	Aquatic Life Long-term Average (AW) ^c			Drinking Water (DW)		
Parameter	Units	Analytical Results												
Physical Parameters														
pH	pH	-	-	-	-	-	-	-	-	7.50	6.5 - 9	6.5 - 9	6.5 - 8.5	
Total Hardness	mg/L	150	147	115	109	5	54.9	n/a	n/a	n/a	n/a	n/a	n/a	
Total Dissolved Solids	mg/L	170	178	149	143	4	75	n/a	n/a	n/a	n/a	n/a	n/a	
Total Suspended Solids	mg/L	3.4	3.4	4.2	< 2.0	*	< 2.0	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Organic Carbon	mg/L	0.61	0.68	2.27	2.46	*	1.64	n/a	n/a	n/a	n/a	n/a	n/a	
Total Nitrogen-N	mg/L	0.0550	0.100	0.0640	0.142	*	< 0.0500	n/a	n/a	n/a	n/a	n/a	n/a	
Field Parameters														
Field Temperature	C	1.1	1.1	6.9	6.9	*	3.4	n/a	n/a	n/a	n/a	n/a	15	
Field Conductivity	µS/cm	284.5	283.0	240.2	240.2	*	122.2	n/a	n/a	n/a	n/a	n/a	n/a	
pH (field)	pH	7.73	8.15	7.25	7.25	*	7.06	6.5 - 9	6.5 - 9	6.5 - 9	6.5 - 9	6.5 - 9	6.5 - 8.5	
Field ORP	mV	233.8	249.7	22	22	*	218.6	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Oxygen	mg/L	11.7	12.18	6.45	6.45	*	9.56	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Inorganics														
Dissolved Aluminum	µg/L	< 5.0	< 5.0	< 5.0	< 5.0	*	9.1	100 (pH>=6.5)	50 (pH>=6.5)	n/a	n/a	n/a	n/a	
Dissolved Calcium	mg/L	33.8	32.8	28.6	27.3	5	11.4	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Iron	µg/L	28	22	50	98	65	11	350 (max)	n/a	n/a	n/a	n/a	n/a	
Dissolved Magnesium	mg/L	15.9	15.7	10.5	9.93	6	6.40	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Manganese	µg/L	5.32	5.21	8.54	9.03	6	9.52	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Potassium	mg/L	0.50	0.49	0.55	0.52	6	0.95	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Sodium	mg/L	2.12	2.12	8.06	6.78	17	2.24	n/a	n/a	n/a	n/a	n/a	n/a	
Total Alkalinity	mg/L	122	122	99.3	95.5	4	55.6	n/a	n/a	n/a	n/a	n/a	n/a	
Nitrate (as N)	µg/L	105	102	16	14	*	36	32,800 (max)	3,000	10,000	10,000	10,000	10,000	
Nitrite (as N)	µg/L			< 10	< 10	*		240 (Cl (mg/L) 6-<8)	100 (Cl (mg/L) 8-<10)	1,000	1,000	1,000	1,000	
				< 10	< 10	*		300 (Cl (mg/L) 8-<10)	20 (Cl (mg/L) <2)	80 (Cl (mg/L) 6-<8)	80 (Cl (mg/L) 6-<8)	80 (Cl (mg/L) 6-<8)	80 (Cl (mg/L) 6-<8)	
Chloride	mg/L	0.85	0.86	8.38	7.51	11	0.20	600	150	250	250	250	250	
Fluoride	µg/L	< 100	100	< 100	< 100	*	< 100	1,093.022 - 1,497.108	n/a	1,500	1,500	1,500	1,500	
Sulfate	mg/L			21.4	21.4	*	10.3	1,093.022 - 1,497.108	218 (H 30-75)	500	500	500	500	
				36.8	36.8	21.1	21.1	n/a	309 (H 75-180)	309 (H 75-180)	309 (H 75-180)	309 (H 75-180)	309 (H 75-180)	
Alkalinity, Bicarbonate (as CaCO3)	mg/L	122	122	99.3	95.5	4	55.6	n/a	n/a	n/a	n/a	n/a	n/a	
Alkalinity, Carbonate (as CaCO3)	mg/L	< 1.0	< 1.0	< 1.0	< 1.0	*	< 1.0	n/a	n/a	n/a	n/a	n/a	n/a	
Alkalinity, Hydroxide (as CaCO3)	mg/L	< 1.0	< 1.0	< 1.0	< 1.0	*	< 1.0	n/a	n/a	n/a	n/a	n/a	n/a	
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	< 1.0	< 1.0	< 1.0	< 1.0	*	< 1.0	n/a	n/a	n/a	n/a	n/a	n/a	
Kjeldahl Nitrogen-N	mg/L	0.055	0.100	0.064	0.142	*	< 0.050	n/a	n/a	n/a	n/a	n/a	n/a	
Dissolved Metals														
Antimony	µg/L	< 0.20	< 0.20	< 0.20	< 0.20	*	< 0.20	100 (pH>=6.5)	50 (pH>=6.5)	n/a	n/a	n/a	n/a	
Arsenic	µg/L	< 0.50	< 0.50	< 0.50	< 0.50	*	< 0.50	n/a	n/a	n/a	n/a	n/a	n/a	
Barium	µg/L	44.6	43.6	62.5	61.5	2	128	n/a	n/a	n/a	n/a	n/a	n/a	
Beryllium	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Boron	µg/L	7.7	10.0	< 5.0	< 5.0	*	14.0	n/a	n/a	n/a	n/a	n/a	n/a	
Cadmium	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	*	< 0.010	0.317 - 0.893 ^d	0.136 - 0.285 ^d	n/a	n/a	n/a	n/a	
Chromium	µg/L	1.02	< 0.50	< 0.50	< 0.50	*	< 0.50	n/a	n/a	n/a	n/a	n/a	n/a	
Cobalt	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Copper	µg/L	< 0.40 ^a	< 0.40 ^a	< 0.40 ^a	< 0.40 ^a	*	< 0.40 ^a	1.6 - 3.9 ^e	0.3 - 0.6 ^e	n/a	n/a	n/a	n/a	
Lead	µg/L	< 0.20	< 0.20	< 0.20	< 0.20	*	< 0.20	n/a	n/a	n/a	n/a	n/a	n/a	
Lithium	µg/L	2.08	2.02	0.75	0.68	10	6.51	n/a	n/a	n/a	n/a	n/a	n/a	
Mercury	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	*	< 0.010	n/a	n/a	n/a	n/a	n/a	n/a	
Molybdenum	µg/L	0.68	0.67	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Nickel	µg/L	0.55	< 0.40	< 0.40	< 0.40	*	< 0.40	n/a	n/a	n/a	n/a	n/a	n/a	
Selenium	µg/L	< 0.50	< 0.50	< 0.50	< 0.50	*	< 0.50	n/a	n/a	n/a	n/a	n/a	n/a	
Silver	µg/L	< 0.050	< 0.050	< 0.050	< 0.050	*	< 0.050	n/a	n/a	n/a	n/a	n/a	n/a	
Thallium	µg/L	< 0.020	< 0.020	< 0.020	< 0.020	*	< 0.020	n/a	n/a	n/a	n/a	n/a	n/a	
Titanium	µg/L	< 5.0	< 5.0	< 5.0	< 5.0	*	< 5.0	n/a	n/a	n/a	n/a	n/a	n/a	
Tungsten	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	*	< 1.0	n/a	n/a	n/a	n/a	n/a	n/a	
Uranium	µg/L	0.979	0.963	0.209	0.197	6	0.052	n/a	8.5	n/a	n/a	n/a	n/a	
Vanadium	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	*	< 1.0	n/a	n/a	n/a	n/a	n/a	n/a	
Zinc	µg/L	< 4.0	< 4.0	< 4.0	< 4.0	*	< 4.0	n/a	n/a	n/a	n/a	n/a	n/a	
Bismuth	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Phosphorous	µg/L	< 50	< 50	< 50	< 50	*	< 50	n/a	n/a	n/a	n/a	n/a	n/a	
Silicon	µg/L	2,500	2,400	5,100	5,000	2	4,300	n/a	n/a	n/a	n/a	n/a	n/a	
Strontium	µg/L	291	287	229	218	5	281	n/a	n/a	n/a	n/a	n/a	n/a	
Sulphur	µg/L	12,900	12,700	7,200	7,500	*	3,300	n/a	n/a	n/a	n/a	n/a	n/a	
Tellurium	µg/L	< 0.50	< 0.50	< 0.50	< 0.50	*	< 0.50	n/a	n/a	n/a	n/a	n/a	n/a	
Thorium	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Tin	µg/L	< 0.20	< 0.20	< 0.20	< 0.20	*	< 0.20	n/a	n/a	n/a	n/a	n/a	n/a	
Zirconium	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	0.15	n/a	n/a	n/a	n/a	n/a	n/a	
Total Metals														
Aluminum	µg/L	32.3	25.0	7.5	10.2	*	15.0	n/a	n/a	9,500	9,500	9,500	9,500	
Antimony	µg/L	< 0.20	< 0.20	< 0.20	< 0.20	*	< 0.20	n/a	9	n/a	n/a	n/a	n/a	
Arsenic	µg/L	0.61	0.57	< 0.50	< 0.50	*	< 0.50	5	n/a	10	10	10	10	
Barium	µg/L	46.5	45.5	61.2	64.3	5	136	n/a	1,000	n/a	n/a	n/a	n/a	
Beryllium	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	0.13	n/a	n/a	n/a	n/a	
Bismuth	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	n/a	n/a	n/a	n/a	n/a	n/a	
Boron	µg/L	13.1	16.9	8.8	7.2	*	16.6	n/a	1,200	5,000	5,000	5,000		
Cadmium	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	*	< 0.010	n/a	n/a	5	5	5	5	
Calcium	µg/L	36,100	35,500	28,700	30,300	5	12,300	n/a	n/a	n/a	n/a	n/a	n/a	
Chromium	µg/L	< 0.50	0.74	< 0.50	< 0.50	*	< 0.50	n/a	1 (Cr(+6))	n/a	n/a	n/a	n/a	
Cobalt	µg/L	< 0.10	< 0.10	< 0.10	< 0.10	*	< 0.10	110	4	n/a	n/a	n/a	n/a	
Copper	µg/L	1.10	0.48	0.75	0.66	*	0.79	n/a	n/a	1,000	1,000	1,000		
Iron	µg/L	158	129	109	134	21	20	1,000 (max)	n/a	300	300	300		
Lead	µg/L	0.30	0.22	< 0.20	< 0.20	*	< 0.20	38.054 - 136.803	4.794 - 8.646	10	10	10		
Lithium	µg/L	2.25	2.13	0.77	0.82	6	6.88	n/a	n/a	n/a	n/a	n/a		
Magnesium	µg/L	16,400	16,000	9,870	10,600	7	6,880	n/a	n/a	n/a	n/a	n/a		
Manganese	µg/L	9.45	8.72	8.44	9.04	7	11.5	1,144.998 - 2,193	846.56 - 1,265	50	50	50		
Mercury	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	*	< 0.010	n/a	0.02 ^f	1	1	1		
Molybdenum	µg/L	0.69	0.73	< 0.10	< 0.10	*	< 0.10	2,000	1,000	250	250	250		
Nickel	µg/L	< 0.40	0.63	0.43	< 0.40	*	< 0.40	n/a	25 - 130.071	n/a	n/a	n/a		
Phosphorous	µg/L	< 50	< 50	< 50	< 50	*	< 50	n/a	n/a	n/a	n/a	n/a		
Potassium	µg/L	540	520	550	580	5	1,020	n/a	n/a	n/a	n/a	n/a		
Selenium	µg/L	< 0.50	< 0.50	< 0.50	< 0.50	*	< 0.50	n/a	2	10	10	10		
Silicon	µg/L	2,600	2,600	4,900	5,200	*	4,800	n/a	n/a	n/a	n/a	n/a		
Silver	µg/L			< 0.050	< 0.050	*	< 0.050	0.1 (H <=100)	0.05 (H <=100)	n/a	n/a	n/a	n/a	
				< 0.050	< 0.050	< 0.050	< 0.050	3 (H >100)	1.5					



Drawings

- › 666768-100: Site Location Plan
- › 666768-101: Site Information Review
- › 666768-102: Borehole Location Plan
- › 666768-103: Borehole Location Plan
- › 666768-104: Surface Water Sample Locations



LEGEND

-  Selkirk Mountain Location
-  Highway
-  Roads
-  Railway

NOTES

1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale, however scale bar will remain accurate.
3. Intended for illustration purposes, accuracy has not been verified for construction or navigation purposes.

REFERENCES

Service Layer Credits: World Imagery:
Source: Esri, DigitalGlobe, GeoEye,
Earthstar Geographics, CNES/Airbus DS,



SNC • LAVALIN

CLIENT NAME:
Ministry of Transportation and Infrastructure

PROJECT LOCATION:
Columbia- Shuswap Regional District, BC

Site Location Plan



BY: ECH

DATE: 2020-03-13

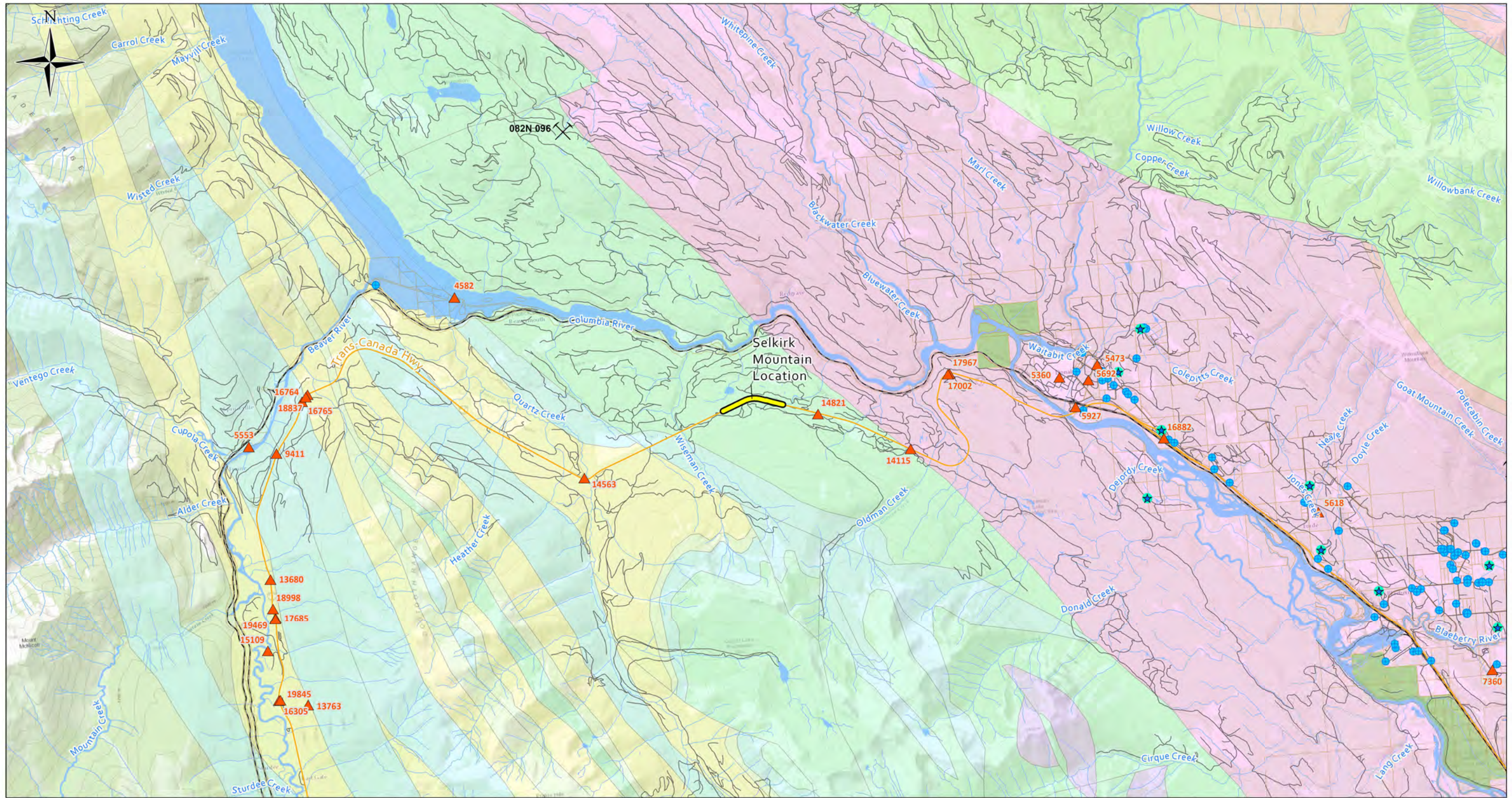
REF No:

REV:

CHKD: GG

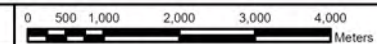
SCALE: 1:60,000

666768-100



LEGEND

- Selkirk Mountain Location
- minfile_bc_alb
- Environmental Remediation Sites
- Surface Water Points of Diversion
- Groundwater Well
- Local Government Boundaries
- Highway
- Roads
- Railway
- Stream
- BC Parcel Fabric
- Provincial Parks, Eco Reserves and Protected Areas - All
- Badshot Formation (limestone, marble, calcareous sedimentary rocks)
- Chancellor Formation (Upper) (limestone, slate, siltstone, argillite)
- Hamill Group (quartzite, quartz arenite sedimentary rocks)
- Horsethief Creek Group (coarse clastic sedimentary rocks)
- Horsethief Creek Group (limestone, marble, calcareous sedimentary rocks)
- Horsethief Creek Group (mudstone, siltstone, shale fine clastic sedimentary rocks)
- McKay Group (mudstone, siltstone, shale fine clastic sedimentary rocks)
- Middle Chancellor Formation (limestone, marble, calcareous sedimentary rocks)



REFERENCES

1. Map data source include ESRI Base Layers, DataBC, SNC-Lavalin, and MOTI

NOTES

1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale, however scale bar will remain accurate.
3. Intended for illustration purposes, accuracy has not been verified for construction or navigation purposes.

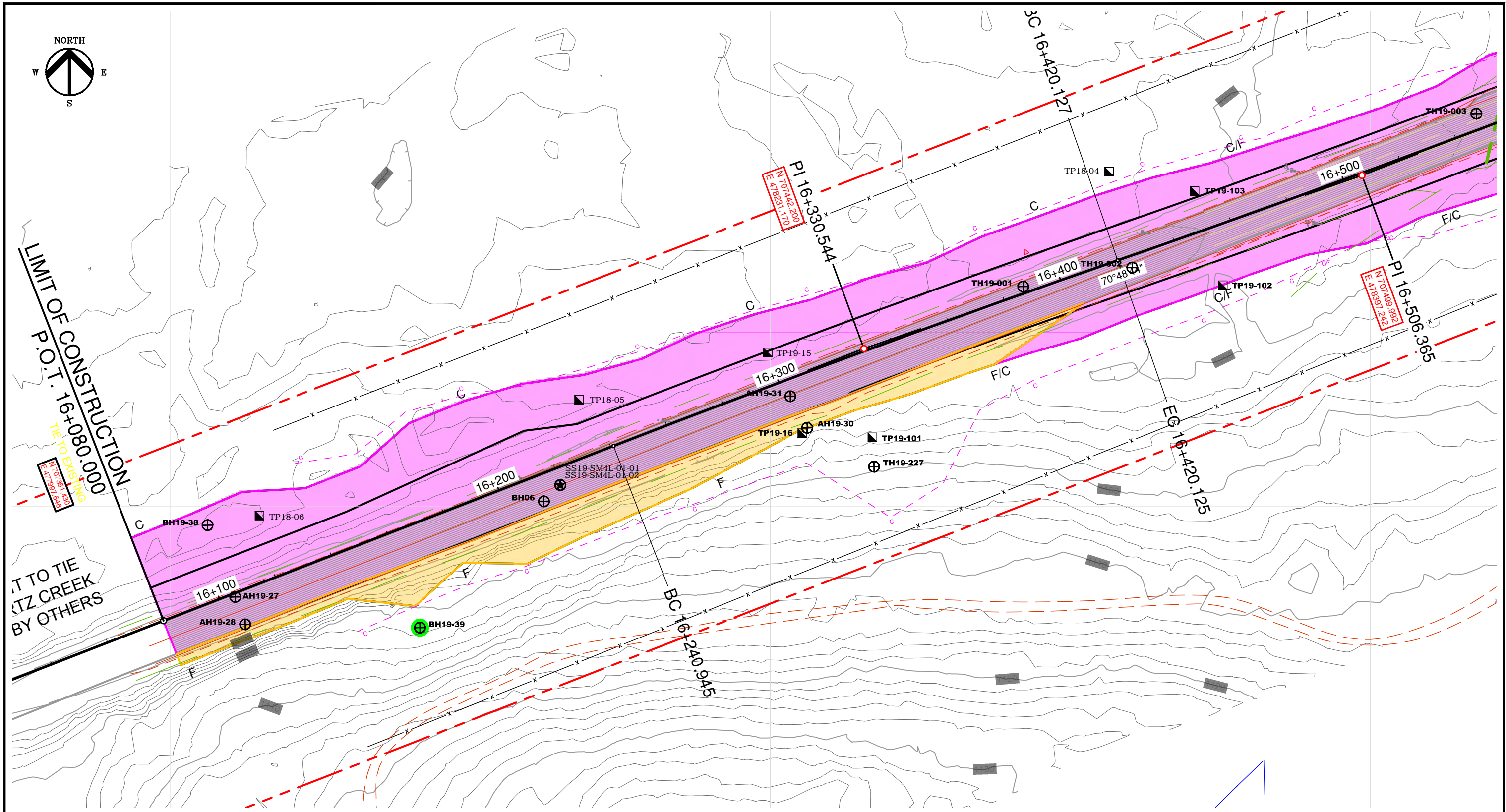


SNC-LAVALIN

CLIENT NAME: Ministry of Transportation and Infrastructure
 PROJECT LOCATION: Columbia-Shuswap Regional District

Site Information Review

BY: ECH	SCALE: 1:100,000	DATE: 2020-03-13	REF No: REV: 0
CHK'D: GG	PROJ COORD SYS: NAD 1983 UTM Zone 10N	666768-101	



LEGEND

- RIGHT-OF-WAY
- LOT BOUNDARY
- x FENCE
- ~ MAJOR CONTOUR
- ~ MINOR CONTOUR
- PAVEMENT EDGE
- CREEK
- DRAINAGE DITCH
- DIRT ROAD
- PROPOSED PAVEMENT EDGE
- PROPOSED CUT LINE
- PROPOSED CUT ZONE
- PROPOSED FILL LINE
- PROPOSED FILL ZONE
- ▣ TEST PIT LOCATION
- ⊕ TESTHOLE LOCATION
- ⊕ BEDROCK BOREHOLE
- ⊕ SURFICIAL SOIL SAMPLE

NOTES

1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED PRIOR TO INTRUSIVE WORK. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

DWG. NO.	DATE	DESCRIPTION	BY	CHK
R2-1041-100	2019-09-12	M.O.T.I.		
REVISIONS				
1	2020-03-16	ISSUED TO CLIENT	PRT	CP
0	2020-02-06	ISSUED TO CLIENT AS DRAFT	PES	GG

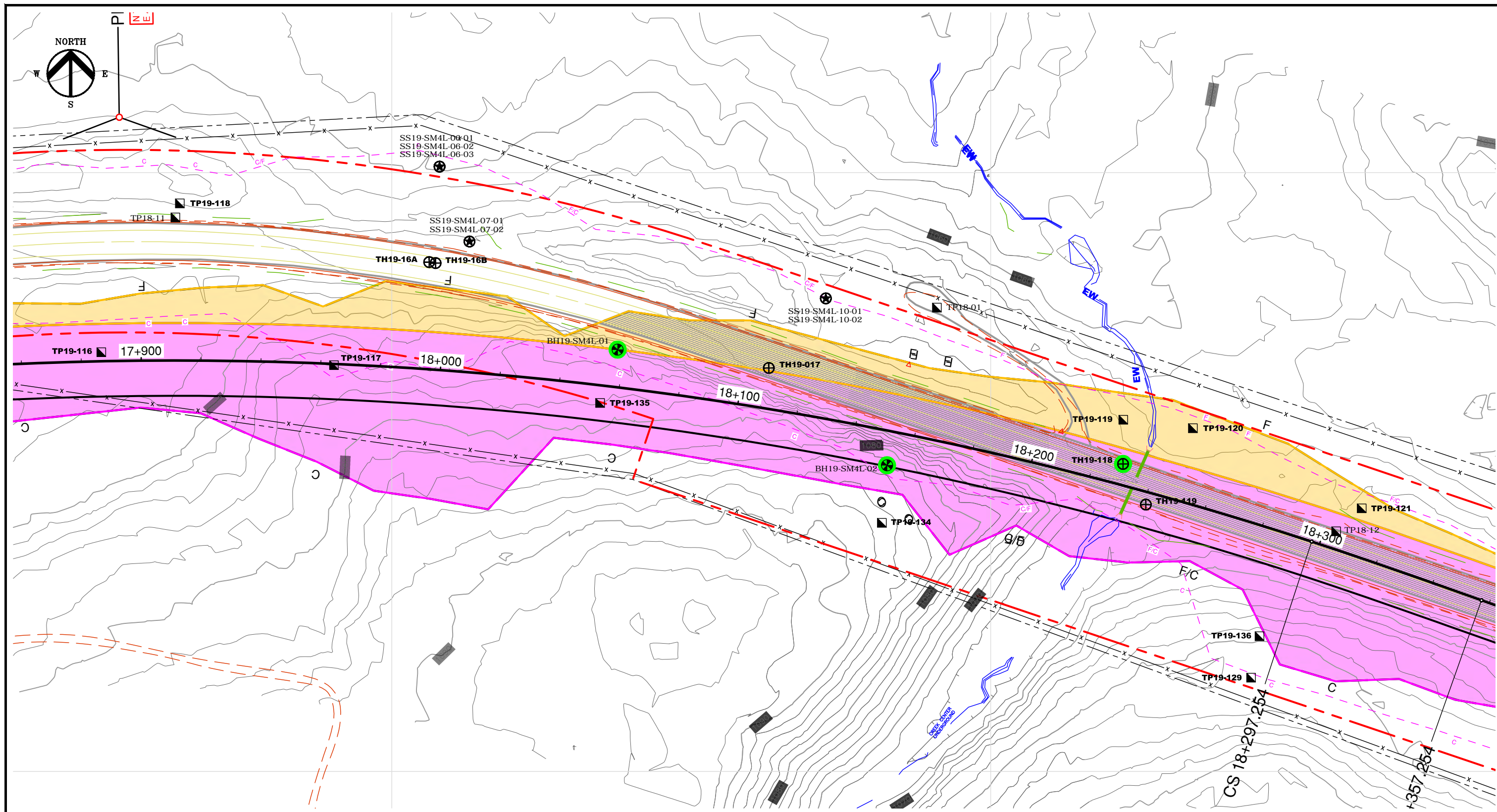
CLIENT NAME:
MINISTRY OF TRANSPORTATION
AND INFRASTRUCTURE

PROJECT LOCATION:
TRANS CANADA HIGHWAY
SELKIRK MOUNTAINS

TITLE:
**BOREHOLE LOCATION PLAN
(KEY PLAN 102)**

DWN BY: PES	SCALE: 1:1,250	DATE: 2020-02-06	DWG No: 666768-102	REV: 1
CHK'D: GG	PLOT: 20200316.1201	CADFILE: 666768R0		





LEGEND

- RIGHT-OF-WAY
- LOT BOUNDARY
- x FENCE
- MAJOR CONTOUR
- MINOR CONTOUR
- PAVEMENT EDGE
- CREEK
- DRAINAGE DITCH
- DIRT ROAD
- PROPOSED PAVEMENT EDGE
- PROPOSED CUT LINE
- PROPOSED CUT ZONE
- PROPOSED FILL ZONE
- TEST PIT LOCATION
- ⊕ TESTHOLE LOCATION
- ⊗ BEDROCK BOREHOLE
- ⊙ SURFICIAL SOIL SAMPLE



NOTES

1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED PRIOR TO INTRUSIVE WORK. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

R2-1041-100	2019-09-12	M.O.T.I.
DWG. NO.	DATE	DESCRIPTION
REVISIONS		
1	2020-03-16	ISSUED TO CLIENT
0	2020-02-06	ISSUED TO CLIENT AS DRAFT
REV.	DATE	DESCRIPTION

CLIENT NAME:
MINISTRY OF TRANSPORTATION
AND INFRASTRUCTURE

PROJECT LOCATION:
TRANS CANADA HIGHWAY
SELKIRK MOUNTAINS

TITLE:
**BOREHOLE LOCATION PLAN
(KEY PLAN 106)**

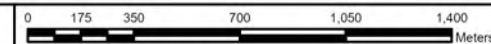


DWN BY: PES	SCALE: 1:1,250	DATE: 2020-02-06	DWG No: 666768-103
CHK'D: GG	PLOT: 20200316.1201	CADFILE: 666768R0	REV: 1



LEGEND

- Borehole
- Water Sample Location
- Selkirk Mountain Location
- Highway
- Roads
- Railway



REFERENCES

1. Map data source include ESRI Base Layers.....

NOTES

1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale, however scale bar will remain accurate.
3. Intended for illustration purposes, accuracy has not been verified for construction or navigation purposes.



SNC • LAVALIN

CLIENT NAME: Ministry of Transportation and Infrastructure
 PROJECT LOCATION: Columbia-Shuswap Regional District

Water Sampling Location Plan

BY: ECH	SCALE: 1:25,000	DATE: 2020-03-13	REF No:	REV: 0
CHK'D: GG	PROJ COORD SYS: NAD 1983 UTM Zone 10N	666768-104		



Attachment 1

Borehole Logs



ROCK CORE LOG

Drill Hole #: **BH19-SM4L-01**

Project: **Highway 1, Selkirk Passing Lane**

Location: Near Golden, BC

Date(s) Drilled: 2019/11/05 - 2019/11/06

Drilling Company: Blue Max Drilling

Prepared by: 666768

Datum: Zone 10U NAD 83

Alignment: Vertical

Driller:

Northing/Easting: 5704740, 479602

Station/Offset:

Drill Make/Model: Mobile B47

Logged by: RW/CA Reviewed by:

Elevation: 1073.10 m

Drilling Method: HQ

DEPTH (m)	DRILLING DETAILS	RECOVERY % RQD %	CORE RUN NO	CORE QUALITY	DISCONTINUITY SPACING	INTACT ROCK STRENGTH	WEATHERING	UCS (MPa)	ROCK SYMBOL	ROCK MASS DESCRIPTION	CLASSIFICATION	# OF JOINTS	STRUCTURAL DISCONTINUITY DESCRIPTION	INSTALLATION	ELEVATION (m)
1										START OF ROCK CORE AT 1.35m					1072
2	ISA11		1	Excellent		R4-R5	F			ARKOSE, pink, disseminated moderately weathered sulphide mineralization.	BR	1	JN; At 1.58 m - J, Jr=1, alpha=9°, Ja=1/ JN; At 1.68 m - J, Jr=1, alpha=21°, Ja=1		1071
			2	Poor		R4-R5	F			No Return.		3	At 2.18 m - J, Jr=2, alpha=60°, Ja=1 JN; At 2.19 m - J, Jr=2, alpha=<5°, Ja=1		
3			3	Poor		R4	F			PELITE and ARKOSE (inter-bedded), green-grey, laminated.	BR	1	At 2.19 m - J, Jr=2, alpha=<5°, Ja=1 JN; At 2.8 m - B, alpha=26°, Ja=1		1070
4			3	Poor		R4	F			ARKOSE, pink, no visible sulphide mineralization.		5	JN; At 3.51 m - J, Jr=1.5, alpha=20°, Ja=1 JN; At 3.56 m - J, Jr=1.5, alpha=20°, Ja=1 JN; At 3.63 m - J, Jr=1.5, alpha=20°, Ja=1 JN; At 3.96 m - J, Jr=1.5, alpha=85°, Ja=1 JN; At 4.11 m - J, Jr=1.5, alpha=29°, Ja=1		1069
5			4	Excellent		R4-R5	F					4	JN; At 4.72 m - J, Jr=1, alpha=40°, Ja=1 JN; At 4.98 m - J, Jr=1, alpha=20°, Ja=1 JN; At 5.31 m - J, Jr=1, alpha=45°, Ja=1 JN; At 5.41 m - J, Jr=1, alpha=11°, Ja=1 JN; At 6.76 m - J, Jr=2, alpha=42°, Ja=8		1068
6	ISA21		5	Excellent		R5	F					2	At 7.34 m - J, Jr=1, alpha=65°, Ja=1 JN; At 8.18 m - J, Jr=1, alpha=49°, Ja=1 JN; At 8.51 m - J, Jr=1, alpha=20°, Ja=1 JN; At 8.61 m - J, Jr=1, alpha=28°, Ja=1		1067
7			5	Excellent		R5	F					2			1066
8			6	Excellent		R5	F					3			1065
9			6	Excellent		R5	F					3			1064
10	SA3		7	Fair		R5	F					3			

Below 6.1 m iron staining on fracture surfaces, disseminated fresh sulphide mineralization.

MOTI-ROCK-REV3 666768 LOGS.GPJ MOTI_DATATEMPLATE_REV3.GDT 20/03/16

Discontinuity Spacing: No. of fractures/m

Rock Strength (MPa)	
R0 Extremely Weak >1	R3 Medium Strong 25-50
R1 Very Weak 1-5	R4 Strong 50-100
R2 Weak 5-25	R5 Very Strong 100-250
	R6 Extremely Strong >250

Weathering	
F Fresh	HW Highly
SW Slightly	CW Completely
MW Moderately	RS Residual Soil

Final Depth of Hole: 14.6 m
Depth to Top of Rock: 1.4 m
Page 1 of 2



Ministry of Transportation and Infrastructure

ROCK CORE LOG

Drill Hole #: **BH19-SM4L-01**

Project: **Highway 1, Selkirk Passing Lane**

Date(s) Drilled: 2019/11/05 - 2019/11/06

Location: Near Golden, BC

Drilling Company: Blue Max Drilling

Prepared by: 666768

Datum: Zone 10U NAD 83

Alignment: Vertical

Driller:

Northing/Easting: 5704740, 479602

Station/Offset:

Drill Make/Model: Mobile B47

Logged by: RW/CA Reviewed by:

Elevation: 1073.10 m

Drilling Method: HQ

DEPTH (m)	DRILLING DETAILS	RECOVERY % RQD %	CORE RUN NO	CORE QUALITY	DISCONTINUITY SPACING	INTACT ROCK STRENGTH	WEATHERING	UCS (MPa)	ROCK SYMBOL	ROCK MASS DESCRIPTION	CLASSIFICATION	# OF JOINTS	STRUCTURAL DISCONTINUITY DESCRIPTION	INSTALLATION	ELEVATION (m)
10		20 40 60 80								ARKOSE, pink, no visible sulphide mineralization. (continued)					1063
11			8	Very Poor		R4	F			Below 10.67 m iron staining on fracture surfaces, no visible sulphide mineralization.		2	JN; At 10.26 m - J, Jr=1, alpha=5°, Ja=8 JN; At 10.54 m - J, Jr=1, alpha=15°, Ja=8		1062
12			9	Good		R5	F			Below 11.43 m pink-orange, disseminated sulphide mineralization. Below 11.76 m pink, iron staining on fracture surfaces, disseminated sulphide mineralization.		1	JN; At 10.92 m - J, Jr=1.5, alpha=8°, Ja=1 JN; At 11.43 m - J, Jr=1.5, alpha=23°, Ja=1		1061
13			10	Excellent		R5	F								1060
14			11	Fair		R5	MW					4	JN; At 13.79 m - J, Jr=1.5, alpha=15°, Ja=8 Between 13.79 - 14.17 m - Rubble.		1059
15										END OF HOLE	14.63m		JN; At 14.04 m - J, Jr=1.5, alpha=15°, Ja=8 JN; At 14.21 m - J, Jr=1.5, alpha=15°, Ja=8 JN; At 14.23 m - J, Jr=1.5, alpha=15°, Ja=8		1058
16															1057
17															1056
18															1055
19															

MOTI-ROCK-REV3 666768_LOGS.GPJ MOTI_DATATEMPLATE_REV3.GDT 20/03/16

Discontinuity Spacing: No. of fractures/m	Rock Strength (MPa)	R3 Medium Strong 25-50	Weathering	Final Depth of Hole: 14.6 m
	R0 Extremely Weak >1 R1 Very Weak 1-5 R2 Weak 5-25	R4 Strong 50-100 R5 Very Strong 100-250 R6 Extremely Strong >250	F Fresh SW Slightly MW Moderately HW Highly CW Completely RS Residual Soil	Depth to Top of Rock: 1.4 m

Page 2 of 2



Ministry of Transportation and Infrastructure

ROCK CORE LOG

Drill Hole #: **BH19-SM4L-02**

Project: **Highway 1, Selkirk Passing Lane**

Location: Near Golden, BC

Date(s) Drilled: 2019/11/07

Drilling Company: Blue Max Drilling

Prepared by: 666768

Datum: Zone 10U NAD 83

Alignment: Vertical

Northing/Easting: 5704702, 479692

Station/Offset:

Driller:

Drill Make/Model: Mobile B47

Drilling Method: HQ

Logged by: RW/CA Reviewed by:

Elevation: 1094.92 m

DEPTH (m)	DRILLING DETAILS	RECOVERY % RQD %	CORE RUN NO	CORE QUALITY	DISCONTINUITY SPACING	INTACT ROCK STRENGTH	WEATHERING	UCS (MPa)	ROCK SYMBOL	ROCK MASS DESCRIPTION	CLASSIFICATION	# OF JOINTS	STRUCTURAL DISCONTINUITY DESCRIPTION	INSTALLATION	ELEVATION (m)
1										START OF ROCK CORE AT 1.37m					
1.37 - 1.52			1	Excellent		R4	MW			ARKOSE, orange-pink, no visible sulphide mineralization. Below 1.52 m - iron staining on fracture surfaces.		0	From 1.52 - 1.73 m - Rubble.		1093
1.52 - 3.05			2	Good		R4	F				BR	0			1092
3.05 - 3.15										ARKOSE, orange-pink, iron staining on fracture surfaces.	BR				
3.15 - 3.20										ARKOSE and PELITE (inter-bedded), green, laminated, no visible sulphide mineralization.		6	At 3.2 m - J, Jr=1, alpha=48°, Ja=1		
3.20 - 3.45			3	Poor		R5	F			Below 3.20 m - orange-pink, iron staining on fracture surfaces.		6	From 3.45 - 3.71 m - Rubble.		1091
3.45 - 3.73										Below 3.74 m - dark pink, iron staining on fracture surfaces.	BR		At 3.73 m - J, Jr=1, alpha=45°, Ja=1		
3.73 - 4.11										Below 4.06 m - green, iron staining on fracture surfaces.		6	At 4.11 m - J, Jr=1.5, alpha=45°, Ja=8		
4.11 - 4.17										Below 4.57 m - pink-grey, laminated, iron staining on fracture surfaces.		6	At 4.17 m - J, Jr=1.5, alpha=25°, Ja=8		
4.17 - 4.27												6	At 4.27 m - J, Jr=1.5, alpha=12°, Ja=8		1090
4.27 - 4.34												6	At 4.34 m - J, Jr=1.5, alpha=55°, Ja=8		
4.34 - 4.72			4	Fair		R4	SW			ARKOSE, mottled orange-pink green, iron staining, disseminated sulphide mineralization.		6	At 4.72 m - J, Jr=1.5, alpha=55°, Ja=8		1089
4.72 - 4.98												6	At 4.98 m - J, Jr=1.5, alpha=31°, Ja=8		
4.98 - 5.21												6	At 5.21 m - J, Jr=1.5, alpha=62°, Ja=8		
5.21 - 5.51												6	At 5.51 m - J, Jr=1, alpha=62°, Ja=1		
5.51 - 5.81												6	At 5.81 m - J, Jr=1, alpha=62°, Ja=1		1088
5.81 - 5.84												6	At 5.84 m - J, Jr=1, alpha=55°, Ja=1		
5.84 - 5.94												6	From 5.94 - 6.10 m - Rubble.		
5.94 - 6.40												6	From 6.40 - 6.60 m - Rubble.		
6.40 - 6.60												6	JN;		
6.60 - 7.57												6	At 7.57 m - J, Jr=1, alpha=5°, Ja=1		1087

MOTI-ROCK-REV3_666768_LOGS.GPJ MOTI_DATATEMPLATE_REV3.GDT 20/03/16

Discontinuity Spacing: No. of fractures/m	Rock Strength (MPa)		Weathering		Final Depth of Hole: 18.3 m Depth to Top of Rock: 1.4 m Page 1 of 3							
	R0 Extremely Weak >1	R1 Very Weak 1-5	R2 Weak 5-25	R3 Medium Strong 25-50		R4 Strong 50-100	R5 Very Strong 100-250	R6 Extremely Strong >250	F Fresh	SW Slightly	MW Moderately	HW Highly



Ministry of
Transportation
and Infrastructure

ROCK CORE LOG

Drill Hole #: **BH19-SM4L-02**

Project: **Highway 1, Selkirk Passing Lane**

Location: Near Golden, BC

Date(s) Drilled: 2019/11/07

Drilling Company: Blue Max Drilling

Prepared by: 666768

Datum: Zone 10U NAD 83

Alignment: Vertical

Northing/Easting: 5704702, 479692

Station/Offset:

Logged by: RW/CA Reviewed by:

Elevation: 1094.92 m

Driller:

Drill Make/Model: Mobile B47

Drilling Method: HQ

DEPTH (m)	DRILLING DETAILS	RECOVERY % RQD %	CORE RUN NO	CORE QUALITY	DISCONTINUITY SPACING	INTACT ROCK STRENGTH	WEATHERING	UCS (MPa)	ROCK SYMBOL	ROCK MASS DESCRIPTION	CLASSIFICATION	# OF JOINTS	STRUCTURAL DISCONTINUITY DESCRIPTION	INSTALLATION	ELEVATION (m)
8			6	Fair		R4	SW			8.41m	1	From 8.43 - 8.50 m - Rubble.		1086	
9												At 8.92 m - J, Jr=1, alpha=20°, Ja=1			
10			7	Good		R4	F				1	Below 9.14 m - green-grey, iron staining, laminated.		1085	
11											BR	JN; At 10.51 m - J, Jr=1.5, alpha=15°, Ja=1		1084	
12			8	Fair		R4	F				6	Below 9.78 m - mottled pink-orange-grey, iron staining, mottled quartz. Below 9.91 m - green-grey, laminated. Below 10.06 m - mottled pink-grey, disseminated sulphide mineralization. Below 10.67 m - green-grey, iron staining on fracture surfaces, no visible sulphide mineralization. Below 10.97 m - pink-grey, iron staining on fracture surfaces, zone of intact joints (rubble).		1083	
13												JN; At 11.0 m - J, Jr=1, alpha=58°, Ja=1 JN; At 11.10 m - J, Jr=1, alpha=50°, Ja=1 JN; At 11.13 m - J, Jr=1, alpha=40°, Ja=1 JN; At 11.18 m - J, Jr=1, alpha=14°, Ja=1			
14			9	Fair		R5	F-SW				4	Below 11.68 m - pink-grey, iron staining on fracture surfaces, laminated, mottled quartz. Below 12.44 m - fresh, pink, iron staining on fracture surfaces, mottled quartz.		1082	
15												JN; At 11.86 m - J, Jr=1.5, alpha=18°, Ja=1 JN; At 11.94 m - J, Jr=1, alpha=20°, Ja=1			
			10	Excellent		R5	F-SW			13.5m	1	Below 12.98 m - green-brown, laminated.		1081	
											BR	JN; At 12.70 m - J, Jr=1.5, alpha=20°, Ja=1 JN; At 12.78 m - J, Jr=1.5, alpha=5°, Ja=1 JN; At 12.88 m - J, Jr=1, alpha=20°, Ja=1			
			11	Fair		R5	MW			14.63m 14.71m	5	ARKOSE, fresh, pink, iron staining on fracture surfaces, mottled quartz, disseminated sulphide mineralization.		1080	
											BR	From 12.96 - 13.11 m - Rubble. JN; At 13.59 m - J, Jr=1, alpha=22°, Ja=1			
												From 14.02 - 14.15 m - Rubble.			

MOTI-ROCK-REV3_666768_LOGS.GPJ MOTI_DATATEMPLATE_REV3.GDT 20/03/16

Discontinuity Spacing: No. of fractures/m	Rock Strength (MPa)		Weathering		Final Depth of Hole: 18.3 m Depth to Top of Rock: 1.4 m Page 2 of 3
	R0 Extremely Weak >1 R1 Very Weak 1-5 R2 Weak 5-25	R3 Medium Strong 25-50 R4 Strong 50-100 R5 Very Strong 100-250 R6 Extremely Strong >250	F Fresh SW Slightly MW Moderately	HW Highly CW Completely RS Residual Soil	



Ministry of Transportation and Infrastructure

ROCK CORE LOG

Drill Hole #: **BH19-SM4L-02**

Project: **Highway 1, Selkirk Passing Lane**

Location: Near Golden, BC

Date(s) Drilled: 2019/11/07

Drilling Company: Blue Max Drilling

Prepared by: 666768

Datum: Zone 10U NAD 83

Alignment: Vertical

Northing/Easting: 5704702, 479692

Station/Offset:

Driller:

Drill Make/Model: Mobile B47

Logged by: RW/CA Reviewed by:

Elevation: 1094.92 m

Drilling Method: HQ

DEPTH (m)	DRILLING DETAILS	RECOVERY % RQD %	CORE RUN NO	CORE QUALITY	DISCONTINUITY SPACING	INTACT ROCK STRENGTH	WEATHERING	UCS (MPa)	ROCK SYMBOL	ROCK MASS DESCRIPTION	CLASSIFICATION	# OF JOINTS	STRUCTURAL DISCONTINUITY DESCRIPTION	INSTALLATION	ELEVATION (m)
15										mineralization. ARKOSE, pink-grey, iron staining on fracture surfaces, disseminated sulphide mineralization, zone of intact joints (rubble). <i>(continued)</i>			JN; At 14.27 m - J, Jr=1, alpha=65°, Ja=1		
16			12	Fair		R2	MW-HW			Below 15.54 m - pink-grey, iron staining on fracture surfaces, rubble. Below 15.65 m - fresh, pink-grey, iron staining on fracture surfaces.	BR	2	JN; At 14.30 m - J, Jr=1, alpha=78°, Ja=1 JN; At 14.53 m - J, Jr=1, alpha=52°, Ja=1 JN; At 14.63 m - J, Jr=1, alpha=52°, Ja=1 JN; At 14.65 m - J, Jr=1, alpha=52°, Ja=1		1079
17										16.76m PELITE and ARKOSE (inter-bedded), orange-grey, iron staining on fracture surfaces, clay-silt-sand infilling rubble.	BR		From 15.57 - 15.81 m - Rubble. JN; At 16.15 m - J, Jr=1, alpha=25°, Ja=1		1078
18			13	Fair		R2	F			17.09m ARKOSE, pink-grey, iron staining on fracture surfaces.	BR	0	JN; At 16.36 m - J, Jr=1, alpha=35°, Ja=1		1077
18.29m										END OF HOLE			From 16.76 - 17.32 m - Rubble.		1076
19															1075
20															1074
21															1073
22															1073

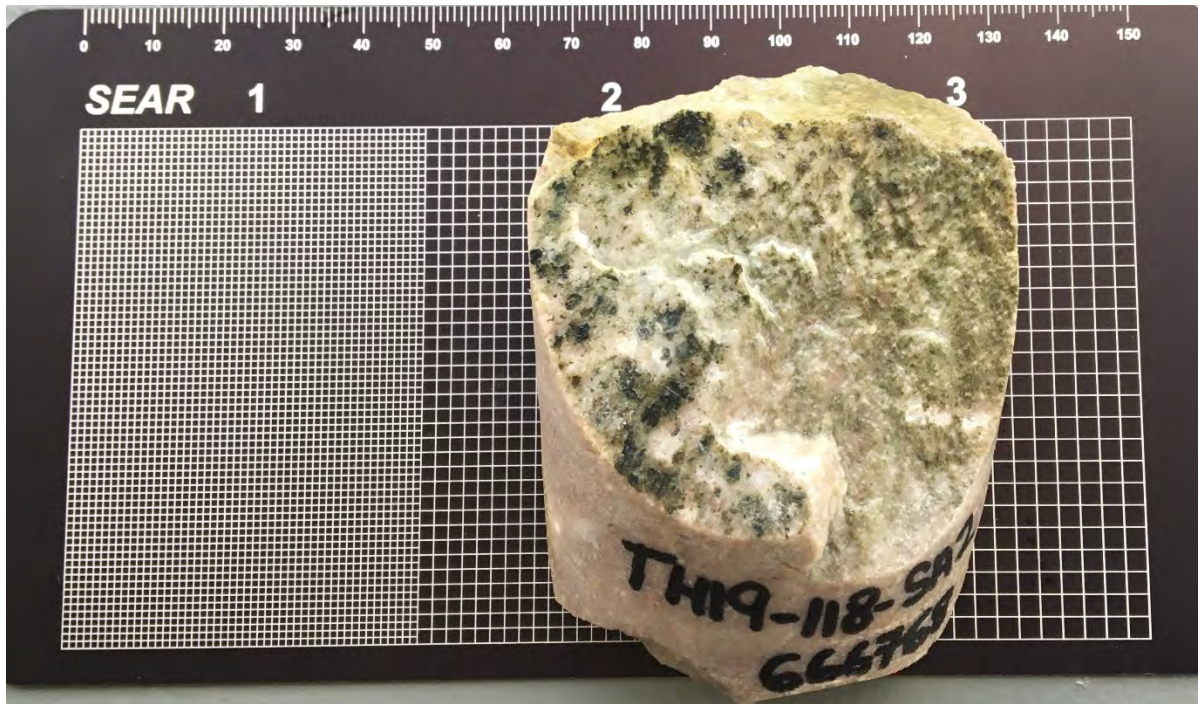
MOTI-ROCK-REV3 666768_LOGS.GPJ MOTI_DATATEMPLATE_REV3.GDT 20/03/16

Discontinuity Spacing: No. of fractures/m	Rock Strength (MPa)	R3 Medium Strong 25-50	Weathering	Final Depth of Hole: 18.3 m
	R0 Extremely Weak >1 R1 Very Weak 1-5 R2 Weak 5-25	R4 Strong 50-100 R5 Very Strong 100-250 R6 Extremely Strong >250	F Fresh SW Slightly MW Moderately	Depth to Top of Rock: 1.4 m
			HW Highly CW Completely RS Residual Soil	Page 3 of 3

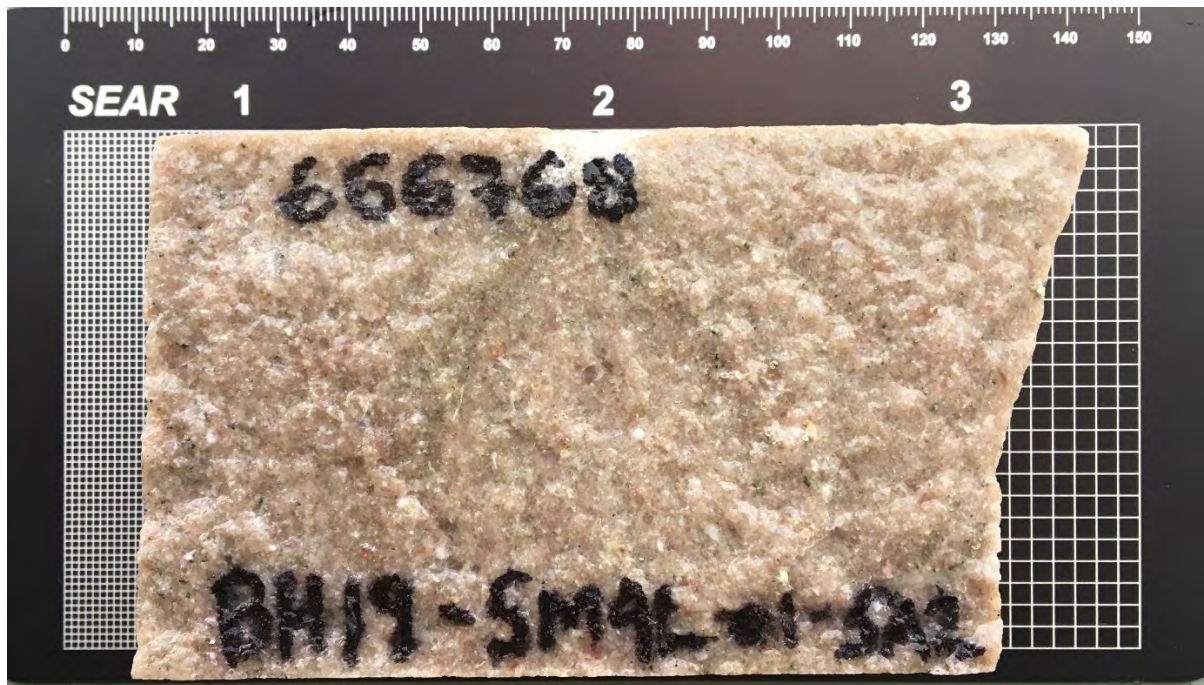


Attachment 2

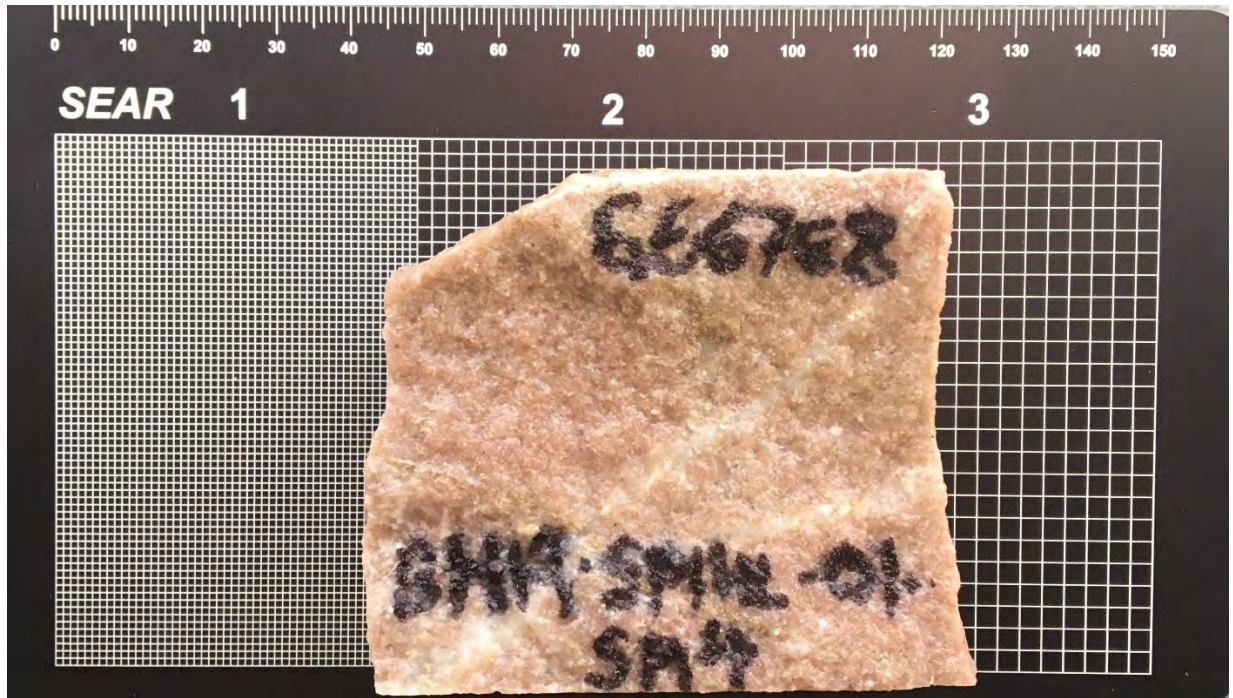
Photographs



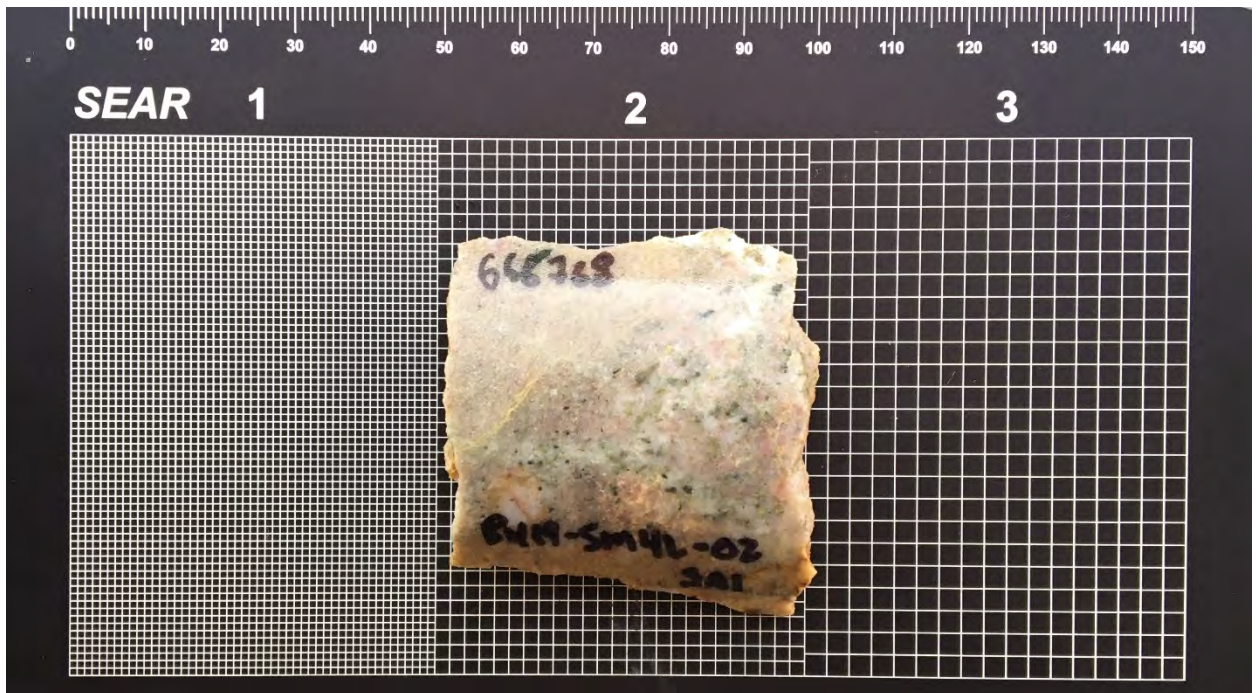
Photograph 1: Sample of ARKOSE from TH19-118-SA2.



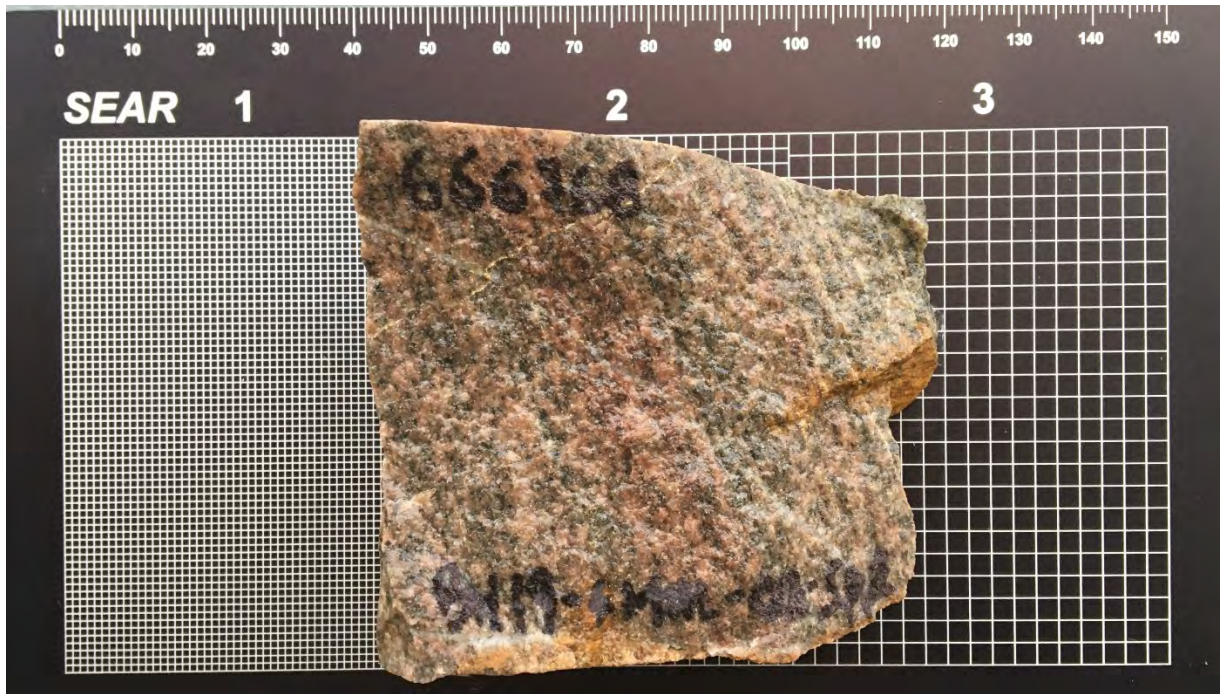
Photograph 2: Sample of ARKOSE from BH19-SM4L-01-SA2.



Photograph 3: Sample of ARKOSE from BH19-SM4L-01-SA4.



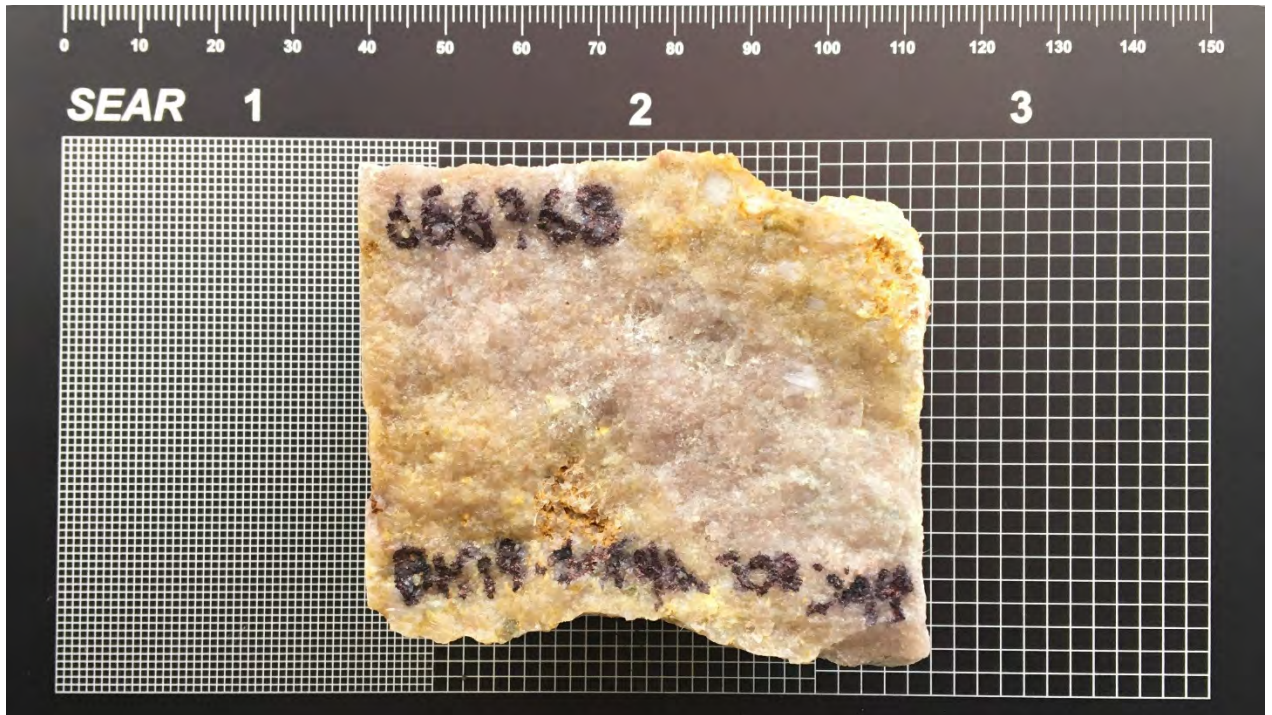
Photograph 4: Sample of ARKOSE from BH19-SM4L-02-SA1.



Photograph 5: Sample of interbedded PELITE and ARKOSE from BH19-SM4L-02-SA2.



Photograph 6: Sample of interbedded PELITE and ARKOSE from BH19-SM4L-02-SA3.



Photograph 7: Sample of ARKOSE from BH19-SM4L-02-SA4.



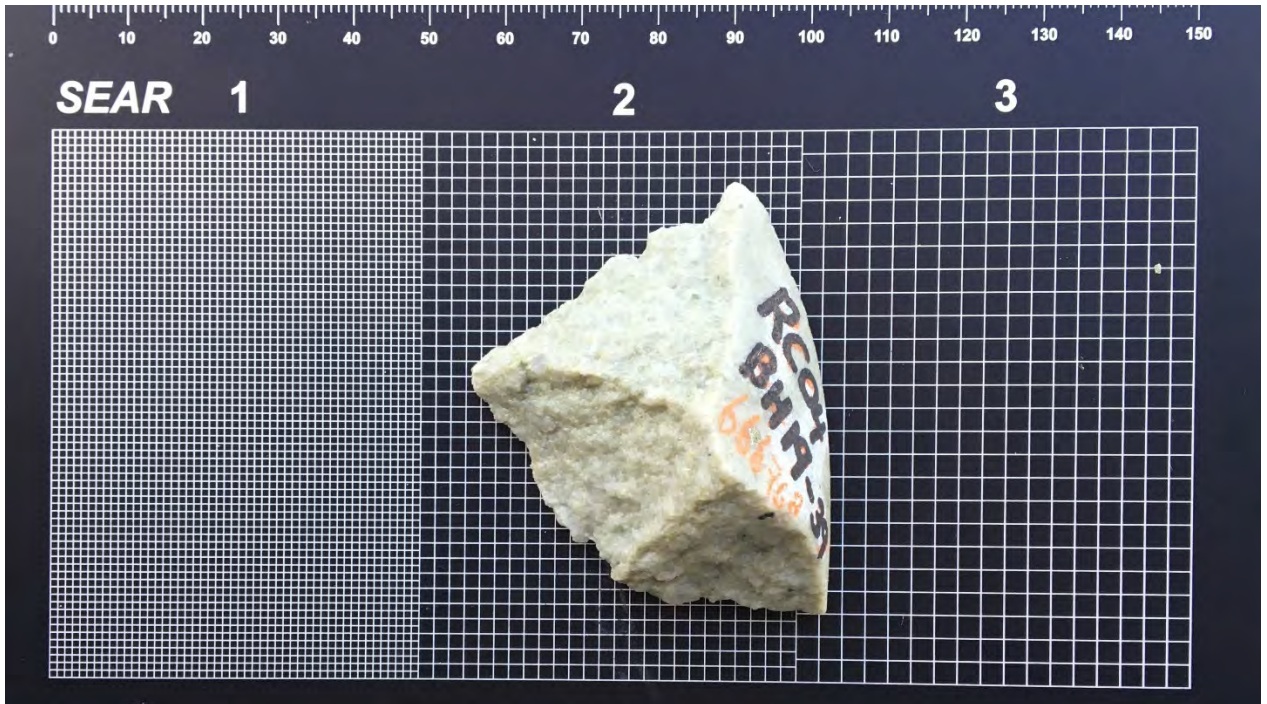
Photograph 8: Sample of interbedded PELITE and ARKOSE from BH19-39-RC01.



Photograph 9: Sample of QUARTZITE from BH19-39-RC02.



Photograph 10: Sample of QUARTZITE from BH19-39-RC03.



Photograph 11: Sample of QUARTZITE from BH19-39-RC04.



Attachment 3

Laboratory Certificates of Analysis

**Report 190598 for
Randy Williams,
SNC Lavalin,
3 – 520 Lake Street,
Nelson, BC, V1L 4C6
tel: 250-505-3772
Randy.Williams@snclavalin.com**

December 2019

Samples: BH19-SM4L: 01-SA2, 02-SA3, 02-SA2

Summary:

Sample BH19-SM4L-01-SA2 is of metamorphosed pebbly arkose that contains scattered pebbles of quartz and of K-feldspar set in a groundmass of fine to medium grained quartz with much less abundant K-feldspar and plagioclase (altered slightly to sericite), with interstitial patches of sericite and minor muscovite, and minor calcite and pyrite.

Sample BH19-SM4L 02-SA3 is of metamorphosed pebbly arkose that contains scattered coarser equant to moderately elongate grains of quartz and lesser ones of K-feldspar that are interpreted as original pebbles. These are set in a groundmass of finer grained detrital quartz with much less abundant detrital K-feldspar and muscovite that are enclosed in much finer grained sericite, in part with minor to abundant limonite.

Sample BH19-SM4L 02-SA2 is of metamorphosed arkose that is dominated by equant, very fine detrital grains of quartz, with much less abundant similar grains of plagioclase (some altered slightly to sericite) and of K-feldspar, and two pebbles of quartz. These are set in a groundmass of sericite and biotite/chlorite(?), with minor ilmenite, leucoxene, kaolinite, and rutile. A diffuse vein is of quartz. A veinlet of limonite has an alteration envelope containing patches of limonite, mainly associated with sericite.

Photographic Notes:

The scanned section shows the gross textural features of the sections; these features are seen much better on the digital image than on the printed image. For the photographs, sample numbers are shown in the upper left corner, photo numbers are shown in the lower left corner, and the letter in the lower right corner indicates the lighting conditions: plane polarized incident light (= P); incident light in crossed nicols (= X); reflected light (= R); reflected light in nearly crossed nicols and incident light in crossed nicols (= ~RX). Locations of photographs are shown on the scanned section. Descriptions of the photographs are at the end of the report.

**John G. Payne, Ph.D., P.Geol.
Tel: (604)-597-1080
e-mail: jppayne@telus.net**

Sample BH19-MS4L-01-SA2**Metamorphosed Pebbly Arkose****Alteration: Sericite-Calcite**

Scattered pebbles of quartz and of K-feldspar are set in a groundmass of fine to medium grained quartz with much less abundant K-feldspar and plagioclase (altered slightly to sericite), with interstitial patches of sericite and minor muscovite, and minor calcite and pyrite.

mineral	percentage	main grain size range (mm)
pebbles		
quartz	3- 4%	1.2-2
K-feldspar	1- 2	1.2-1.5
groundmass		
quartz	75-80	0.3-1
K-feldspar	5- 7	0.5-1
plagioclase/sericite	4- 5	0.3-0.5
sericite	4- 5	0.01-0.02
muscovite	0.4	0.1-0.2 (a few up to 0.6 mm long)
calcite	0.1	0.05-0.5
pyrite	0.1	0.07-0.15 (one grain 0.6 mm long)
ilmenite	trace	0.2
zircon	trace	0.05-0.1
leucoxene	trace	patches up to 0.1 mm
rutile	trace	0.05-0.07

Scattered to locally concentrated equant to moderately elongate coarser grains of quartz and of untwinned K-feldspar are interpreted to be original pebbles.

In the groundmass, quartz forms anhedral equant to slightly elongate grains. A few particles up to 0.5 mm across are of aggregates of equant quartz grains (0.02-0.03 mm).

K-feldspar forms anhedral grains that commonly have weakly to moderately developed coarse cross-hatched twins. Several grains (0.8-1 mm) were recrystallized into diffuse subgrain aggregates.

Plagioclase forms anhedral grains, some of which were altered slightly to locally moderately to sericite.

Sericite forms interstitial patches up to 0.2 mm in size of unoriented equant flakes.

Calcite forms disseminated, irregular to locally skeletal interstitial grains.

Muscovite forms disseminated slightly elongate flakes, and a few elongate flakes, some of which were warped slightly to moderately.

Pyrite forms a few anhedral to subhedral equant grains and one euhedral, moderately elongate grain.

Leucoxene (probably after ilmenite or sphene) forms disseminated anhedral patches up to 0.1 mm in size.

Zircon forms a few anhedral to subhedral, equant to slightly elongate grains.

Ilmenite forms an elongate anhedral grain.

Rutile forms a few anhedral equant grains.

Sample BH19-SM4L 02-SA3**Metamorphosed Pebbly Arkose**

Scattered coarser equant to moderately elongate grains of quartz and lesser ones of K-feldspar are interpreted as original pebbles. These are set in a groundmass of finer grained detrital quartz with much less abundant detrital K-feldspar and muscovite that are enclosed in much finer grained sericite, in part with minor to abundant limonite.

mineral	percentage	main grain size range (mm)	
pebbles			
quartz	2- 3%	0.7-1.5	
K-feldspar	1	0.7-1.2	(one grain 1.7 mm long)
groundmass			
quartz	80-85	0.07-0.3	(a few 0.4-0.7 mm)
K-feldspar	4- 5	0.1-0.3	
sericite	8-10	0.01-0.03	
limonite	1- 2	cryptocrystalline	
muscovite	0.3	0.1-0.5	(a few from 0.5-1 mm long)
Mineral X	trace	0.1	
leucoxene	trace	0.04-0.07	
zircon	trace	0.025-0.03	

Quartz forms scattered subrounded, slightly to moderately elongate pebbles.

K-feldspar forms equant to elongate, anhedral pebbles.

The rock is dominated by equant, anhedral quartz grains.

K-feldspar forms scattered angular grains, commonly with weakly developed twins.

Sericite forms interstitial selvages between detrital grains and scattered patches up to 0.7 mm across, possibly in part after plagioclase.

Muscovite forms scattered flakes, larger ones of which commonly are warped moderately. One cluster consists of subradiating aggregates composed of grains 0.05-0.1 mm long.

Limonite occurs in many interstitial patches of sericite, giving the combination a pale to medium orange brown colour.

A few areas up to a few mm long contain moderately abundant to abundant extremely fine grained quartz in the groundmass; these may represent local zones of cataclastic deformation.

Mineral X (high relief, moderate birefringence) forms a few anhedral equant grains.

Leucoxene forms scattered patches, probably secondary after ilmenite or rutile.

Zircon forms a few equant anhedral grains.

Sample BH19-SM4L 02-SA2**Metamorphosed Arkose
Veinlets: Quartz; Limonite**

The sample is dominated by equant, very fine grains of quartz, with much less abundant similar grains of plagioclase (some altered slightly to sericite) and of K-feldspar, and two pebbles of quartz. These are set in a groundmass of sericite and biotite/chlorite(?), with minor ilmenite, leucoxene, kaolinite, and rutile. A diffuse vein is of quartz. A veinlet of limonite has an alteration envelope containing patches of limonite, mainly associated with sericite.

mineral	percentage	main grain size range (mm)
pebble		
quartz	0.3%	1-1.3
groundmass		
quartz	80-83	0.07-0.3
plagioclase	4- 5	0.1-0.3
K-feldspar	3- 4	0.1-0.3
sericite	4- 5	0.01-0.03
biotite/chlorite(?)	2- 3	0.03-0.15
muscovite	0.3	0.15-0.5
ilmenite/leucoxene	0.3	0.02-0.05
kaolinite	0.2	0.005-0.007
limonite	0.3	cryptocrystalline-0.01
rutile	minor	0.02-0.08
zircon	trace	0.03-0.05 (one grain 0.1 mm long)
vein, veinlet		
1) quartz	1-2	0.03-0.15
2) limonite	0.2	cryptocrystalline (including envelope)

Quartz forms anhedral, mainly equant grains and one subrounded pebble.

K-feldspar forms anhedral, mainly equant grains, commonly with weakly developed twinning.

Plagioclase forms anhedral, equant grains, some of which have well developed albite twinning. Some grains were altered slightly to locally moderately to sericite.

Sericite forms wispy seams interstitial to detrital grains and is concentrated in scattered patches up to 0.3 mm in size.

Biotite/chlorite(?) forms ragged, equant grains intergrown coarsely with sericite. It is slightly pleochroic from pale to light brown, with one good cleavage with parallel extinction and length-slow optical orientation.

Muscovite forms disseminated, equant to elongate grains; many of the elongate grains are warped moderately.

Ilmenite and leucoxene each forms scattered anhedral patches up to 0.15 mm in size.

Kaolinite forms scattered interstitial patches up to 0.15 mm in size and locally is intergrown with sericite.

Rutile forms disseminated, anhedral to subhedral grains.

Zircon forms anhedral, commonly angular equant grains.

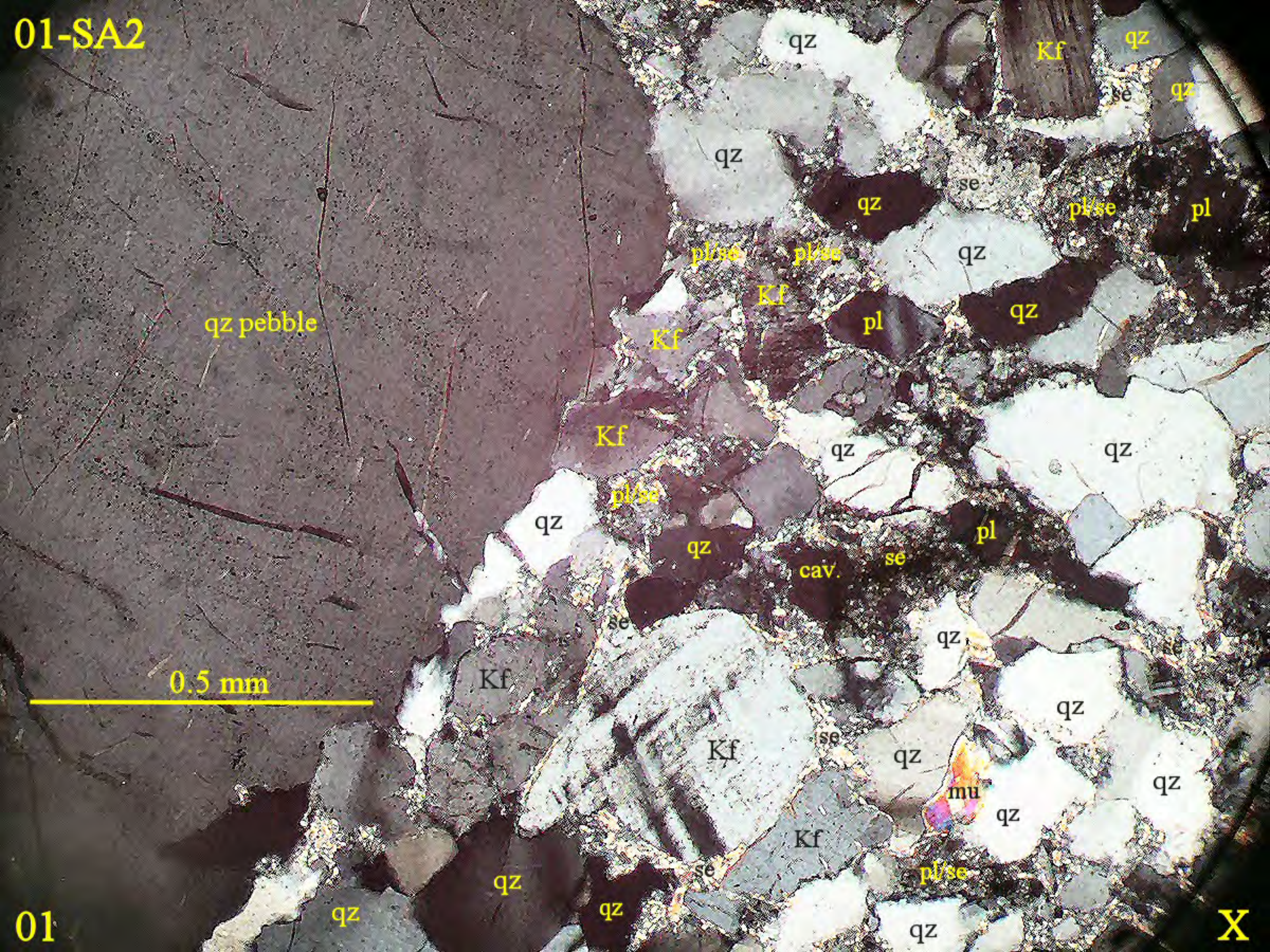
A diffuse vein 0.5-0.8 mm wide is of very fine to locally fine grained quartz.

A wispy seam up to 0.03 mm wide is of limonite. Bordering the veinlet is an alteration envelope up to 8 mm wide containing 2-3% limonite patches intergrown with sericite.

List of Photographs

Photo	Section	Description
01	01-SA2	to the left: large quartz pebble; to the right: intergrowth of quartz, K-feldspar, and plagioclase (commonly altered slightly to moderately to sericite) with interstitial patches of sericite and a flake of muscovite; one small cavity in a sericite-rich patch.
02	01-SA2	K-feldspar pebble (altered slightly to sericite), groundmass of quartz grains, one quartz aggregate, K-feldspar grains, plagioclase grains (altered moderately to sericite), with interstitial patches of sericite.
03	02-SA3	K-feldspar pebble (altered moderately in patches to limonite-sericite) surrounded by finer grained detrital quartz and minor plagioclase (altered moderately to sericite), with interstitial patches of sericite (in part with limonite) and one elongate cluster of muscovite
04	02-SA3	anhedral quartz grains and one large K-feldspar grain with interstitial patches of sericite, in part with abundant limonite, and one interstitial patch of muscovite, in part consisting of fan-textured aggregates.
05	02-SA3	detrital grains of quartz and minor ones of K-feldspar and of plagioclase (altered slightly to sericite) in a groundmass of sericite with scattered patches of sericite-biotite/chlorite(?) and minor ilmenite; a diffuse zone in the centre of the photo contains abundant extremely fine grained quartz in the matrix, possibly in part at least formed by local cataclastic deformation.
06	02-SA2	detrital grains of quartz, much less abundant ones of plagioclase (altered slightly to moderately to sericite) and K-feldspar, and one elongate warped flake of muscovite; interstitial patches of sericite, biotite-chlorite(?), and lesser kaolinite.
07	02-SA2	detrital grains of quartz and much less abundant ones of K-feldspar and of plagioclase (altered slightly to moderately to sericite) with interstitial patches of sericite and locally biotite/chlorite(?); cut by diffuse vein of quartz with very variable grain size.
08	02-SA2	detrital grains of quartz and much less abundant ones of plagioclase (altered slightly to moderately to sericite) and of K-feldspar, and a few flakes of muscovite (largest one warped moderately) with interstitial patches of sericite and limonite (in the alteration envelope bordering the late limonite veinlet).

01-SA2



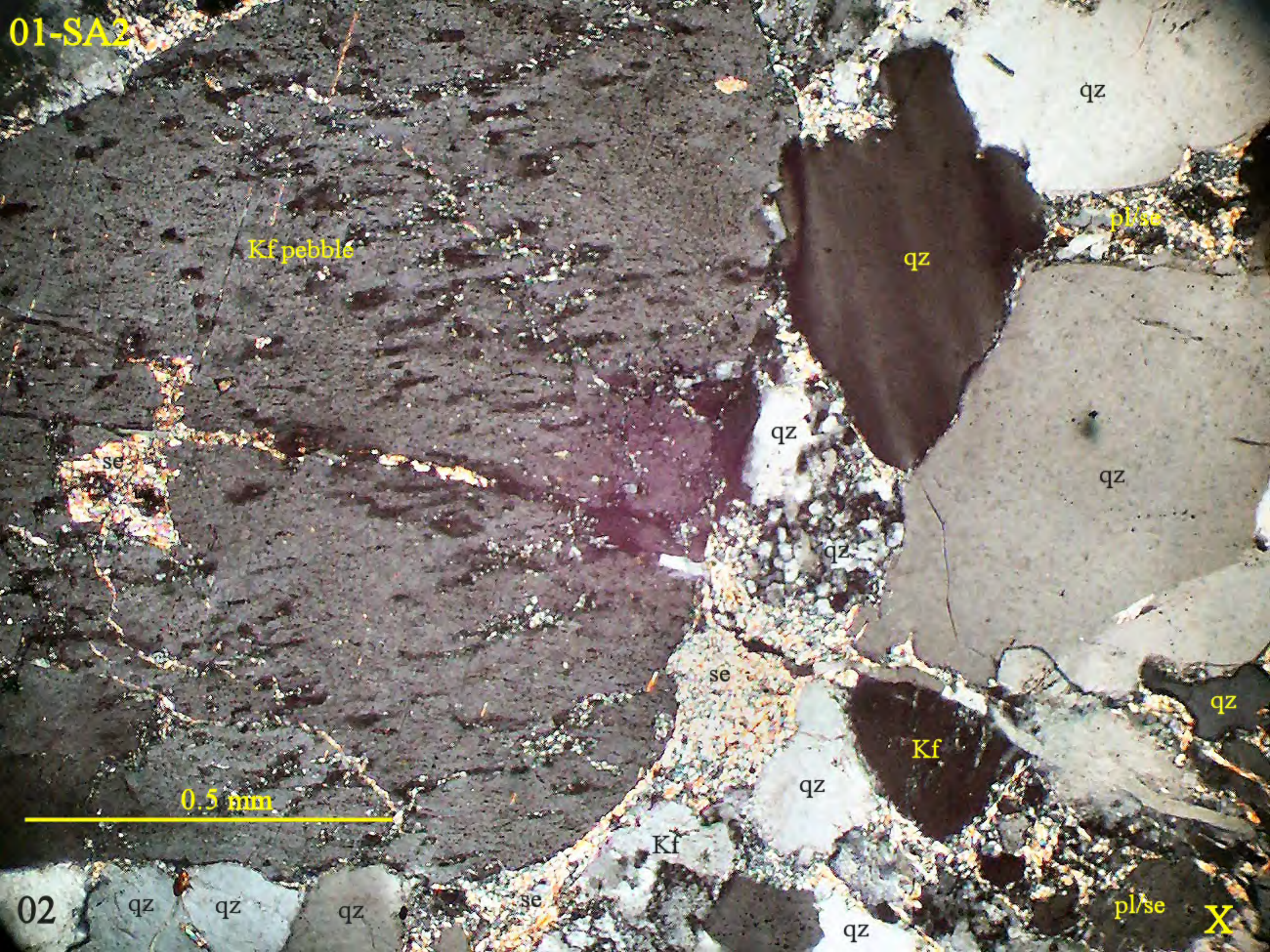
qz pebble

0.5 mm

01

X

01-SA2



Kf pebble

qz

pl/se

qz

qz

qz

se

qz

qz

Kf

se

qz

0.5 mm

Kf

02

qz

qz

qz

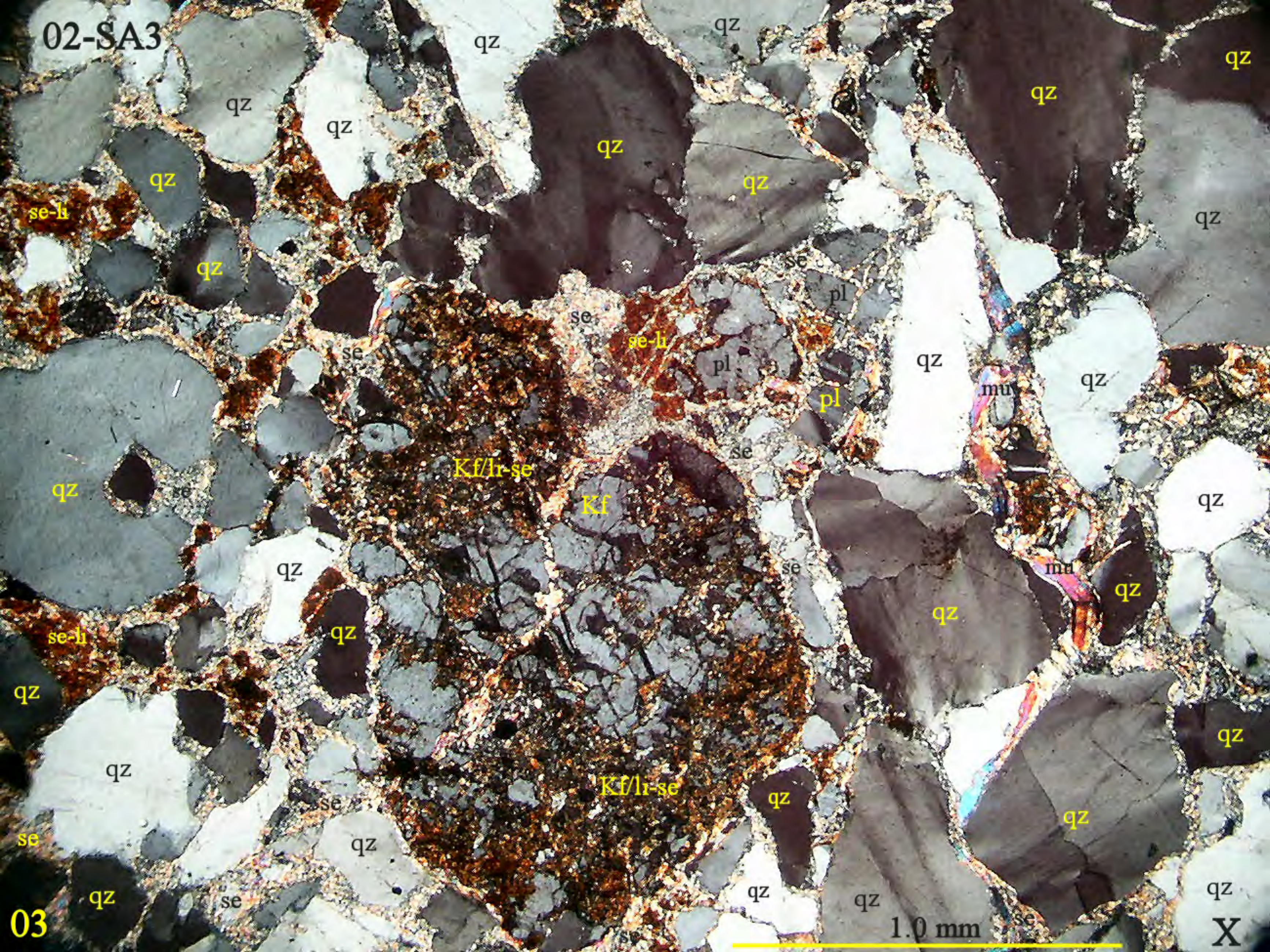
se

qz

pl/se

X

02-SA3



qz

qz

qz

qz

qz

qz

qz

qz

qz

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qz

se-li

qz

se

se-li

se

pl

se

pl

pl

qz

mu

qz

qz

Kf/lr-se

Kf

se

qz

se

ma

qz

se-li

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se

se

qz

qz

qz

qz

se

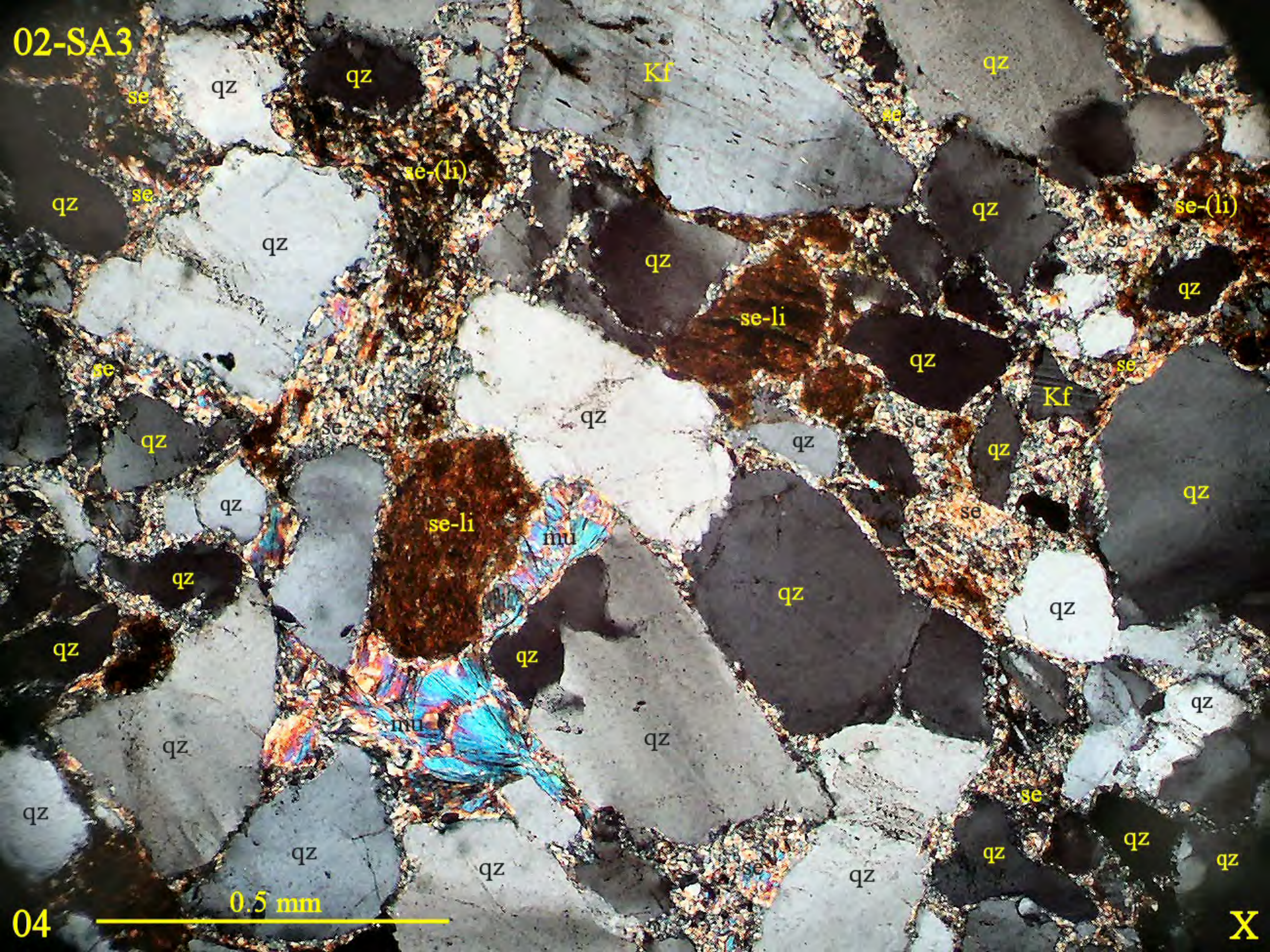
qz

1.0 mm

03

X

02-SA3

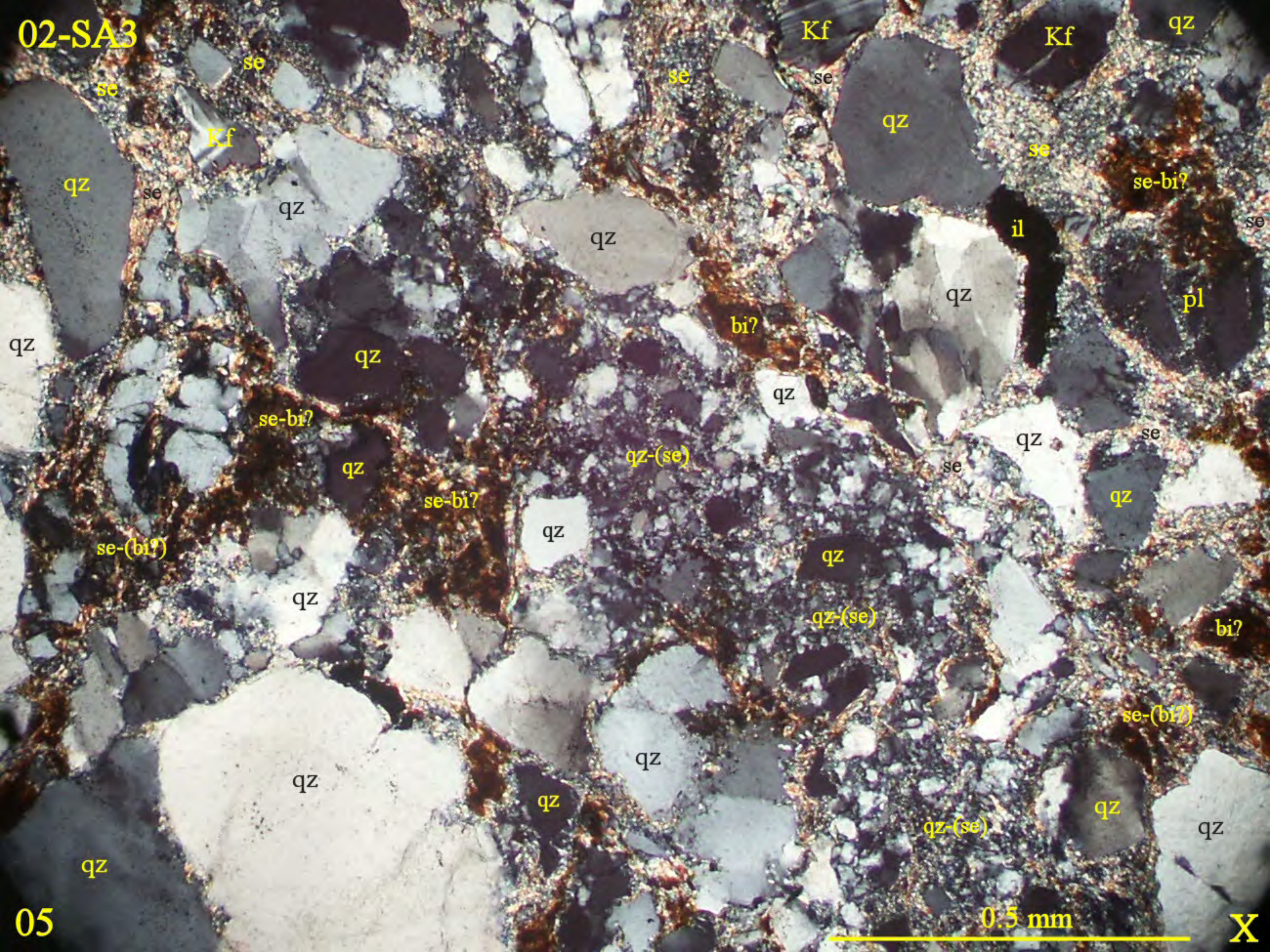


04

0.5 mm

X

02-SA3

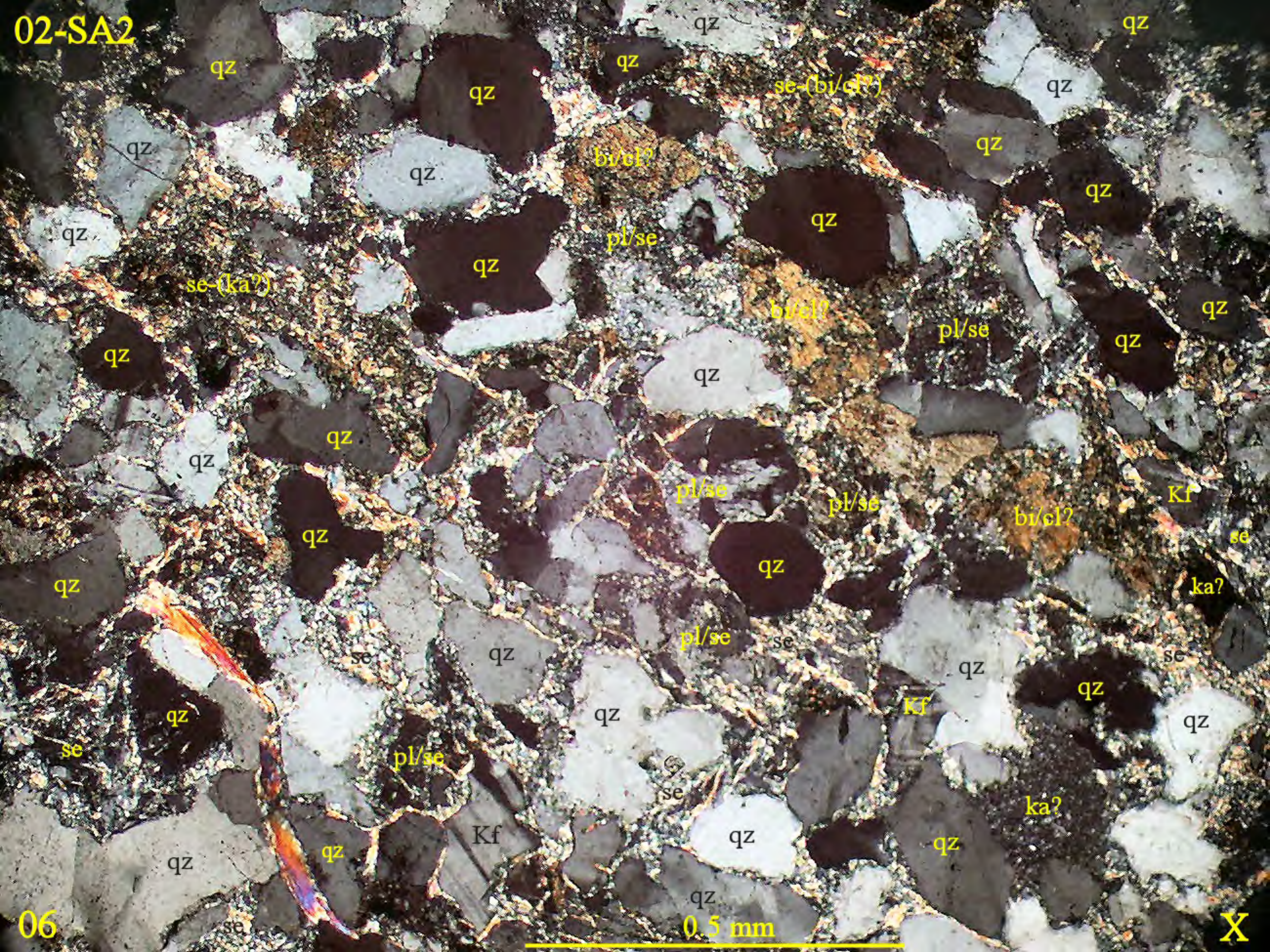


05

0.5 mm

X

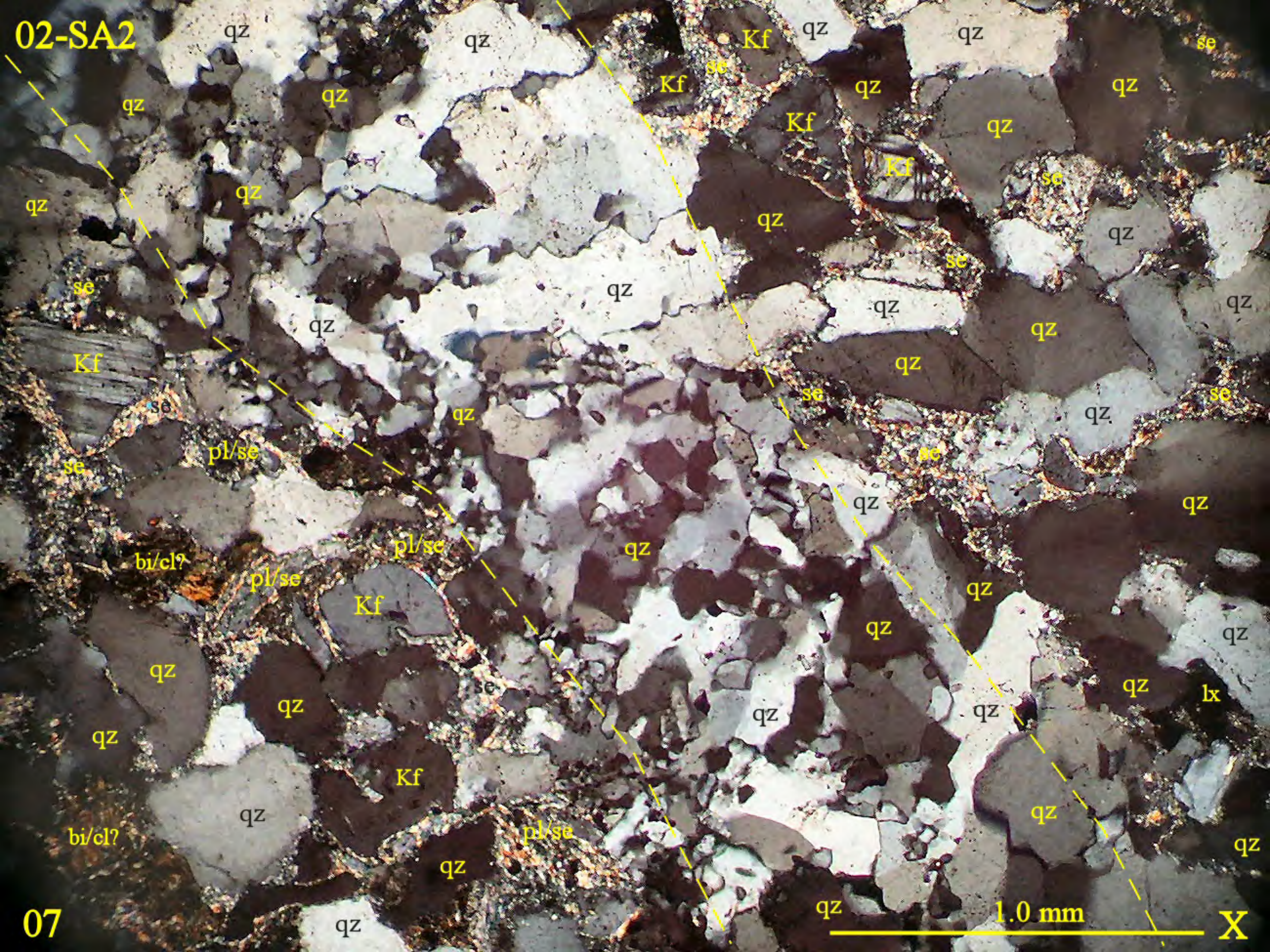
02-SA2



06

0.5 mm

X



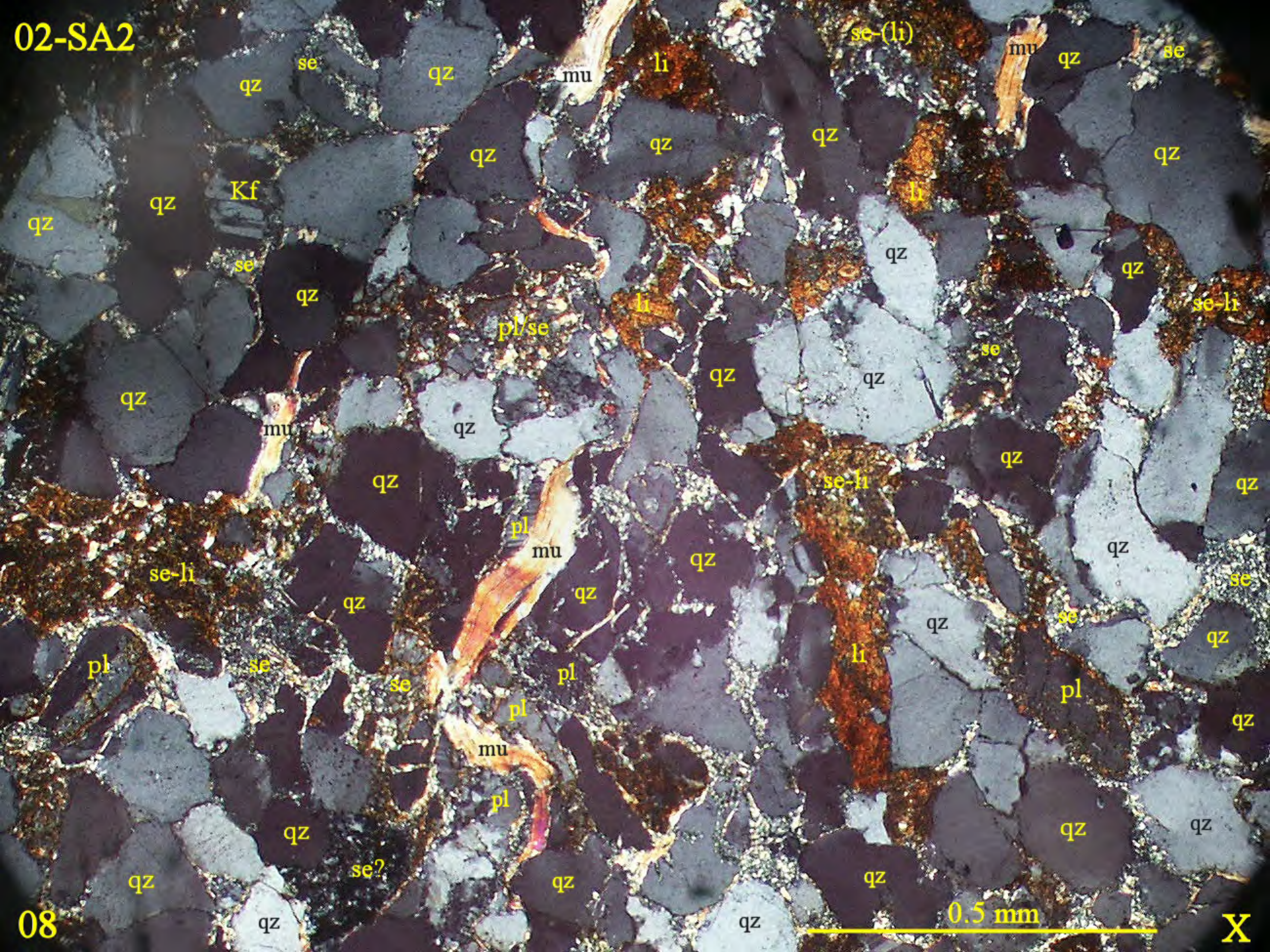
02-SA2

07

1.0 mm

X

02-SA2



08

0.5 mm

X

CERTIFICATE OF ANALYSIS - COVER PAGE



CLIENT INFORMATION	
Company:	SNC-Lavalin Inc.
Project Manager:	Randy S. Williams, P.Geo., Geoscientist/Project Manager, Environment & Geoscience, Infrastructure.
Contact Person:	Randy S. Williams
Email Address:	Randy.Williams@snclavalin.com
Mailing Address:	520 Lake Street, Nelson, BC V1L 4C6.
Contact No:	Off: (250) 505-3772; D: (250) 354-1664 x 53204
Fax No:	

PROJECT INFORMATION	
Project Name:	MOTI Selkirk Mtn. 4-Laning
Project Number:	666768

RESULTS					
Reported To:	<table border="0"> <tr> <td align="center">1</td> <td>Randy S. Williams (Randy.Williams@snclavalin.com)</td> </tr> <tr> <td align="center">2</td> <td>Vicky Lipinski (Vicky.Lipinski@snclavalin.com)</td> </tr> </table>	1	Randy S. Williams (Randy.Williams@snclavalin.com)	2	Vicky Lipinski (Vicky.Lipinski@snclavalin.com)
1	Randy S. Williams (Randy.Williams@snclavalin.com)				
2	Vicky Lipinski (Vicky.Lipinski@snclavalin.com)				
cc:	N/A				
Date Reported:	Dec. 19, 2019 (Thursday)				
Rietveld XRD:	Dec. 20, 2019 (Friday)				
NAG Result:	Jan 20, 2019 (Sunday)				

INVOICE	
Submitted To:	Accounts Payable Processing Centre (payables@snclavalin.com)
cc:	Randy S. Williams (Randy.Williams@snclavalin.com)
Address:	SNC-Lavalin Inc. 520 Lake Street, Nelson, BC V1L 4C6.
Contact No:	(250) 354-1664 x 53204
Client PO No:	N/A
Global Invoice No:	ARD1964-1219A; NAG: ARD1964-0120-A
Date Submitted:	Dec. 19, 2019 (Thursday); NAG: Jan 20, 2019 (Sunday)

COMPANY INFORMATION	
Legal Name:	Global ARD Testing Services Inc.
Mailing Address:	6891 Antrim Avenue, Burnaby, BC, Canada V5J 4M5.
Contact No:	Main: (604) 428-2730 Ivy Rajan (Cell): (604) 319-7707 Prab Bhatia (Cell): (604) 603-1359
Fax No:	(604) 428-2731

REPORTING	
Global Project No:	1964
Report Version:	2
Pages (Including Cover):	8
Report Title:	COA 13 MOTI-Selkirk Mtn 4-Laning Samples (rec'd 25-Nov19) V2
Analysis Reviewed By:	Ivy Rajan (IRajan@GlobalARDTesting.com)
Position:	Acid Rock Drainage (ARD) Lab & Project Manager
Report Certified By:	Ivy Rajan
Signature:	

NOTES	
All samples are stored at no charge for 90 days past reporting date.	
HCT, column, custom leach columns (Lysimeters) & SAD column samples will be stored free for 90 days past kinetic testing program or Closedown.	
Please contact the lab if you require additional sample storage time.	
Storage charges will apply.	



CERTIFICATE OF ANALYSIS - SAMPLE DETAILS

PAGE: 2 of 8
GLOBAL PROJECT NO: 1964
CLIENT: SNC-Lavalin Inc.
PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
PROJECT NO: 666768
REPORT VERSION: 2

S. No.	Sample ID	Sample Description	Wt. of Sample Rec'd (kg)	Condition (Wet/Dry)	Global Notes (if any)
1	TH19-118-SA2	Drill Core	Dry	1.10	
2	BH19-SM4L-01-SA1	Drill Core	Dry	1.00	On hold for 90 days
3	BH19-SM4L-01-SA2	Drill Core	Dry	1.05	
4	BH19-SM4L-01-SA4	Drill Core	Dry	1.10	
5	BH19-SM4L-02-SA1	Drill Core	Dry	1.15	
6	BH19-SM4L-02-SA2	Drill Core	Dry	1.05	
7	BH19-SM4L-02-SA3	Drill Core	Dry	1.05	
8	BH19-SM4L-02-SA4	Drill Core	Dry	1.10	
9	BH19-SM4L-02-SA5	Drill Core	Dry	1.10	On hold for 90 days
10	BH19-39-RC01	Drill Core	Dry	1.05	
11	BH19-39-RC02	Drill Core	Dry	1.10	
12	BH19-39-RC03	Drill Core	Dry	1.05	
13	BH19-39-RC04	Drill Core	Dry	1.05	

Total wt. of samples rec'd (kg): 11.85

Sample Receipt Info:	
Date Samples Received:	Nov. 25, 2019 (Monday)
No. of Samples Received:	13
Samples Received By:	Savanah

Analytical Instructions:	
From:	Randy Williams (Randy.Williams@snclavalin.com)
Date:	as per COC confirmation. Nov. 22, 2019 (Friday)

Sieving - % Passing (Pulverizing) QAQC:	
Analyte:	Pass %
Unit:	%
RDL:	0.01
(1) TH19-118-SA2	95.6%

CERTIFICATE OF ANALYSIS - ABA RESULTS

PAGE: 3 of 8
 GLOBAL PROJECT NO: 1964
 CLIENT: SNC-Lavalin Inc.
 PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
 PROJECT NO: 666768
 REPORT VERSION: 2

S. No.	Sample ID	Paste pH	Fizz Rating	Total Inorganic C	CaCO ₃ Equivalents ^{*1}	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur ^{*1}	AP ^{*2}	Mod. ABA NP	NNP ^{*3}	NPR ^{*4}
Units:		pH Units		wt %	kg CaCO ₃ /tonne	wt %	wt %	wt %		kg CaCO ₃ /tonne		
Reported Detection Limit:		0.1		0.02	1.7	0.005	0.01	0.01	0.3	0.5		
1	TH19-118-SA2	8.3	None			0.270	<0.01	0.27	8.4	0.9	-7.5	0.1
2	BH19-SM4L-01-SA1											
3	BH19-SM4L-01-SA2	8.5	None			0.169	<0.01	0.17	5.3	1.4	-3.9	0.3
4	BH19-SM4L-01-SA4	8.5	None			0.088	<0.01	0.09	2.8	1.6	-1.2	0.6
5	BH19-SM4L-02-SA1	8.3	None			0.008	<0.01	0.01	0.3	2.2	2.0	8.8
6	BH19-SM4L-02-SA2	8.2	None			<0.005	<0.01	<0.01	<0.3	2.6	2.6	N/A
7	BH19-SM4L-02-SA3	7.8	None	<0.02	<1.7	0.007	0.01	<0.01	<0.3	4.1	4.1	N/A
8	BH19-SM4L-02-SA4	7.6	None			0.156	0.01	0.15	4.6	0.6	-4.0	0.1
9	BH19-SM4L-02-SA5											
10	BH19-39-RC01	8.5	Moderate	0.57	47.5	0.523	<0.01	0.52	16.3	48.8	32.5	3.0
11	BH19-39-RC02	8.4	Moderate			0.302	0.02	0.28	8.8	42.8	34.0	4.9
12	BH19-39-RC03	8.5	None			0.712	<0.01	0.71	22.3	9.2	-13.1	0.4
13	BH19-39-RC04	8.7	None			0.879	<0.01	0.88	27.5	7.2	-20.3	0.3
Replicate Analysis:												
1	TH19-118-SA2					0.270						
1 R	TH19-118-SA2 (Rep)					0.271						
7	BH19-SM4L-02-SA3			<0.02	<1.7							
7 R	BH19-SM4L-02-SA3 (Rep)			<0.02	<1.7							
10	BH19-39-RC01	8.5	Moderate	0.57	47.5		<0.01			48.8		
10 R	BH19-39-RC01 (Rep)	8.5	Moderate	0.57	47.5		<0.01			48.3		
13	BH19-39-RC04					0.879						
13 R	BH19-39-RC04 (Rep)					0.878						
Reference Material Analysis:												
Reference Material	KZK-1			NIST 88b		STD KZK-1	RTS-3a			1) KZK-1 (Slight) 2) KZK-1 (Moderate)		
Ref. Material Certified Value	8.80			12.66		0.800	1.10			1) 58.9 2) 61.6		
Reference Material Results	8.90			12.66, 12.52		0.800, 0.794	1.13			1) 56.3 (2) N/A		
Tolerance (+/-) or Acceptance Range	0.09			90% - 110%		90% - 110%	0.99 - 1.21			1) 1.1 2) 3.4		
Method Blank Analysis:												
Method Blank Results				<0.02, <0.02		<0.005	<0.01					
GLOBAL SOP NO./METHOD:	ARD-004	ARD-007		HCl leach/ CO ₂ -Coulometer	Calc.	LECO	ARD-013 (HCl Leach)	Calc.	Calc.	ARD-005	Calc.	Calc.

NOTES:

Job No: 19T550813

Date of Analysis: Dec. 05/06, 2019

pH of DI water used (pH units): 5.72

EC of DI water used ($\mu\text{S}/\text{cm}$): 0.27

METHODS:

Total sulphur by Leco.

Total Inorganic Carbon (TIC): HCl leach, evolved CO_2 analysed by CO_2 Coulometer.

ABBREVIATIONS:

R = Rep = Replicate (a replicate is a sub-sample scooped from a single pulp sample bag produced per client sample)

D = Dup = Duplicate (a duplicate is 2nd sub-pulp sample bag produced by processing a 2nd split of the client sample.

A duplicate pulp sample is prepared only at client request.

EC = Electric Conductivity

NP = Neutralization Potential

Calc. = Calculation

IND = Indeterminate

COA = Certificate Of Analysis

N/A = Not Applicable

NR = Not Reported

CALCULATIONS:

*1 Sulphide-Sulphur: Total-sulphur - sulphate-sulphur

*2 AP (Acid Potential): Sulphide-sulphur x 31.25

*3 NNP (Net Neutralization Potential): NP - AP

*4 NPR (Neutralization Potential Ratio): NP/AP

REFERENCES:

Sample Preparation: ASTM E877-08; MEND Report 1.20.1, Version 0 (2009)

ABA: Air-dried, jaw-crushed, split by riffing and pulverized to 85% passing 200 mesh (75 μm).

Modified ABA (Sobek) NP: MEND Acid Rock Drainage Prediction Manual, MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991.

Paste pH / Fizz Rating: Sobek, A.A., Schuller, W.A., Freeman, J.R. and Smith, R.M.; US EPA-600/2-78-054 (1978).

Sulphate Sulphur: Based on MEND method. The S extracted is determined by analysing the extract for SO_4 using UV-Vis Spectrophotometer (STD Method 4500-SO42- E).

CERTIFICATE OF ANALYSIS • MEND-SHAKE FLASK EXTRACTION RESULTS

Parameter	Method	Unit	RDL	1	2	3	4	5	6	7	8	9	10	11	12	13	13 D	Method Blank
				Sample ID														
				BH19-118-SA2	BH19-SM4L-01-SA1	BH19-SM4L-01-SA2	BH19-SM4L-01-SA4	BH19-SM4L-02-SA1	BH19-SM4L-02-SA2	BH19-SM4L-02-SA3	BH19-SM4L-02-SA4	BH19-SM4L-02-SA5	BH19-39-RC01	BH19-39-RC02	BH19-39-RC03	BH19-39-RC04	BH19-39-RC04 (Dup)	
Weight of dry sample used	Weighing Scale	g	0.01	250		250	250	250	250	250	250		250	250	250	250	250	N/A
Volume of DI water used	Graduated Cylinder	mL	0.50	750		750	750	750	750	750	750		750	750	750	750	750	750
On Filtered Samples (using 0.45 micron filter paper):																		
pH	Meter	pH units	0.01	6.8		7.0	7.0	7.0	6.7	6.5	6.2		8.4	8.0	7.7	8.8	8.8	5.54
EC	Meter	µS/cm	1.0	28		17	25	30	17	23	17		86	79	75	75	77	1.00
ORP	Meter	mV	1.0	224		210	183	208	221	224	246		155	144	131	120	123	250
Acidity (to pH 8.3)	Titration/Calc.	mg CaCO ₃ /L	0.5	5.6		4.4	5.0	8.1	5.0	7.5	5.6		<0.5	2.8	2.5	<0.5	<0.5	5.5
Alkalinity (to pH 4.5)	Titration/Calc.	mg CaCO ₃ /L	0.5	7.5		6.3	9.0	9.4	6.3	5.0	4.4		31.3	28.8	25.0	25.6	25.0	1.0
Dissolved Sulphate (SO ₄)	Colourimetry	mg/L	0.5	4.6		0.5	<0.5	3.7	1.2	4.9	3.2		4.6	4.6	6.9	6.3	6.0	<0.5
Dissolved Metals Analysis by ICP-MS:																		
Hardness, Total (as CaCO ₃)	Calc.	mg/L	0.5	2.9		3.3	4.5	4.2	1.4	6.2	0.9		35.1	31.5	27.7	27.1	26.7	<0.5
Aluminum Dissolved	ICP-MS	mg/L	0.001	0.056		0.09	0.068	0.081	0.136	0.024	0.017		0.181	0.082	0.181	0.234	0.241	<0.001
Antimony Dissolved	ICP-MS	mg/L	0.0001	0.0007		0.0004	0.0004	0.0007	0.0006	0.0005	0.0002		0.0003	0.0002	0.0003	0.0007	0.0007	<0.0001
Arsenic Dissolved	ICP-MS	mg/L	0.0002	0.0017		0.0037	0.0024	0.0002	0.0004	0.0004	0.0002		0.0004	0.0004	0.0015	0.0059	0.0033	<0.0002
Barium Dissolved	ICP-MS	mg/L	0.0002	0.0395		0.0013	0.0033	0.0333	0.0029	0.0388	0.0031		0.0057	0.0024	0.003	0.0019	0.0019	<0.0002
Beryllium Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Boron Dissolved	ICP-MS	mg/L	0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium Dissolved	ICP-MS	mg/L	0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium Dissolved	ICP-MS	mg/L	0.05	0.78		0.81	1.16	1.02	0.28	1.15	0.25		8.32	8.42	5.15	4.83	4.75	0.06
Chromium Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001		<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper Dissolved	ICP-MS	mg/L	0.0005	<0.0005		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0009		<0.0005	0.0009	0.001	0.0011	0.0011	<0.0005
Iron Dissolved	ICP-MS	mg/L	0.02	<0.02		<0.02	<0.02	<0.02	0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Lithium Dissolved	ICP-MS	mg/L	0.0005	0.0012		0.0014	0.002	0.0022	0.0007	0.0008	0.0013		0.0077	0.0023	0.0029	0.001	0.0011	<0.0005
Magnesium Dissolved	ICP-MS	mg/L	0.05	0.22		0.3	0.4	0.4	0.169	0.81	0.065		3.47	2.54	3.61	3.66	3.61	<0.005
Manganese Dissolved	ICP-MS	mg/L	0.0002	0.0012		0.0011	0.0024	0.004	0.0008	0.0037	0.0032		0.0019	0.0011	0.008	0.0056	0.0058	<0.0002
Mercury Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	0.0001	0.0002	0.0001	<0.0001	<0.0001		0.0002	0.0005	0.0001	0.0001	0.0001	<0.0001
Nickel Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Phosphorus Dissolved	ICP-MS	mg/L	0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Potassium Dissolved	ICP-MS	mg/L	0.05	4.36		1.93	2.72	4.36	2.89	1.81	2.61		2.65	2.37	3.3	3.61	3.61	<0.05
Selenium Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	0.0006	<0.0005	0.0005	<0.0005
Silicon Dissolved	ICP-MS	mg/L	0.05	0.99		1.07	1.77	1.35	1.4	1.23	0.73		0.88	1.1	1.31	1.45	1.44	<0.05
Silver Dissolved	ICP-MS	mg/L	0.00008	<0.00008		<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008		<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
Sodium Dissolved	ICP-MS	mg/L	0.02	0.73		0.56	0.96	0.94	0.61	0.37	0.65		0.24	0.49	0.44	0.7	0.69	<0.02
Strontium Dissolved	ICP-MS	mg/L	0.0002	0.0158		0.0037	0.0075	0.0108	0.0012	0.0099	0.0021		0.0511	0.0394	0.0376	0.0288	0.03	<0.0002
Sulphur Dissolved	ICP-MS	mg/L	0.5	1.2		<0.5	<0.5	0.7	<0.5	1.4	1		1.4	1.4	3.6	4.4	4.8	<0.5
Tellurium Dissolved	ICP-MS	mg/L	0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thallium Dissolved	ICP-MS	mg/L	0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Thorium Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Tin Dissolved	ICP-MS	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Titanium Dissolved	ICP-MS	mg/L	0.0005	0.0007		<0.0005	0.0007	0.0005	0.0013	0.0008	<0.0005		<0.0005	<0.0005	<0.0005	0.0005	0.0005	<0.0005
Tungsten Dissolved	ICP-MS	ug/L	0.0001	0.0014		0.0002	0.0039	0.0008	0.0003	0.0004	<0.0001		0.0022	0.0003	0.0006	0.0016	0.0016	<0.0001
Uranium Dissolved	ICP-MS	mg/L	0.00005	<0.00005		<0.00005	0.00007	0.00006	<0.00005	<0.00005	<0.00005		0.00022	0.00032	0.00032	0.00043	0.00044	<0.00005
Vanadium Dissolved	ICP-MS	mg/L	0.001	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc Dissolved	ICP-MS	mg/L	0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium Dissolved	ICP-MS	mg/L	0.0001	<0.0001		<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Ion Balance:																		
Major Anions	Calc.	meq/L		0.25		0.14	0.18	0.26	0.15	0.20	0.15		0.72	0.67	0.64	0.64	0.63	
Major Cations	Calc.	meq/L		0.21		0.15	0.21	0.25	0.14	0.19	0.11		0.80	0.72	0.68	0.69	0.68	
Difference	Calc.	meq/L		-0.04		0.01	0.03	-0.02	-0.01	-0.01	-0.04		0.08	0.05	0.04	0.05	0.06	
Balance (%)		%		-8.4%		4.8%	7.7%	-3.6%	-2.2%	-3.1%	-14.6%		5.2%	3.6%	2.7%	3.6%	4.5%	
Shake Flask Extract ID:				777900		777905	777906	777907	777908	777909	777910		777911	777912	777913	777914	777915	777916

NOTES:
Job No:
Date of Analysis (24 h): July 03/04, 2019
pH of DI water used (pH Units): 5.73
EC of DI water used (µS/cm): 0.85
ABBREVIATIONS:
R / Rep = Replicate (which involves the analysis of the same Shake Flask Extract aliquot).
D / Dup = Duplicate (which involves the analysis of a separate SF extract, produced by processing a second split of the original client sample received).
Calc. = Calculation
EC = Electrical Conductivity
IC = Ion Chromatography
SIE = Selective Ion Electrode
N/A = Not Applicable.
NR = Not Reported.
mg/L = Milligrams per Litre
REFERENCE:
Prediction Manual for Drainage Chemistry from Sulphidic Geologic Material, MEND Report 1.20.1; Version 0 - Dec. 2009. Section 11.5; P 11 (8-9).
Extraction Method used: Using gyratory shaker for 24 h (± 2 h; gentle agitation).
Liquid: Solid ratio used: 3: 1; L: S: 750 mL DI H₂O: 250 g of sample [if rock: 85% passing 1/4 inch (i.e. 6.3 mm); if tailings: as-rec'd homogenized material]

CERTIFICATE OF ANALYSIS - MEND SFE QA/QC RESULTS



PAGE: 5 of 8
GLOBAL PROJECT NO: 1964
CLIENT: SNC-Lavalin Inc.
PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
PROJECT NO: 666768
REPORT VERSION: 2

MEND SFE - Sulphate:

Certified Reference Material	Parameter: Sulphate	% Recovery	Matrix Spike % Recovery	Units	QC Limits (%)
STD Mineral Water (29.7 mg/L)	29.3	98.7%		%	80 - 120
Spiked Blank (19.61 mg/L)	19.70		100.5%	%	80 - 120

MEND SFE - Dissolved Metals:

Parameter	Batch	Sample ID	Dup #1	Dup #2	RPD	Method Blank	Method Blank Spike	Lower	Upper
Aluminum Dissolved	777873		0.026	0.026	2.1%	<0.001	104%	85%	115%
Antimony Dissolved	777873		0.0002	0.0002	NA	<0.0001	97%	85%	115%
Arsenic Dissolved	777873		0.0008	0.0002	NA	<0.0002	105%	85%	115%
Barium Dissolved	777873		0.0496	0.0507	2.2%	<0.0002	94%	85%	115%
Beryllium Dissolved	777873		<0.0001	<0.0001	NA	<0.0001	103%	85%	115%
Bismuth Dissolved	777873		<0.0001	<0.0001	NA	<0.0001	94%	85%	115%
Boron Dissolved	777873		<0.01	<0.01	NA	<0.01	106%	85%	115%
Cadmium Dissolved	777873		0.00002	0.00002	NA	<0.00001	100%	85%	115%
Calcium Dissolved	777873		17.3	17.4	0.7%	<0.05	104%	85%	115%
Chromium Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	92%	85%	115%
Cobalt Dissolved	777873		<0.0001	<0.0001	NA	<0.0001	105%	85%	115%
Copper Dissolved	777873		<0.0005	0.0005	NA	<0.0005	97%	85%	115%
Iron Dissolved	777873		<0.02	<0.02	NA	<0.02	110%	85%	115%
Lead Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	96%	85%	115%
Lithium Dissolved	777873		0.0254	0.0250	1.5%	<0.0005	99%	85%	115%
Magnesium Dissolved	777873		15.3	15.5	1.3%	<0.05	101%	85%	115%
Manganese Dissolved	777873		0.0017	0.0016	2.5%	<0.0002	98%	85%	115%
Mercury Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	101%	85%	115%
Molybdenum Dissolved	777873		0.0016	0.0016	0.4%	<0.0001	103%	85%	115%
Nickel Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	98%	85%	115%
Phosphorus Dissolved	777873		<0.05	<0.05	NA	<0.05	109%	85%	115%
Potassium Dissolved	777873		6.88	7.07	2.7%	<0.05	97%	85%	115%
Selenium Dissolved	777873		0.0012	0.0006	NA	<0.0005	98%	85%	115%
Silicon Dissolved	777873		0.44	0.44	0.5%	<0.05	98%	85%	115%
Silver Dissolved	777873		<0.00008	<0.00008	NA	<0.00008	102%	85%	115%
Sodium Dissolved	777873		54.9	55.3	0.8%	<0.02	97%	85%	115%
Strontium Dissolved	777873		0.529	0.530	0.2%	<0.0002	95%	85%	115%
Sulphur Dissolved	777873		63.3	62.3	1.5%	<0.5	104%	85%	115%
Tellurium Dissolved	777873		<0.0002	<0.0002	NA	<0.0002	96%	85%	115%
Thallium Dissolved	777873		0.00012	0.00012	NA	<0.00005	94%	85%	115%
Thorium Dissolved	777873		0.0001	<0.0001	NA	<0.0001	92%	85%	115%
Tin Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	95%	85%	115%
Titanium Dissolved	777873		<0.0005	<0.0005	NA	<0.0005	94%	85%	115%
Tungsten Dissolved	777873		<0.0001	<0.0001	NA	<0.0001	95%	85%	115%
Uranium Dissolved	777873		0.00077	0.00077	0.0%	<0.00005	94%	85%	115%
Vanadium Dissolved	777873		<0.001	<0.001	NA	<0.001	92%	85%	115%
Zinc Dissolved	777873		<0.001	<0.001	NA	<0.001	90%	85%	115%
Zirconium Dissolved	777873		0.0001	<0.0001	NA	<0.0001	96%	85%	115%

NOTES:

Job No:

RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Greyed coloured data does not belong to this report.



CERTIFICATE OF ANALYSIS - RESULTS OF STRONG ACID LEACHABLE METALS (SALM) IN SOIL

PAGE: 6 of 8
 GLOBAL PROJECT NO: 1964
 CLIENT: SNC-Lavalin Inc.
 PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
 PROJECT NO: 666768
 REPORT VERSION: 2

Parameter	Method	Unit	RDL	1	2	3	4	5	6	7	8	9	10	11	12	13
				Sample ID												
				TH19-118-SA2	BH19-SM4L-01-SA1	BH19-SM4L-01-SA2	BH19-SM4L-01-SA4	BH19-SM4L-02-SA1	BH19-SM4L-02-SA2	BH19-SM4L-02-SA3	BH19-SM4L-02-SA4	BH19-SM4L-02-SA5	BH19-39-RC01	BH19-39-RC02	BH19-39-RC03	BH19-39-RC04
Particle Size Used	Sieving	mm		< 2		< 2	< 2	< 2	< 2	< 2			< 2	< 2	< 2	< 2
pH 1:2	pH Meter	pH units	0.05	8.01		8.69	8.68	8.22	8.22	7.56	6.94		8.86	8.83	9.02	9.16
BC CSR Omnibus Metals:																
Aluminum	ICP-OES	µg/g	10	1730		1800	827	1330	4390	7910	748		5200	3940	4300	2690
Antimony	ICP-MS	µg/g	0.1	0.2		<0.1	<0.1	<0.1	<0.1	0.3	<0.1		0.2	0.2	0.1	<0.1
Arsenic	ICP-MS	µg/g	0.1	0.8		39.0	6.6	0.2	0.1	0.3	6.5		0.8	5.0	5.0	1.9
Barium	ICP-MS	µg/g	0.5	92.8		12.7	11.1	88.6	46.7	298.0	23.7		46.9	23.5	16.2	11.1
Beryllium	ICP-MS	µg/g	0.1	0.2		<0.1	<0.1	0.1	0.3	0.9	<0.1		0.4	0.1	0.2	0.1
Bismuth	ICP-MS	µg/g	0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Boron	ICP-MS	µg/g	0.5	0.8		0.7	<0.5	0.6	1.3	1.6	<0.5		0.6	0.6	<0.5	0.5
Cadmium	ICP-MS	µg/g	0.01	0.03		<0.01	<0.01	<0.01	0.02	0.02	<0.01		0.08	0.03	0.03	0.02
Chromium	ICP-MS	µg/g	1	10		23	27	11	8	4	5		4	13	8	6
Cobalt	ICP-MS	µg/g	0.1	9.2		1.0	1.7	0.8	1.7	6.4	0.9		23.6	7.8	5.0	2.3
Copper	ICP-MS	µg/g	0.2	1.4		0.9	1.5	1.4	0.6	0.4	0.5		0.5	0.7	0.6	0.6
Iron	ICP-OES	µg/g	10	3470		4850	5420	3370	7410	22700	3740		25400	32700	14900	10800
Lead	ICP-MS	µg/g	0.1	2.0		1.7	1.1	0.6	1.1	2.8	2.4		3.1	2.9	4.1	1.6
Lithium	ICP-MS	µg/g	0.5	<0.5		<0.5	0.6	0.6	1.7	3.7	<0.5		4.2	5.0	3.9	1.1
Manganese	ICP-MS	µg/g	1	4		28	39	50	51	77	4		296	390	77	53
Mercury	ICP-MS	µg/g	0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01
Molybdenum	ICP-MS	µg/g	0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	0.2	<0.2	<0.2
Nickel	ICP-MS	µg/g	0.5	2.9		1.9	2.0	1.0	1.7	6.6	0.9		16.1	5.7	5.5	2.2
Selenium	ICP-MS	µg/g	0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.2	0.1	0.1	0.2
Silver	ICP-MS	µg/g	0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5
Strontium	ICP-MS	µg/g	1	5		3	4	4	4	7	1		36	41	18	13
Thallium	ICP-MS	µg/g	0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1
Tin	ICP-MS	µg/g	0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2
Tungsten	ICP-MS	µg/g	0.05	0.05		<0.05	0.10	<0.05	<0.05	0.07	<0.05		0.08	<0.05	<0.05	<0.05
Uranium	ICP-MS	µg/g	0.2	<0.2		<0.2	<0.2	<0.2	0.2	0.3	<0.2		1.8	1.8	0.3	1.1
Vanadium	ICP-MS	µg/g	1	1		<1	<1	<1	<1	2	<1		2	<1	<1	<1
Zinc	ICP-MS	µg/g	1	3		1	1	2	3	7	<1		9	4	1	<1
Zirconium	ICP-MS	µg/g	0.1	0.9		0.4	0.2	0.2	0.9	0.6	0.2		3.8	0.8	1.1	1.1
Extract ID:				758222		758250	758251	758252	758253	758254	758255		758256	758257	758258	758259

Notes:

Job No:
 Results are based on the dry weight of the sample
 RDL = Reported Detection Limit as per Guideline Standard
 µg/g = Micrograms per gram
 Date of Analysis: Dec. 04, 2019

REFERENCE:

pH 1:2: BC MOE Lab Manual B (pH, Electrometric, Soil)
 Metals: BC MOE Lab Manual C (SALM) and EPA 6010C & EPA 6020A.

CERTIFICATE OF ANALYSIS - SALM QA/QC RESULTS



PAGE: 7 of 8
 GLOBAL PROJECT NO: 1964
 CLIENT: SNC-Lavalin Inc.
 PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
 PROJECT NO: 666768
 REPORT VERSION: 2

Parameter	Batch	Sample ID	Dup #1	Dup #2	RPD	Method Blank	Reference Material	Lower	Upper	Method Blank Spike	Lower	Upper
BC CSR Omnibus Metals in Soil												
pH:												
pH 1:2	761241		5.80	5.83	0.5%		103%	90%	110%	100%	95%	105%
Metals:												
Aluminum	761241		17400	17000	2.3%	<10	97%	70%	130%	108%	90%	110%
Antimony	761241		<0.1	<0.1	NA	<0.1	102%	70%	130%	102%	90%	110%
Arsenic	761241		1.3	1.5	14.3%	<0.1	90%	70%	130%	98%	90%	110%
Barium	761241		41.7	43.8	4.8%	<0.5	101%	70%	130%	96%	90%	110%
Beryllium	761241		0.2	0.2	NA	<0.1	92%	70%	130%	99%	90%	110%
Bismuth	761241		<0.5	<0.5	NA	<0.5				99%	90%	110%
Boron	761241		0.9	0.9	NA	<0.5				104%	90%	110%
Cadmium	761241		0.08	0.08	3.6%	<0.01	108%	70%	130%	101%	90%	110%
Chromium	761241		11	10	1.4%	<1	102%	70%	130%	101%	90%	110%
Cobalt	761241		4.9	5.1	4.7%	<0.1	95%	70%	130%	100%	90%	110%
Copper	761241		17.1	16.4	4.2%	<0.2	95%	70%	130%	99%	90%	110%
Iron	761241		15100	16300	8.0%	<10	105%	70%	130%	107%	90%	110%
Lead	761241		4.0	3.8	5.0%	<0.1	101%	70%	130%	108%	90%	110%
Lithium	761241		4.5	4.6	2.2%	<0.5				99%	90%	110%
Manganese	761241		185	190	3.0%	<1	85%	70%	130%	100%	90%	110%
Mercury	761241		0.02	0.01	NA	<0.01	106%	70%	130%	94%	90%	110%
Molybdenum	761241		1.5	1.5	2.0%	<0.2	96%	70%	130%	103%	90%	110%
Nickel	761241		5.0	5.6	11.6%	<0.5	97%	70%	130%	101%	90%	110%
Selenium	761241		0.1	0.3	NA	<0.1				99%	90%	110%
Silver	761241		<0.5	<0.5	NA	<0.5	113%	70%	130%	99%	90%	110%
Strontium	761241		23	24	3.9%	<1	98%	70%	130%	102%	90%	110%
Thallium	761241		<0.1	<0.1	NA	<0.1	88%	70%	130%	102%	90%	110%
Tin	761241		0.2	0.2	NA	<0.2	95%	70%	130%	103%	90%	110%
Tungsten	761241		0.24	0.25	NA	<0.05	88%	70%	130%	105%	90%	110%
Uranium	761241		0.9	0.9	NA	<0.2	89%	70%	130%	96%	90%	110%
Vanadium	761241		44	43	1.8%	<1	100%	70%	130%	101%	90%	110%
Zinc	761241		33	33	2.2%	<1	96%	70%	130%	102%	90%	110%
Zirconium	761241		0.5	0.4	NA	<0.1				100%	90%	110%

NOTES:

Job No: 19V550261

All results are based on the dry weight of the sample

RDL = Reported Detection Limit as per Guideline Standard.

Greyed data does not belong to this report.

CERTIFICATE OF ANALYSIS ▪ SINGLE ADDITION NAG RESULTS (EGi Method)



PAGE: 8 of 8
GLOBAL PROJECT NO: 1964
CLIENT: SNC-Lavalin Inc.
PROJECT NAME: MOTI Selkirk Mtn. 4-Laning
PROJECT NO: 666768
REPORT VERSION: 2

S. No:	Sample ID	Pulp Sample Weight (g)	Vol. of 15% H ₂ O ₂ (mL)	NAG pH (pH Units)	NaOH to pH 4.5 (mL)	NaOH to pH 7.0 (mL)	NaOH Conc. (N)	NAG Acidity pH 4.5 (kg H ₂ SO ₄ /tonne)	NAG Acidity pH 7.0 (kg H ₂ SO ₄ /tonne)	% RPD		
										to pH 4.5	to pH 7.0	Acceptance Criteria
13	BH19-39-RC04	2.5	250	2.80	6.55	8.50	0.1	12.8	16.7			
QUALITY ASSURANCE / QUALITY CONTROL												
<i>Method Blank Analysis:</i>												
Method Blank (15% H ₂ O ₂ Solution)		N/A	250	5.22	0.00	5.50	0.1					
GLOBAL SOP NO:		ARD-017										

NOTES:

Date of Analysis: Jan. 17/18, 2020

pH (pH Units) of 15% H₂O₂ (buffered with 0.5 N NaOH): 5.52

EC (µS/cm) of 15% H₂O₂ (buffered with 0.5 N NaOH): 8.0

pH (pH Units) of DI water used: 5.66

EC (µS/cm) of DI water used: 0.46

Solid:Liquid ratio used: 1:100; 2.5 g Pulp Sample: 250 mL 15% H₂O₂.

pH measurement of 15% H₂O₂ solution was conducted at room temperature & buffered with 0.5N NaOH solution to ensure a pH between 4 and 7.

NAG pH & method blank pH measurements were taken after digesting with peroxide solution and making up the solution to its original volume of 250 mL with DI water.

On client's request the NAG procedure is repeated using 1 g of pulp sample when the NAG value for pH 4.5 exceeds 25 kg H₂SO₄ per tonne.

ABBREVIATIONS:

R = Replicate (i.e. using a pulp sample from the same bag).

D = Duplicate (i.e. client sample is processed to produced a 2nd pulp bag & analyzed as a duplicate).

RPD = Relative Percent Difference.

RDL = Reportable Detection Limit.

EDL = Estimated Detection Limit

Calc. = Calculation

REFERENCE:

Egi - Environmental Geochemistry International; Single Addition Net Acid Generation (NAG) Test Procedure; Miller et al; Revised Dec. 2006; Page 2 to 4.

CERTIFICATE OF ANALYSIS

REPORTED TO SNC-Lavalin Inc. (Nelson)
#3-520 Lake Street
Nelson, BC V1L 4C6

ATTENTION Randy Williams

PO NUMBER 666768

PROJECT 666768

PROJECT INFO Selkirk Mountain Hwy

WORK ORDER N001171

RECEIVED / TEMP 2019-11-05 09:30 / 1°C

REPORTED 2019-11-28 15:46

COC NUMBER B37561

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry



It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve



Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Work Order Comments:

Custody Seals Intact: YES

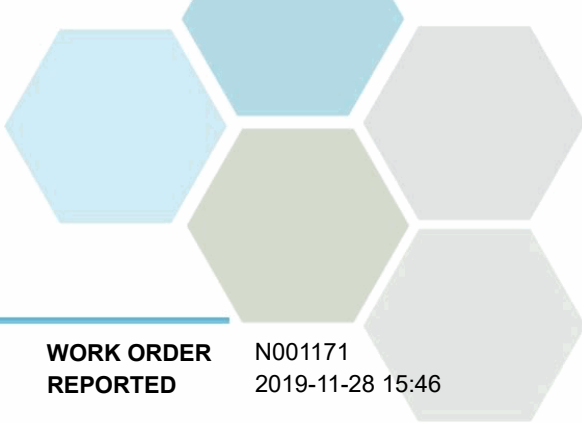
If you have any questions or concerns, please contact me at bshaw@caro.ca

Authorized By:

Bryan Shaw, Ph.D., P.Chem.
Client Service Coordinator

1-888-311-8846 | www.caro.ca

#110 4011 Viking Way Richmond, BC V6V 2K9 | #102 3677 Highway 97N Kelowna, BC V1X 5C3 | 17225 109 Avenue Edmonton, AB T5S 1H7



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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CRUS-20191104 (N001171-01) | Matrix: Water | Sampled: 2019-11-04 10:30

Anions

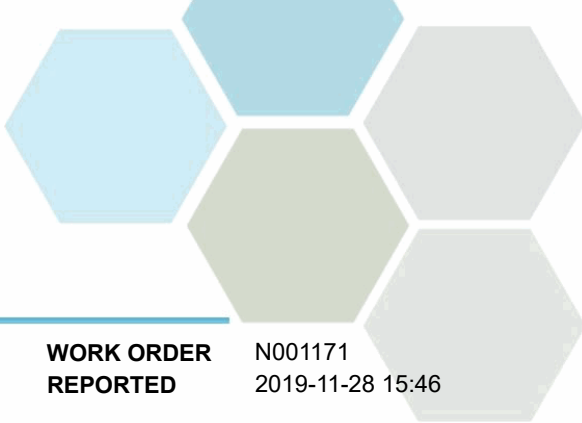
Chloride	0.86	0.10	mg/L	2019-11-07	
Fluoride	0.10	0.10	mg/L	2019-11-07	
Nitrate (as N)	0.102	0.010	mg/L	2019-11-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-11-07	
Sulfate	36.8	1.0	mg/L	2019-11-07	

Calculated Parameters

Hardness, Total (as CaCO3)	147	0.500	mg/L	N/A	
Nitrogen, Total	0.100	0.0500	mg/L	N/A	

Dissolved Metals

Lithium, dissolved	0.00202	0.00010	mg/L	2019-11-12	
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Barium, dissolved	0.0436	0.0050	mg/L	2019-11-12	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, dissolved	0.0100	0.0050	mg/L	2019-11-12	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, dissolved	32.8	0.20	mg/L	2019-11-12	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Iron, dissolved	0.022	0.010	mg/L	2019-11-12	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Magnesium, dissolved	15.7	0.010	mg/L	2019-11-12	
Manganese, dissolved	0.00521	0.00020	mg/L	2019-11-12	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-11-14	
Molybdenum, dissolved	0.00067	0.00010	mg/L	2019-11-12	
Nickel, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-11-12	
Potassium, dissolved	0.49	0.10	mg/L	2019-11-12	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, dissolved	2.4	1.0	mg/L	2019-11-12	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, dissolved	2.12	0.10	mg/L	2019-11-12	
Strontium, dissolved	0.287	0.0010	mg/L	2019-11-12	
Sulfur, dissolved	12.7	3.0	mg/L	2019-11-12	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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CRUS-20191104 (N001171-01) | Matrix: Water | Sampled: 2019-11-04 10:30, Continued

Dissolved Metals, Continued

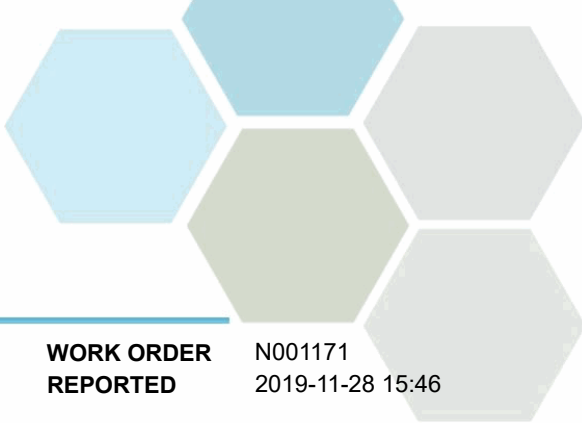
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, dissolved	0.000963	0.000020	mg/L	2019-11-12	
Vanadium, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, dissolved	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	

General Parameters

Alkalinity, Total (as CaCO3)	122	1.0	mg/L	2019-11-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Bicarbonate (as CaCO3)	122	1.0	mg/L	2019-11-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Carbon, Dissolved Organic	0.68	0.50	mg/L	2019-11-08	
Nitrogen, Total Kjeldahl	0.100	0.050	mg/L	2019-11-13	
Solids, Total Dissolved	178	15	mg/L	2019-11-09	
Solids, Total Suspended	3.4	2.0	mg/L	2019-11-08	

Total Metals

Aluminum, total	0.0250	0.0050	mg/L	2019-11-12	
Antimony, total	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, total	0.00057	0.00050	mg/L	2019-11-12	
Barium, total	0.0455	0.0050	mg/L	2019-11-12	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, total	0.0169	0.0050	mg/L	2019-11-12	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, total	35.5	0.20	mg/L	2019-11-12	
Chromium, total	0.00074	0.00050	mg/L	2019-11-12	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, total	0.00048	0.00040	mg/L	2019-11-12	
Iron, total	0.129	0.010	mg/L	2019-11-12	
Lead, total	0.00022	0.00020	mg/L	2019-11-12	
Lithium, total	0.00213	0.00010	mg/L	2019-11-12	
Magnesium, total	16.0	0.010	mg/L	2019-11-12	
Manganese, total	0.00872	0.00020	mg/L	2019-11-12	
Mercury, total	< 0.000010	0.000010	mg/L	2019-11-13	
Molybdenum, total	0.00073	0.00010	mg/L	2019-11-12	
Nickel, total	0.00063	0.00040	mg/L	2019-11-12	
Phosphorus, total	< 0.050	0.050	mg/L	2019-11-12	
Potassium, total	0.52	0.10	mg/L	2019-11-12	
Selenium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, total	2.6	1.0	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
CRUS-20191104 (N001171-01) Matrix: Water Sampled: 2019-11-04 10:30, Continued					
<i>Total Metals, Continued</i>					
Silver, total	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, total	2.13	0.10	mg/L	2019-11-12	
Strontium, total	0.291	0.0010	mg/L	2019-11-12	
Sulfur, total	12.8	3.0	mg/L	2019-11-12	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, total	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, total	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, total	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, total	0.000954	0.000020	mg/L	2019-11-12	
Vanadium, total	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, total	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, total	< 0.00010	0.00010	mg/L	2019-11-12	

CRDS-20191104 (N001171-02) | Matrix: Water | Sampled: 2019-11-04 09:30

Anions

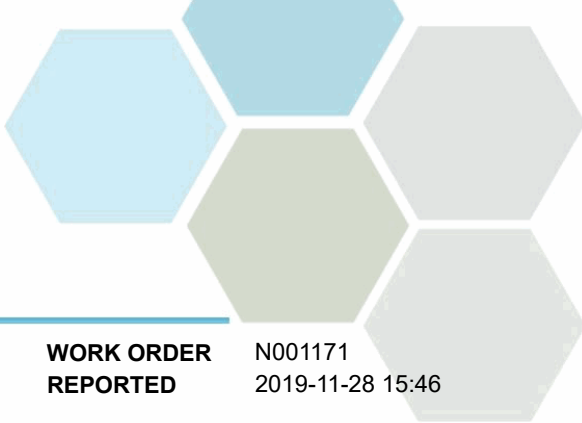
Chloride	0.85	0.10	mg/L	2019-11-07	
Fluoride	< 0.10	0.10	mg/L	2019-11-07	
Nitrate (as N)	0.105	0.010	mg/L	2019-11-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-11-07	
Sulfate	36.8	1.0	mg/L	2019-11-07	

Calculated Parameters

Hardness, Total (as CaCO3)	150	0.500	mg/L	N/A	
Nitrogen, Total	0.0550	0.0500	mg/L	N/A	

Dissolved Metals

Lithium, dissolved	0.00208	0.00010	mg/L	2019-11-12	
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Barium, dissolved	0.0446	0.0050	mg/L	2019-11-12	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, dissolved	0.0077	0.0050	mg/L	2019-11-12	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, dissolved	33.8	0.20	mg/L	2019-11-12	
Chromium, dissolved	0.00102	0.00050	mg/L	2019-11-12	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Iron, dissolved	0.028	0.010	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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CRDS-20191104 (N001171-02) | Matrix: Water | Sampled: 2019-11-04 09:30, Continued

Dissolved Metals, Continued

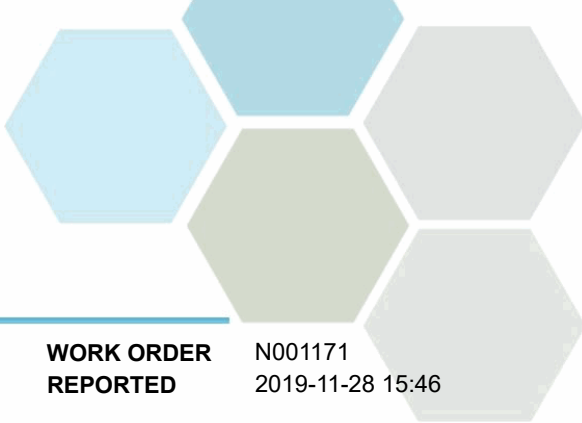
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Magnesium, dissolved	15.9	0.010	mg/L	2019-11-12	
Manganese, dissolved	0.00532	0.00020	mg/L	2019-11-12	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-11-14	
Molybdenum, dissolved	0.00068	0.00010	mg/L	2019-11-12	
Nickel, dissolved	0.00055	0.00040	mg/L	2019-11-12	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-11-12	
Potassium, dissolved	0.50	0.10	mg/L	2019-11-12	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, dissolved	2.5	1.0	mg/L	2019-11-12	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, dissolved	2.12	0.10	mg/L	2019-11-12	
Strontium, dissolved	0.291	0.0010	mg/L	2019-11-12	
Sulfur, dissolved	12.9	3.0	mg/L	2019-11-12	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, dissolved	0.000979	0.000020	mg/L	2019-11-12	
Vanadium, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, dissolved	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	

General Parameters

Alkalinity, Total (as CaCO3)	122	1.0	mg/L	2019-11-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Bicarbonate (as CaCO3)	122	1.0	mg/L	2019-11-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Carbon, Dissolved Organic	0.61	0.50	mg/L	2019-11-08	
Nitrogen, Total Kjeldahl	0.055	0.050	mg/L	2019-11-13	
Solids, Total Dissolved	170	15	mg/L	2019-11-09	
Solids, Total Suspended	3.4	2.0	mg/L	2019-11-08	

Total Metals

Aluminum, total	0.0323	0.0050	mg/L	2019-11-12	
Antimony, total	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, total	0.00061	0.00050	mg/L	2019-11-12	
Barium, total	0.0465	0.0050	mg/L	2019-11-12	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

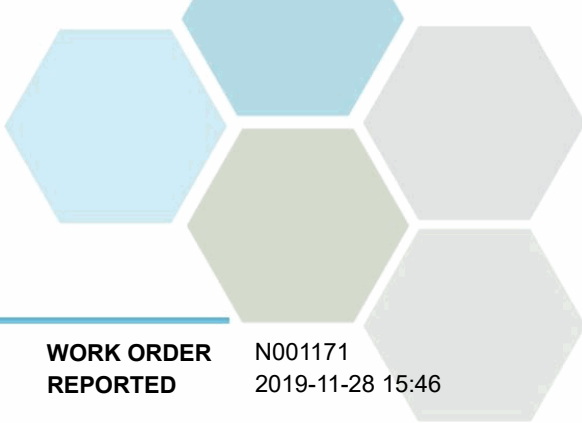
WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
CRDS-20191104 (N001171-02) Matrix: Water Sampled: 2019-11-04 09:30, Continued					
<i>Total Metals, Continued</i>					
Boron, total	0.0131	0.0050	mg/L	2019-11-12	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, total	36.1	0.20	mg/L	2019-11-12	
Chromium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, total	0.00110	0.00040	mg/L	2019-11-12	
Iron, total	0.158	0.010	mg/L	2019-11-12	
Lead, total	0.00030	0.00020	mg/L	2019-11-12	
Lithium, total	0.00225	0.00010	mg/L	2019-11-12	
Magnesium, total	16.4	0.010	mg/L	2019-11-12	
Manganese, total	0.00945	0.00020	mg/L	2019-11-12	
Mercury, total	< 0.000010	0.000010	mg/L	2019-11-13	
Molybdenum, total	0.00069	0.00010	mg/L	2019-11-12	
Nickel, total	< 0.00040	0.00040	mg/L	2019-11-12	
Phosphorus, total	< 0.050	0.050	mg/L	2019-11-12	
Potassium, total	0.54	0.10	mg/L	2019-11-12	
Selenium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, total	2.6	1.0	mg/L	2019-11-12	
Silver, total	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, total	2.18	0.10	mg/L	2019-11-12	
Strontium, total	0.293	0.0010	mg/L	2019-11-12	
Sulfur, total	12.7	3.0	mg/L	2019-11-12	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, total	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, total	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, total	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, total	0.000991	0.000020	mg/L	2019-11-12	
Vanadium, total	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, total	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, total	< 0.00010	0.00010	mg/L	2019-11-12	

SWMP-20191104 (N001171-03) | Matrix: Water | Sampled: 2019-11-04 13:15

Anions

Chloride	8.38	0.10	mg/L	2019-11-07	
Fluoride	< 0.10	0.10	mg/L	2019-11-07	
Nitrate (as N)	0.016	0.010	mg/L	2019-11-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-11-07	
Sulfate	21.1	1.0	mg/L	2019-11-07	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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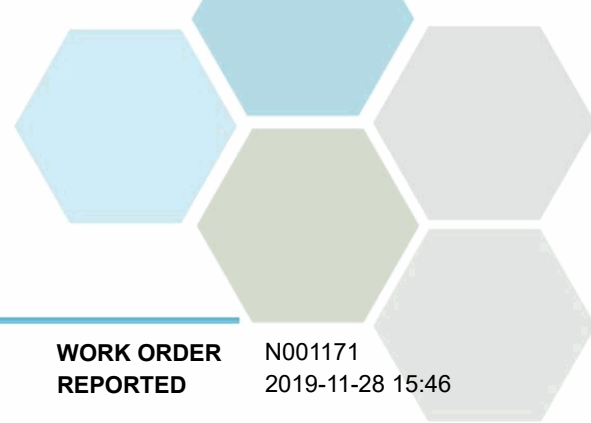
SWMP-20191104 (N001171-03) | Matrix: Water | Sampled: 2019-11-04 13:15, Continued

Calculated Parameters

Hardness, Total (as CaCO3)	115	0.500	mg/L	N/A	
Nitrogen, Total	0.0640	0.0500	mg/L	N/A	

Dissolved Metals

Lithium, dissolved	0.00075	0.00010	mg/L	2019-11-12	
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Barium, dissolved	0.0625	0.0050	mg/L	2019-11-12	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, dissolved	28.6	0.20	mg/L	2019-11-12	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Iron, dissolved	0.050	0.010	mg/L	2019-11-12	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Magnesium, dissolved	10.5	0.010	mg/L	2019-11-12	
Manganese, dissolved	0.00854	0.00020	mg/L	2019-11-12	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-11-14	
Molybdenum, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Nickel, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-11-12	
Potassium, dissolved	0.55	0.10	mg/L	2019-11-12	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, dissolved	5.1	1.0	mg/L	2019-11-12	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, dissolved	8.06	0.10	mg/L	2019-11-12	
Strontium, dissolved	0.229	0.0010	mg/L	2019-11-12	
Sulfur, dissolved	7.2	3.0	mg/L	2019-11-12	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, dissolved	0.000209	0.000020	mg/L	2019-11-12	
Vanadium, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, dissolved	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	



TEST RESULTS

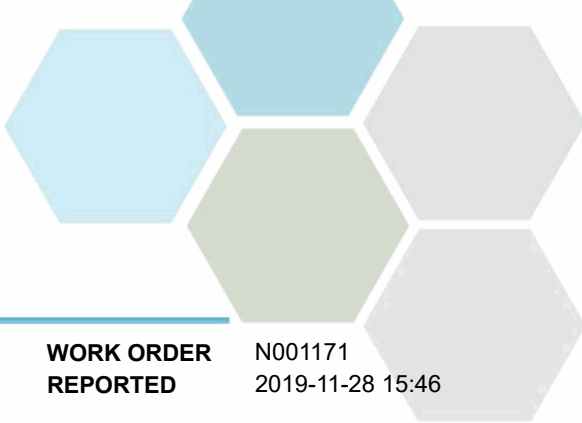
REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
SWMP-20191104 (N001171-03) Matrix: Water Sampled: 2019-11-04 13:15, Continued					
General Parameters					
Alkalinity, Total (as CaCO3)	99.3		1.0 mg/L	2019-11-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0		1.0 mg/L	2019-11-13	
Alkalinity, Bicarbonate (as CaCO3)	99.3		1.0 mg/L	2019-11-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0		1.0 mg/L	2019-11-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0		1.0 mg/L	2019-11-13	
Carbon, Dissolved Organic	2.27		0.50 mg/L	2019-11-08	
Nitrogen, Total Kjeldahl	0.064		0.050 mg/L	2019-11-13	
Solids, Total Dissolved	149		15 mg/L	2019-11-09	
Solids, Total Suspended	4.2		2.0 mg/L	2019-11-08	

Total Metals

Aluminum, total	0.0075		0.0050 mg/L	2019-11-12	
Antimony, total	< 0.00020		0.00020 mg/L	2019-11-12	
Arsenic, total	< 0.00050		0.00050 mg/L	2019-11-12	
Barium, total	0.0612		0.0050 mg/L	2019-11-12	
Beryllium, total	< 0.00010		0.00010 mg/L	2019-11-12	
Bismuth, total	< 0.00010		0.00010 mg/L	2019-11-12	
Boron, total	0.0088		0.0050 mg/L	2019-11-12	
Cadmium, total	< 0.000010		0.000010 mg/L	2019-11-12	
Calcium, total	28.7		0.20 mg/L	2019-11-12	
Chromium, total	< 0.00050		0.00050 mg/L	2019-11-12	
Cobalt, total	< 0.00010		0.00010 mg/L	2019-11-12	
Copper, total	0.00075		0.00040 mg/L	2019-11-12	
Iron, total	0.109		0.010 mg/L	2019-11-12	
Lead, total	< 0.00020		0.00020 mg/L	2019-11-12	
Lithium, total	0.00077		0.00010 mg/L	2019-11-12	
Magnesium, total	9.87		0.010 mg/L	2019-11-12	
Manganese, total	0.00844		0.00020 mg/L	2019-11-12	
Mercury, total	< 0.000010		0.000010 mg/L	2019-11-13	
Molybdenum, total	< 0.00010		0.00010 mg/L	2019-11-12	
Nickel, total	0.00043		0.00040 mg/L	2019-11-12	
Phosphorus, total	< 0.050		0.050 mg/L	2019-11-12	
Potassium, total	0.55		0.10 mg/L	2019-11-12	
Selenium, total	< 0.00050		0.00050 mg/L	2019-11-12	
Silicon, total	4.9		1.0 mg/L	2019-11-12	
Silver, total	< 0.000050		0.000050 mg/L	2019-11-12	
Sodium, total	8.07		0.10 mg/L	2019-11-12	
Strontium, total	0.220		0.0010 mg/L	2019-11-12	
Sulfur, total	7.4		3.0 mg/L	2019-11-12	
Tellurium, total	< 0.00050		0.00050 mg/L	2019-11-12	
Thallium, total	< 0.000020		0.000020 mg/L	2019-11-12	
Thorium, total	< 0.00010		0.00010 mg/L	2019-11-12	
Tin, total	< 0.00020		0.00020 mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
SWMP-20191104 (N001171-03) Matrix: Water Sampled: 2019-11-04 13:15, Continued					
<i>Total Metals, Continued</i>					
Titanium, total	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, total	0.000202	0.000020	mg/L	2019-11-12	
Vanadium, total	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, total	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, total	< 0.00010	0.00010	mg/L	2019-11-12	

SM-DUPA-20191104 (N001171-04) | Matrix: Water | Sampled: 2019-11-04 13:15

Anions

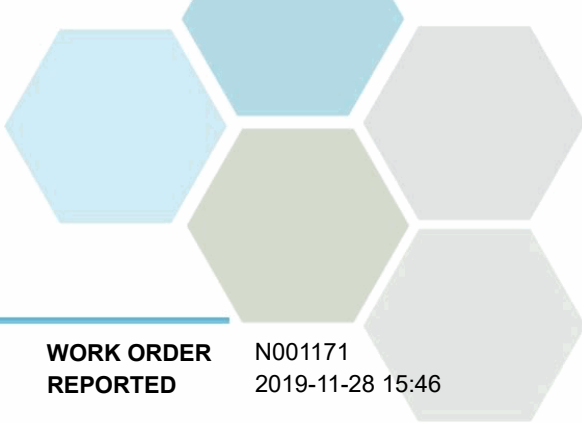
Chloride	7.51	0.10	mg/L	2019-11-07	
Fluoride	< 0.10	0.10	mg/L	2019-11-07	
Nitrate (as N)	0.014	0.010	mg/L	2019-11-07	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-11-07	
Sulfate	21.4	1.0	mg/L	2019-11-07	

Calculated Parameters

Hardness, Total (as CaCO3)	109	0.500	mg/L	N/A	
Nitrogen, Total	0.142	0.0500	mg/L	N/A	

Dissolved Metals

Lithium, dissolved	0.00068	0.00010	mg/L	2019-11-12	
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Barium, dissolved	0.0615	0.0050	mg/L	2019-11-12	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, dissolved	27.3	0.20	mg/L	2019-11-12	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Iron, dissolved	0.098	0.010	mg/L	2019-11-12	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Magnesium, dissolved	9.93	0.010	mg/L	2019-11-12	
Manganese, dissolved	0.00903	0.00020	mg/L	2019-11-12	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-11-14	
Molybdenum, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Nickel, dissolved	< 0.00040	0.00040	mg/L	2019-11-12	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-11-12	
Potassium, dissolved	0.52	0.10	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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SM-DUPA-20191104 (N001171-04) | Matrix: Water | Sampled: 2019-11-04 13:15, Continued

Dissolved Metals, Continued

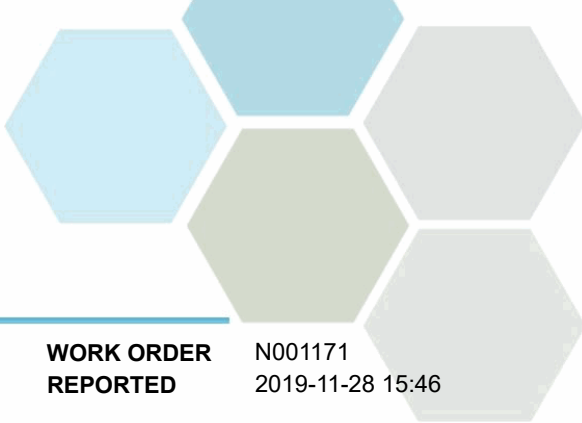
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, dissolved	5.0	1.0	mg/L	2019-11-12	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, dissolved	6.78	0.10	mg/L	2019-11-12	
Strontium, dissolved	0.218	0.0010	mg/L	2019-11-12	
Sulfur, dissolved	7.5	3.0	mg/L	2019-11-12	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, dissolved	0.000197	0.000020	mg/L	2019-11-12	
Vanadium, dissolved	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, dissolved	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-11-12	

General Parameters

Alkalinity, Total (as CaCO3)	95.5	1.0	mg/L	2019-11-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Bicarbonate (as CaCO3)	95.5	1.0	mg/L	2019-11-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-11-13	
Carbon, Dissolved Organic	2.46	0.50	mg/L	2019-11-08	
Nitrogen, Total Kjeldahl	0.142	0.050	mg/L	2019-11-13	
Solids, Total Dissolved	143	15	mg/L	2019-11-09	
Solids, Total Suspended	< 2.0	2.0	mg/L	2019-11-08	

Total Metals

Aluminum, total	0.0102	0.0050	mg/L	2019-11-12	
Antimony, total	< 0.00020	0.00020	mg/L	2019-11-12	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-11-12	
Barium, total	0.0643	0.0050	mg/L	2019-11-12	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-11-12	
Boron, total	0.0072	0.0050	mg/L	2019-11-12	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-11-12	
Calcium, total	30.3	0.20	mg/L	2019-11-12	
Chromium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-11-12	
Copper, total	0.00066	0.00040	mg/L	2019-11-12	
Iron, total	0.134	0.010	mg/L	2019-11-12	
Lead, total	< 0.00020	0.00020	mg/L	2019-11-12	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

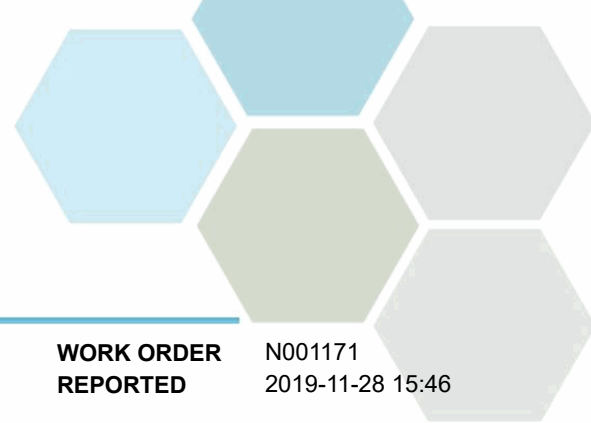
WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL	Units	Analyzed	Qualifier
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SM-DUPA-20191104 (N001171-04) | Matrix: Water | Sampled: 2019-11-04 13:15, Continued

Total Metals, Continued

Lithium, total	0.00082	0.00010	mg/L	2019-11-12	
Magnesium, total	10.6	0.010	mg/L	2019-11-12	
Manganese, total	0.00904	0.00020	mg/L	2019-11-12	
Mercury, total	< 0.000010	0.000010	mg/L	2019-11-13	
Molybdenum, total	< 0.00010	0.00010	mg/L	2019-11-12	
Nickel, total	< 0.00040	0.00040	mg/L	2019-11-12	
Phosphorus, total	< 0.050	0.050	mg/L	2019-11-12	
Potassium, total	0.58	0.10	mg/L	2019-11-12	
Selenium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Silicon, total	5.2	1.0	mg/L	2019-11-12	
Silver, total	< 0.000050	0.000050	mg/L	2019-11-12	
Sodium, total	8.34	0.10	mg/L	2019-11-12	
Strontium, total	0.231	0.0010	mg/L	2019-11-12	
Sulfur, total	7.3	3.0	mg/L	2019-11-12	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-11-12	
Thallium, total	< 0.000020	0.000020	mg/L	2019-11-12	
Thorium, total	< 0.00010	0.00010	mg/L	2019-11-12	
Tin, total	< 0.00020	0.00020	mg/L	2019-11-12	
Titanium, total	< 0.0050	0.0050	mg/L	2019-11-12	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-11-12	
Uranium, total	0.000240	0.000020	mg/L	2019-11-12	
Vanadium, total	< 0.0010	0.0010	mg/L	2019-11-12	
Zinc, total	< 0.0040	0.0040	mg/L	2019-11-12	
Zirconium, total	< 0.00010	0.00010	mg/L	2019-11-12	



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
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Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
Solids, Total Dissolved in Water	SM 2540 C* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

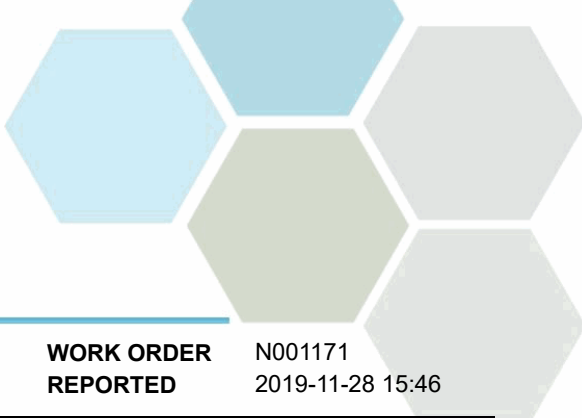
Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: bshaw@caro.ca



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO SNC-Lavalin Inc. (Nelson)
PROJECT 666768

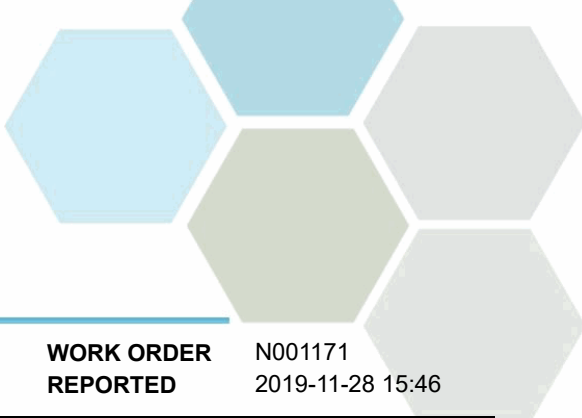
WORK ORDER N001171
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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup):** An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS):** A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS):** A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM):** A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B9K0914									
Blank (B9K0914-BLK1)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK2)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK3)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK4)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK5)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK6)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

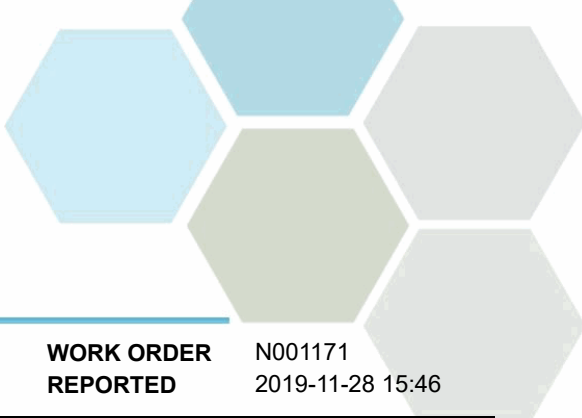
REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B9K0914, Continued									
Blank (B9K0914-BLK6), Continued					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B9K0914-BS1)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.08	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.01	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.01	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS2)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		102	90-110			
Fluoride	4.06	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.00	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	1.99	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS3)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.01	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	4.00	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.02	0.010 mg/L	2.00		101	85-115			
Sulfate	16.1	1.0 mg/L	16.0		101	90-110			
LCS (B9K0914-BS4)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.1	0.10 mg/L	16.0		101	90-110			
Fluoride	4.00	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	3.99	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.02	0.010 mg/L	2.00		101	85-115			
Sulfate	16.1	1.0 mg/L	16.0		101	90-110			
LCS (B9K0914-BS5)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.14	0.10 mg/L	4.00		103	88-108			
Nitrate (as N)	4.11	0.010 mg/L	4.00		103	90-110			
Nitrite (as N)	2.01	0.010 mg/L	2.00		100	85-115			
Sulfate	16.0	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS6)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.09	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.08	0.010 mg/L	4.00		102	90-110			
Nitrite (as N)	2.00	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		99	90-110			

Dissolved Metals, Batch B9K1127

Blank (B9K1127-BLK1)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Dissolved Metals, Batch B9K1127, Continued

Blank (B9K1127-BLK1), Continued

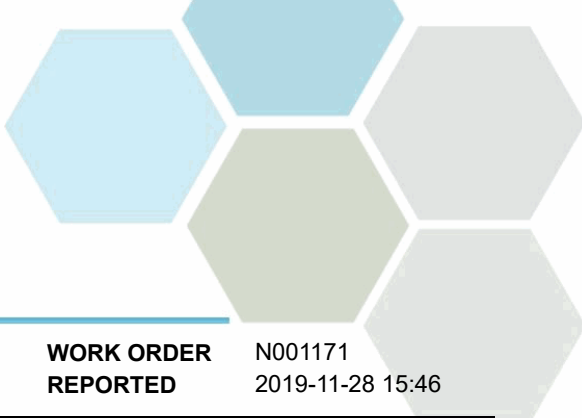
Prepared: 2019-11-12, Analyzed: 2019-11-12

Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							
Zirconium, dissolved	< 0.00010	0.00010 mg/L							

LCS (B9K1127-BS1)

Prepared: 2019-11-12, Analyzed: 2019-11-12

Lithium, dissolved	0.0209	0.00010 mg/L	0.0200		104	80-120			
Aluminum, dissolved	0.0218	0.0050 mg/L	0.0199		110	80-120			
Antimony, dissolved	0.0206	0.00020 mg/L	0.0200		103	80-120			
Arsenic, dissolved	0.0204	0.00050 mg/L	0.0200		102	80-120			
Barium, dissolved	0.0205	0.0050 mg/L	0.0198		104	80-120			
Beryllium, dissolved	0.0207	0.00010 mg/L	0.0198		105	80-120			
Bismuth, dissolved	0.0217	0.00010 mg/L	0.0200		109	80-120			
Boron, dissolved	0.0203	0.0050 mg/L	0.0200		101	80-120			
Cadmium, dissolved	0.0210	0.000010 mg/L	0.0199		105	80-120			
Calcium, dissolved	1.91	0.20 mg/L	2.02		94	80-120			
Chromium, dissolved	0.0203	0.00050 mg/L	0.0198		103	80-120			
Cobalt, dissolved	0.0206	0.00010 mg/L	0.0199		103	80-120			
Copper, dissolved	0.0214	0.00040 mg/L	0.0200		107	80-120			
Iron, dissolved	1.95	0.010 mg/L	2.02		97	80-120			
Lead, dissolved	0.0214	0.00020 mg/L	0.0199		107	80-120			
Magnesium, dissolved	2.04	0.010 mg/L	2.02		101	80-120			
Manganese, dissolved	0.0200	0.00020 mg/L	0.0199		101	80-120			
Molybdenum, dissolved	0.0208	0.00010 mg/L	0.0200		104	80-120			
Nickel, dissolved	0.0200	0.00040 mg/L	0.0200		100	80-120			
Phosphorus, dissolved	1.95	0.050 mg/L	2.00		98	80-120			
Potassium, dissolved	1.99	0.10 mg/L	2.02		99	80-120			
Selenium, dissolved	0.0197	0.00050 mg/L	0.0200		98	80-120			
Silicon, dissolved	2.1	1.0 mg/L	2.00		104	80-120			



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Dissolved Metals, Batch B9K1127, Continued

LCS (B9K1127-BS1), Continued

Prepared: 2019-11-12, Analyzed: 2019-11-12

Silver, dissolved	0.0207	0.000050 mg/L	0.0200		103	80-120			
Sodium, dissolved	2.01	0.10 mg/L	2.02		99	80-120			
Strontium, dissolved	0.0205	0.0010 mg/L	0.0200		103	80-120			
Sulfur, dissolved	4.7	3.0 mg/L	5.00		94	80-120			
Tellurium, dissolved	0.0204	0.00050 mg/L	0.0200		102	80-120			
Thallium, dissolved	0.0215	0.000020 mg/L	0.0199		108	80-120			
Thorium, dissolved	0.0200	0.00010 mg/L	0.0200		100	80-120			
Tin, dissolved	0.0219	0.00020 mg/L	0.0200		110	80-120			
Titanium, dissolved	0.0211	0.0050 mg/L	0.0200		106	80-120			
Tungsten, dissolved	0.0213	0.0010 mg/L	0.0200		106	80-120			
Uranium, dissolved	0.0204	0.000020 mg/L	0.0200		102	80-120			
Vanadium, dissolved	0.0200	0.0010 mg/L	0.0200		100	80-120			
Zinc, dissolved	0.0231	0.0040 mg/L	0.0200		115	80-120			
Zirconium, dissolved	0.0208	0.00010 mg/L	0.0200		104	80-120			

Duplicate (B9K1127-DUP1)

Source: N001171-04

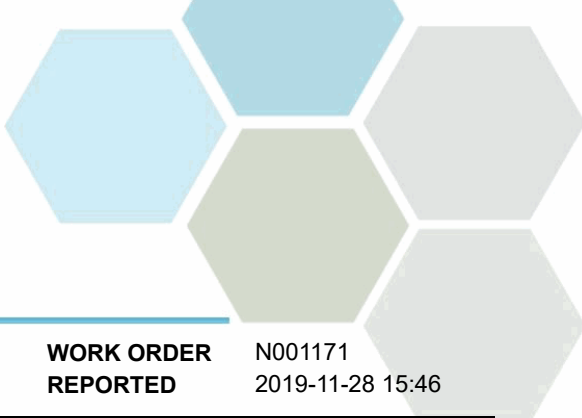
Prepared: 2019-11-12, Analyzed: 2019-11-12

Lithium, dissolved	0.00067	0.00010 mg/L		0.00068			1	14	
Aluminum, dissolved	< 0.0050	0.0050 mg/L		< 0.0050				11	
Antimony, dissolved	< 0.00020	0.00020 mg/L		< 0.00020				20	
Arsenic, dissolved	< 0.00050	0.00050 mg/L		< 0.00050				8	
Barium, dissolved	0.0614	0.0050 mg/L		0.0615			< 1	7	
Beryllium, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				14	
Bismuth, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				20	
Boron, dissolved	< 0.0050	0.0050 mg/L		< 0.0050				13	
Cadmium, dissolved	< 0.000010	0.000010 mg/L		< 0.000010				20	
Calcium, dissolved	26.8	0.20 mg/L		27.3			2	8	
Chromium, dissolved	< 0.00050	0.00050 mg/L		< 0.00050				14	
Cobalt, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				10	
Copper, dissolved	0.00046	0.00040 mg/L		< 0.00040				20	
Iron, dissolved	0.100	0.010 mg/L		0.098			1	14	
Lead, dissolved	< 0.00020	0.00020 mg/L		< 0.00020				20	
Magnesium, dissolved	9.92	0.010 mg/L		9.93			< 1	6	
Manganese, dissolved	0.00909	0.00020 mg/L		0.00903			< 1	9	
Molybdenum, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				19	
Nickel, dissolved	< 0.00040	0.00040 mg/L		< 0.00040				20	
Phosphorus, dissolved	< 0.050	0.050 mg/L		< 0.050				14	
Potassium, dissolved	0.52	0.10 mg/L		0.52			< 1	8	
Selenium, dissolved	< 0.00050	0.00050 mg/L		< 0.00050				20	
Silicon, dissolved	5.0	1.0 mg/L		5.0			< 1	12	
Silver, dissolved	< 0.000050	0.000050 mg/L		< 0.000050				20	
Sodium, dissolved	6.72	0.10 mg/L		6.78			< 1	6	
Strontium, dissolved	0.219	0.0010 mg/L		0.218			< 1	6	
Sulfur, dissolved	7.3	3.0 mg/L		7.5				20	
Tellurium, dissolved	< 0.00050	0.00050 mg/L		< 0.00050				20	
Thallium, dissolved	< 0.000020	0.000020 mg/L		< 0.000020				13	
Thorium, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				20	
Tin, dissolved	< 0.00020	0.00020 mg/L		< 0.00020				20	
Titanium, dissolved	< 0.0050	0.0050 mg/L		< 0.0050				20	
Tungsten, dissolved	< 0.0010	0.0010 mg/L		< 0.0010				20	
Uranium, dissolved	0.000206	0.000020 mg/L		0.000197			5	14	
Vanadium, dissolved	< 0.0010	0.0010 mg/L		< 0.0010				20	
Zinc, dissolved	< 0.0040	0.0040 mg/L		< 0.0040				11	
Zirconium, dissolved	< 0.00010	0.00010 mg/L		< 0.00010				20	

Reference (B9K1127-SRM1)

Prepared: 2019-11-12, Analyzed: 2019-11-12

Lithium, dissolved	0.107	0.00010 mg/L	0.100		107	77-127			
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APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

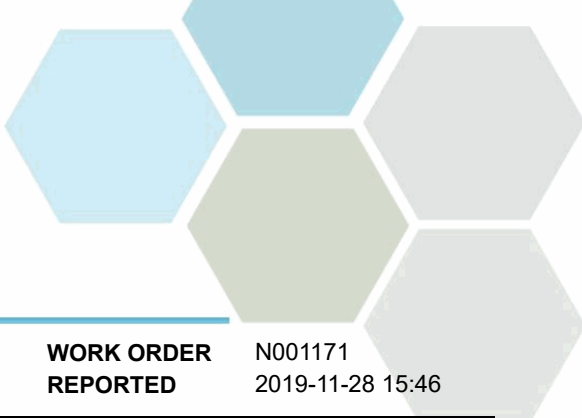
Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9K1127, Continued									
Reference (B9K1127-SRM1), Continued					Prepared: 2019-11-12, Analyzed: 2019-11-12				
Aluminum, dissolved	0.226	0.0050 mg/L	0.235		96	79-114			
Antimony, dissolved	0.0480	0.00020 mg/L	0.0431		111	89-123			
Arsenic, dissolved	0.450	0.00050 mg/L	0.423		106	87-113			
Barium, dissolved	3.18	0.0050 mg/L	3.30		96	85-114			
Beryllium, dissolved	0.215	0.00010 mg/L	0.209		103	79-122			
Boron, dissolved	1.66	0.0050 mg/L	1.65		101	79-117			
Cadmium, dissolved	0.232	0.000010 mg/L	0.221		105	89-112			
Calcium, dissolved	7.40	0.20 mg/L	7.72		96	85-120			
Chromium, dissolved	0.450	0.00050 mg/L	0.434		104	87-113			
Cobalt, dissolved	0.133	0.00010 mg/L	0.124		107	90-117			
Copper, dissolved	0.864	0.00040 mg/L	0.815		106	90-115			
Iron, dissolved	1.26	0.010 mg/L	1.27		99	86-112			
Lead, dissolved	0.116	0.00020 mg/L	0.110		105	90-113			
Magnesium, dissolved	6.69	0.010 mg/L	6.59		102	84-116			
Manganese, dissolved	0.343	0.00020 mg/L	0.342		100	85-113			
Molybdenum, dissolved	0.443	0.00010 mg/L	0.404		110	87-112			
Nickel, dissolved	0.837	0.00040 mg/L	0.835		100	90-114			
Phosphorus, dissolved	0.466	0.050 mg/L	0.499		93	74-119			
Potassium, dissolved	2.99	0.10 mg/L	2.88		104	78-119			
Selenium, dissolved	0.0321	0.00050 mg/L	0.0324		99	89-123			
Sodium, dissolved	18.1	0.10 mg/L	18.0		101	81-117			
Strontium, dissolved	0.949	0.0010 mg/L	0.935		101	82-111			
Thallium, dissolved	0.0414	0.000020 mg/L	0.0385		107	90-113			
Uranium, dissolved	0.256	0.000020 mg/L	0.258		99	87-113			
Vanadium, dissolved	0.867	0.0010 mg/L	0.873		99	85-110			
Zinc, dissolved	0.902	0.0040 mg/L	0.848		106	88-114			

Dissolved Metals, Batch B9K1450

Blank (B9K1450-BLK1)					Prepared: 2019-11-14, Analyzed: 2019-11-14				
Mercury, dissolved	< 0.000010	0.000010 mg/L							
Blank (B9K1450-BLK2)					Prepared: 2019-11-14, Analyzed: 2019-11-14				
Mercury, dissolved	< 0.000010	0.000010 mg/L							
Reference (B9K1450-SRM1)					Prepared: 2019-11-14, Analyzed: 2019-11-14				
Mercury, dissolved	0.00470	0.000010 mg/L	0.00489		96	80-120			
Reference (B9K1450-SRM2)					Prepared: 2019-11-14, Analyzed: 2019-11-14				
Mercury, dissolved	0.00481	0.000010 mg/L	0.00489		98	80-120			

General Parameters, Batch B9K0795

Blank (B9K0795-BLK1)					Prepared: 2019-11-08, Analyzed: 2019-11-08				
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
Blank (B9K0795-BLK2)					Prepared: 2019-11-08, Analyzed: 2019-11-08				
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
Blank (B9K0795-BLK3)					Prepared: 2019-11-08, Analyzed: 2019-11-08				
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
Blank (B9K0795-BLK4)					Prepared: 2019-11-08, Analyzed: 2019-11-08				
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							

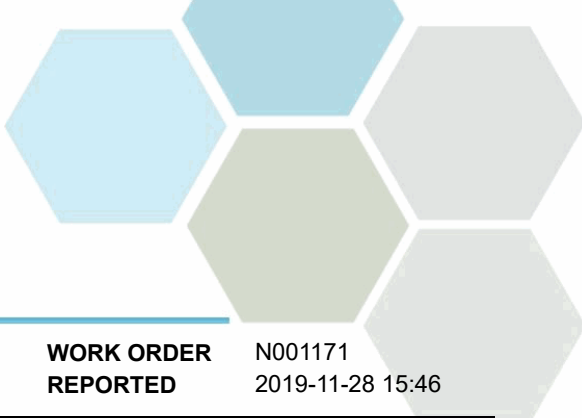


APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B9K0795, Continued									
LCS (B9K0795-BS1)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Carbon, Dissolved Organic	10.4	0.50 mg/L	10.0		104	78-116			
LCS (B9K0795-BS2)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Carbon, Dissolved Organic	10.3	0.50 mg/L	10.0		103	78-116			
LCS (B9K0795-BS3)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Carbon, Dissolved Organic	10.1	0.50 mg/L	10.0		101	78-116			
LCS (B9K0795-BS4)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Carbon, Dissolved Organic	9.99	0.50 mg/L	10.0		100	78-116			
General Parameters, Batch B9K0985									
Blank (B9K0985-BLK1)			Prepared: 2019-11-09, Analyzed: 2019-11-09						
Solids, Total Dissolved	< 15	15 mg/L							
LCS (B9K0985-BS1)			Prepared: 2019-11-09, Analyzed: 2019-11-09						
Solids, Total Dissolved	241	15 mg/L	240		100	85-115			
General Parameters, Batch B9K1067									
Blank (B9K1067-BLK1)			Prepared: 2019-11-11, Analyzed: 2019-11-13						
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
Blank (B9K1067-BLK2)			Prepared: 2019-11-11, Analyzed: 2019-11-13						
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
LCS (B9K1067-BS1)			Prepared: 2019-11-11, Analyzed: 2019-11-13						
Nitrogen, Total Kjeldahl	1.09	0.050 mg/L	1.00		109	85-115			
LCS (B9K1067-BS2)			Prepared: 2019-11-11, Analyzed: 2019-11-13						
Nitrogen, Total Kjeldahl	1.08	0.050 mg/L	1.00		108	85-115			
General Parameters, Batch B9K1236									
Blank (B9K1236-BLK1)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Solids, Total Suspended	< 1.0	1.0 mg/L							
Blank (B9K1236-BLK2)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Solids, Total Suspended	< 1.0	1.0 mg/L							
LCS (B9K1236-BS1)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Solids, Total Suspended	102	10.0 mg/L	100		102	85-115			
LCS (B9K1236-BS2)			Prepared: 2019-11-08, Analyzed: 2019-11-08						
Solids, Total Suspended	106	10.0 mg/L	100		106	85-115			
General Parameters, Batch B9K1326									
Blank (B9K1326-BLK1)			Prepared: 2019-11-13, Analyzed: 2019-11-13						
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

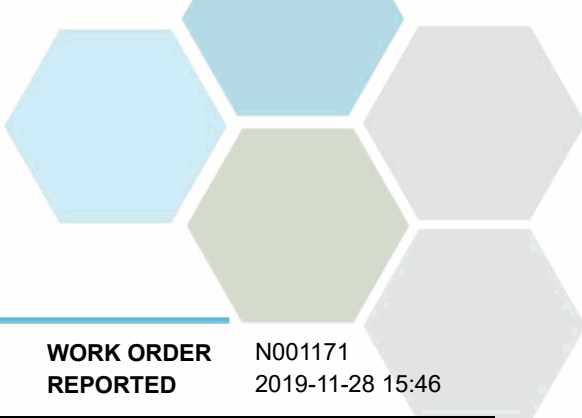
REPORTED TO SNC-Lavalin Inc. (Nelson)
PROJECT 666768

WORK ORDER N001171
REPORTED 2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B9K1326, Continued									
Blank (B9K1326-BLK2)					Prepared: 2019-11-13, Analyzed: 2019-11-13				
Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0 mg/L							
Blank (B9K1326-BLK3)					Prepared: 2019-11-13, Analyzed: 2019-11-13				
Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0 mg/L							
LCS (B9K1326-BS1)					Prepared: 2019-11-13, Analyzed: 2019-11-13				
Alkalinity, Total (as CaCO3)	94.5	1.0 mg/L	100		94	80-120			
LCS (B9K1326-BS2)					Prepared: 2019-11-13, Analyzed: 2019-11-13				
Alkalinity, Total (as CaCO3)	96.3	1.0 mg/L	100		96	80-120			
LCS (B9K1326-BS3)					Prepared: 2019-11-13, Analyzed: 2019-11-13				
Alkalinity, Total (as CaCO3)	96.7	1.0 mg/L	100		97	80-120			

Total Metals, Batch B9K1131

Blank (B9K1131-BLK1)					Prepared: 2019-11-12, Analyzed: 2019-11-12				
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00050	0.00050 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Total Metals, Batch B9K1131, Continued

Blank (B9K1131-BLK1), Continued

Prepared: 2019-11-12, Analyzed: 2019-11-12

Titanium, total	< 0.0050	0.0050 mg/L							
Tungsten, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							

Blank (B9K1131-BLK3)

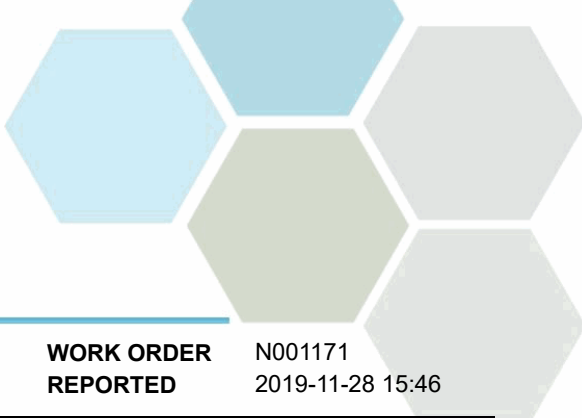
Prepared: 2019-11-12, Analyzed: 2019-11-12

Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00050	0.00050 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							
Titanium, total	< 0.0050	0.0050 mg/L							
Tungsten, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							

LCS (B9K1131-BS1)

Prepared: 2019-11-12, Analyzed: 2019-11-12

Aluminum, total	0.0226	0.0050 mg/L	0.0199	114	80-120
Antimony, total	0.0208	0.00020 mg/L	0.0200	104	80-120
Arsenic, total	0.0209	0.00050 mg/L	0.0200	104	80-120
Barium, total	0.0207	0.0050 mg/L	0.0198	104	80-120
Beryllium, total	0.0205	0.00010 mg/L	0.0198	103	80-120
Bismuth, total	0.0206	0.00010 mg/L	0.0200	103	80-120
Boron, total	0.0218	0.0050 mg/L	0.0200	109	80-120
Cadmium, total	0.0211	0.000010 mg/L	0.0199	106	80-120
Calcium, total	2.09	0.20 mg/L	2.02	104	80-120

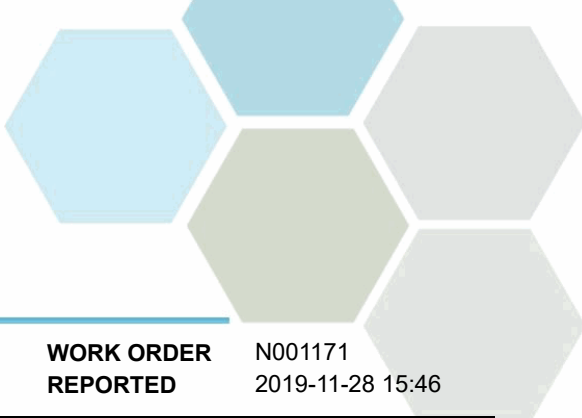


APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B9K1131, Continued									
LCS (B9K1131-BS1), Continued					Prepared: 2019-11-12, Analyzed: 2019-11-12				
Chromium, total	0.0211	0.00050 mg/L	0.0198		107	80-120			
Cobalt, total	0.0214	0.00010 mg/L	0.0199		108	80-120			
Copper, total	0.0225	0.00040 mg/L	0.0200		112	80-120			
Iron, total	2.01	0.010 mg/L	2.02		100	80-120			
Lead, total	0.0204	0.00020 mg/L	0.0199		103	80-120			
Lithium, total	0.0210	0.00010 mg/L	0.0200		105	80-120			
Magnesium, total	2.08	0.010 mg/L	2.02		103	80-120			
Manganese, total	0.0209	0.00020 mg/L	0.0199		105	80-120			
Molybdenum, total	0.0207	0.00010 mg/L	0.0200		104	80-120			
Nickel, total	0.0219	0.00040 mg/L	0.0200		110	80-120			
Phosphorus, total	2.06	0.050 mg/L	2.00		103	80-120			
Potassium, total	2.09	0.10 mg/L	2.02		103	80-120			
Selenium, total	0.0211	0.00050 mg/L	0.0200		105	80-120			
Silicon, total	2.3	1.0 mg/L	2.00		114	80-120			
Silver, total	0.0212	0.000050 mg/L	0.0200		106	80-120			
Sodium, total	2.05	0.10 mg/L	2.02		102	80-120			
Strontium, total	0.0207	0.0010 mg/L	0.0200		103	80-120			
Sulfur, total	4.6	3.0 mg/L	5.00		93	80-120			
Tellurium, total	0.0198	0.00050 mg/L	0.0200		99	80-120			
Thallium, total	0.0204	0.000020 mg/L	0.0199		103	80-120			
Thorium, total	0.0197	0.00010 mg/L	0.0200		99	80-120			
Tin, total	0.0211	0.00020 mg/L	0.0200		105	80-120			
Titanium, total	0.0205	0.0050 mg/L	0.0200		102	80-120			
Tungsten, total	0.0212	0.0010 mg/L	0.0200		106	80-120			
Uranium, total	0.0201	0.000020 mg/L	0.0200		100	80-120			
Vanadium, total	0.0214	0.0010 mg/L	0.0200		107	80-120			
Zinc, total	0.0224	0.0040 mg/L	0.0200		112	80-120			
Zirconium, total	0.0204	0.00010 mg/L	0.0200		102	80-120			
Reference (B9K1131-SRM1)					Prepared: 2019-11-12, Analyzed: 2019-11-12				
Aluminum, total	0.281	0.0050 mg/L	0.303		93	82-114			
Antimony, total	0.0498	0.00020 mg/L	0.0511		97	88-115			
Arsenic, total	0.117	0.00050 mg/L	0.118		99	88-111			
Barium, total	0.764	0.0050 mg/L	0.823		93	83-110			
Beryllium, total	0.0471	0.00010 mg/L	0.0496		95	80-119			
Boron, total	3.27	0.0050 mg/L	3.45		95	80-118			
Cadmium, total	0.0479	0.000010 mg/L	0.0495		97	90-110			
Calcium, total	10.7	0.20 mg/L	11.6		93	85-113			
Chromium, total	0.250	0.00050 mg/L	0.250		100	88-111			
Cobalt, total	0.0392	0.00010 mg/L	0.0377		104	90-114			
Copper, total	0.512	0.00040 mg/L	0.486		105	90-117			
Iron, total	0.476	0.010 mg/L	0.488		98	90-116			
Lead, total	0.193	0.00020 mg/L	0.204		95	90-110			
Lithium, total	0.390	0.00010 mg/L	0.403		97	79-118			
Magnesium, total	3.62	0.010 mg/L	3.79		96	88-116			
Manganese, total	0.105	0.00020 mg/L	0.109		96	88-108			
Molybdenum, total	0.194	0.00010 mg/L	0.198		98	88-110			
Nickel, total	0.251	0.00040 mg/L	0.249		101	90-112			
Phosphorus, total	0.209	0.050 mg/L	0.227		92	72-118			
Potassium, total	6.97	0.10 mg/L	7.21		97	87-116			
Selenium, total	0.119	0.00050 mg/L	0.121		98	90-122			
Sodium, total	7.09	0.10 mg/L	7.54		94	86-118			
Strontium, total	0.372	0.0010 mg/L	0.375		99	86-110			
Thallium, total	0.0782	0.000020 mg/L	0.0805		97	90-113			
Uranium, total	0.0288	0.000020 mg/L	0.0306		94	88-112			
Vanadium, total	0.384	0.0010 mg/L	0.386		99	87-110			



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001171
2019-11-28 15:46

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Total Metals, Batch B9K1131, Continued

Reference (B9K1131-SRM1), Continued

Prepared: 2019-11-12, Analyzed: 2019-11-12

Zinc, total	2.51	0.0040 mg/L	2.49		101	90-113			
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Total Metals, Batch B9K1327

Blank (B9K1327-BLK1)

Prepared: 2019-11-13, Analyzed: 2019-11-13

Mercury, total	< 0.000010	0.000010 mg/L							
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Blank (B9K1327-BLK2)

Prepared: 2019-11-13, Analyzed: 2019-11-13

Mercury, total	< 0.000010	0.000010 mg/L							
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Matrix Spike (B9K1327-MS2)

Source: N001171-01

Prepared: 2019-11-13, Analyzed: 2019-11-13

Mercury, total	0.000281	0.000010 mg/L	0.000250	< 0.000010	112	70-130			
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Reference (B9K1327-SRM1)

Prepared: 2019-11-13, Analyzed: 2019-11-13

Mercury, total	0.00579	0.000010 mg/L	0.00489		118	80-120			
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Reference (B9K1327-SRM2)

Prepared: 2019-11-13, Analyzed: 2019-11-13

Mercury, total	0.00533	0.000010 mg/L	0.00489		109	80-120			
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CERTIFICATE OF ANALYSIS

REPORTED TO	SNC-Lavalin Inc. (Nelson) #3-520 Lake Street Nelson, BC V1L 4C6	WORK ORDER	N001350
ATTENTION	Randy Williams	RECEIVED / TEMP REPORTED	2019-11-08 09:20 / 2°C 2019-11-28 15:49
PO NUMBER	666768	COC NUMBER	B48483
PROJECT	666768		
PROJECT INFO	Selkirk Mountain Hwy		

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry



It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve



Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

Work Order Comments:

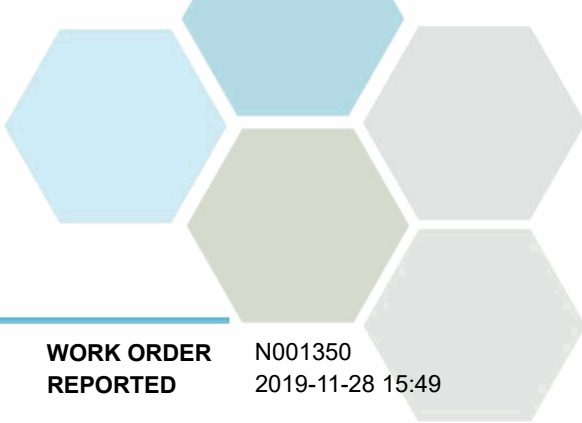
Custody Seals Intact: YES

If you have any questions or concerns, please contact me at bshaw@caro.ca

Authorized By:

Bryan Shaw, Ph.D., P.Chem.
Client Service Coordinator

1-888-311-8846 | www.caro.ca

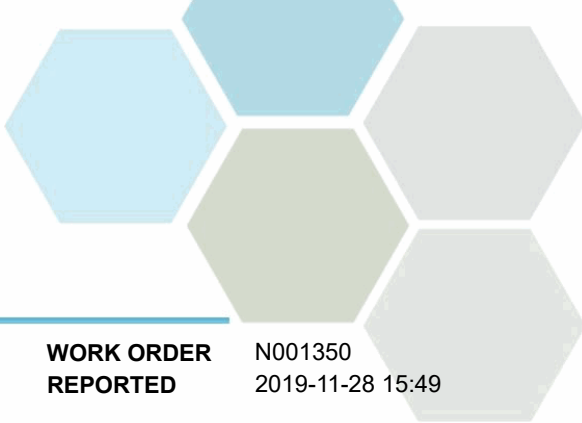


TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL	Units	Analyzed	Qualifier
GULY-20191107 (N001350-01) Matrix: Water Sampled: 2019-11-07 13:00					
Anions					
Chloride	0.20	0.10	mg/L	2019-11-08	
Fluoride	< 0.10	0.10	mg/L	2019-11-08	
Nitrate (as N)	0.036	0.010	mg/L	2019-11-08	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-11-08	
Sulfate	10.3	1.0	mg/L	2019-11-08	
Calculated Parameters					
Hardness, Total (as CaCO3)	54.9	0.500	mg/L	N/A	
Nitrogen, Total	< 0.0500	0.0500	mg/L	N/A	
Dissolved Metals					
Lithium, dissolved	0.00651	0.00010	mg/L	2019-11-18	
Aluminum, dissolved	0.0091	0.0050	mg/L	2019-11-18	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-11-18	
Arsenic, dissolved	< 0.00050	0.00050	mg/L	2019-11-18	
Barium, dissolved	0.128	0.0050	mg/L	2019-11-18	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-11-18	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-11-18	
Boron, dissolved	0.0140	0.0050	mg/L	2019-11-18	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-11-18	
Calcium, dissolved	11.4	0.20	mg/L	2019-11-18	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-11-18	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-11-18	
Copper, dissolved	< 0.00040	0.00040	mg/L	2019-11-18	
Iron, dissolved	0.011	0.010	mg/L	2019-11-18	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-11-18	
Magnesium, dissolved	6.40	0.010	mg/L	2019-11-18	
Manganese, dissolved	0.00952	0.00020	mg/L	2019-11-18	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-11-19	
Molybdenum, dissolved	< 0.00010	0.00010	mg/L	2019-11-18	
Nickel, dissolved	< 0.00040	0.00040	mg/L	2019-11-18	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-11-18	
Potassium, dissolved	0.95	0.10	mg/L	2019-11-18	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-11-18	
Silicon, dissolved	4.3	1.0	mg/L	2019-11-18	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-11-18	
Sodium, dissolved	2.24	0.10	mg/L	2019-11-18	
Strontium, dissolved	0.281	0.0010	mg/L	2019-11-18	
Sulfur, dissolved	3.3	3.0	mg/L	2019-11-18	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-11-18	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-11-18	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-11-18	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-11-18	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL	Units	Analyzed	Qualifier
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GULY-20191107 (N001350-01) | Matrix: Water | Sampled: 2019-11-07 13:00, Continued

Dissolved Metals, Continued

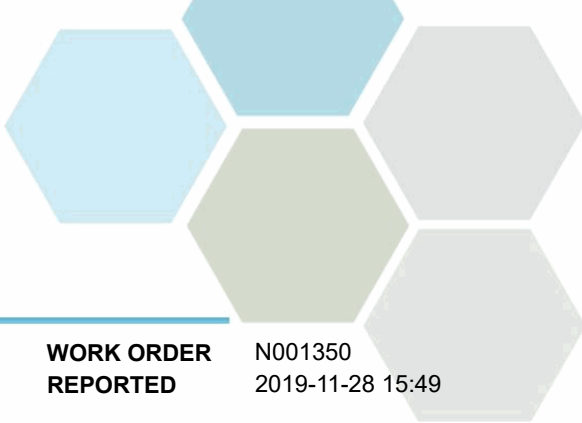
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-11-18	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-11-18	
Uranium, dissolved	0.000052	0.000020	mg/L	2019-11-18	
Vanadium, dissolved	< 0.0010	0.0010	mg/L	2019-11-18	
Zinc, dissolved	< 0.0040	0.0040	mg/L	2019-11-18	
Zirconium, dissolved	0.00015	0.00010	mg/L	2019-11-18	

General Parameters

Alkalinity, Total (as CaCO3)	55.6	1.0	mg/L	2019-11-15	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-11-15	
Alkalinity, Bicarbonate (as CaCO3)	55.6	1.0	mg/L	2019-11-15	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-11-15	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-11-15	
Carbon, Dissolved Organic	1.64	0.50	mg/L	2019-11-12	
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L	2019-11-14	
pH	7.50	0.10	pH units	2019-11-15	HT2
Solids, Total Dissolved	75	15	mg/L	2019-11-14	*
Solids, Total Suspended	< 2.0	2.0	mg/L	2019-11-14	

Total Metals

Aluminum, total	0.0150	0.0050	mg/L	2019-11-18	
Antimony, total	< 0.00020	0.00020	mg/L	2019-11-18	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-11-18	
Barium, total	0.136	0.0050	mg/L	2019-11-18	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-11-18	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-11-18	
Boron, total	0.0166	0.0050	mg/L	2019-11-18	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-11-18	
Calcium, total	12.3	0.20	mg/L	2019-11-18	
Chromium, total	< 0.00050	0.00050	mg/L	2019-11-18	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-11-18	
Copper, total	0.00079	0.00040	mg/L	2019-11-18	
Iron, total	0.020	0.010	mg/L	2019-11-18	
Lead, total	< 0.00020	0.00020	mg/L	2019-11-18	
Lithium, total	0.00688	0.00010	mg/L	2019-11-18	
Magnesium, total	6.88	0.010	mg/L	2019-11-18	
Manganese, total	0.0115	0.00020	mg/L	2019-11-18	
Mercury, total	< 0.000010	0.000010	mg/L	2019-11-18	
Molybdenum, total	< 0.00010	0.00010	mg/L	2019-11-18	
Nickel, total	< 0.00040	0.00040	mg/L	2019-11-18	
Phosphorus, total	< 0.050	0.050	mg/L	2019-11-18	
Potassium, total	1.02	0.10	mg/L	2019-11-18	
Selenium, total	< 0.00050	0.00050	mg/L	2019-11-18	



TEST RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

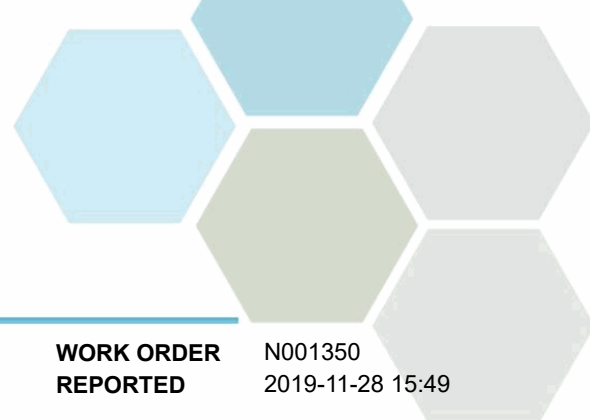
WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL	Units	Analyzed	Qualifier
GULY-20191107 (N001350-01) Matrix: Water Sampled: 2019-11-07 13:00, Continued					
<i>Total Metals, Continued</i>					
Silicon, total	4.8	1.0	mg/L	2019-11-18	
Silver, total	< 0.000050	0.000050	mg/L	2019-11-18	
Sodium, total	2.44	0.10	mg/L	2019-11-18	
Strontium, total	0.298	0.0010	mg/L	2019-11-18	
Sulfur, total	3.3	3.0	mg/L	2019-11-18	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-11-18	
Thallium, total	< 0.000020	0.000020	mg/L	2019-11-18	
Thorium, total	< 0.00010	0.00010	mg/L	2019-11-18	
Tin, total	< 0.00020	0.00020	mg/L	2019-11-18	
Titanium, total	< 0.0050	0.0050	mg/L	2019-11-18	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-11-18	
Uranium, total	0.000060	0.000020	mg/L	2019-11-18	
Vanadium, total	< 0.0010	0.0010	mg/L	2019-11-18	
Zinc, total	< 0.0040	0.0040	mg/L	2019-11-18	
Zirconium, total	< 0.00010	0.00010	mg/L	2019-11-18	

Sample Qualifiers:

* See Notes

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	Kelowna
Solids, Total Dissolved in Water	SM 2540 C* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

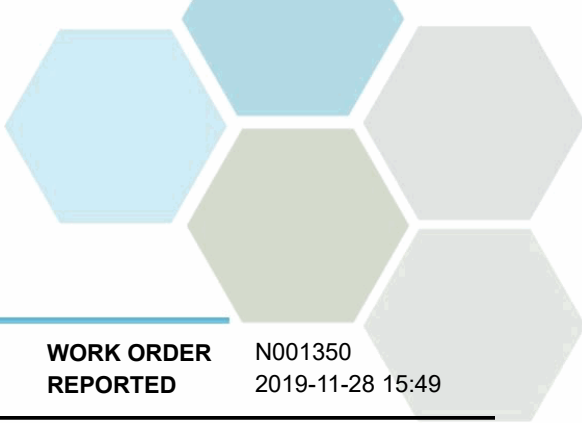
Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
pH units	pH < 7 = acidic, pH > 7 = basic
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: bshaw@caro.ca



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO SNC-Lavalin Inc. (Nelson)
PROJECT 666768

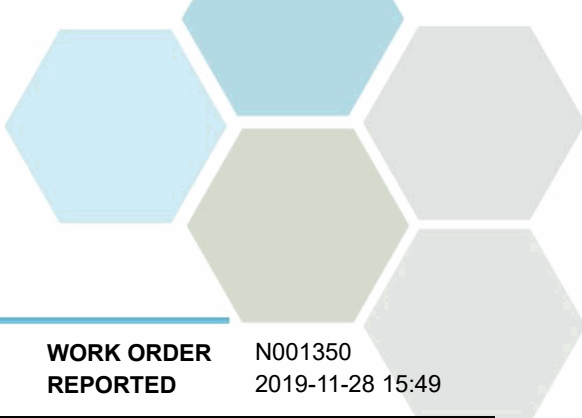
WORK ORDER N001350
REPORTED 2019-11-28 15:49

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup):** An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS):** A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS):** A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM):** A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B9K0914									
Blank (B9K0914-BLK1)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK2)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK3)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK4)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK5)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B9K0914-BLK6)			Prepared: 2019-11-07, Analyzed: 2019-11-07						
Chloride	< 0.10	0.10 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

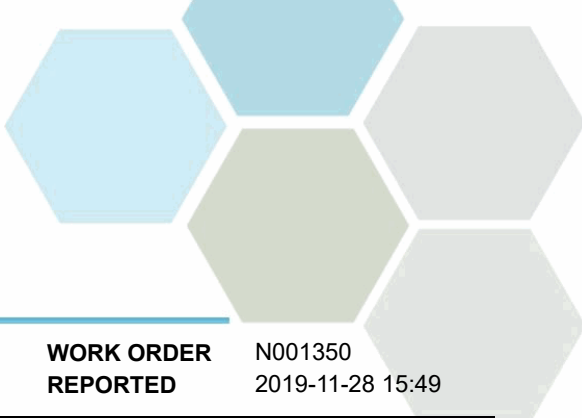
REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B9K0914, Continued									
Blank (B9K0914-BLK6), Continued					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B9K0914-BS1)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.08	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.01	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.01	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS2)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		102	90-110			
Fluoride	4.06	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.00	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	1.99	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS3)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.01	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	4.00	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.02	0.010 mg/L	2.00		101	85-115			
Sulfate	16.1	1.0 mg/L	16.0		101	90-110			
LCS (B9K0914-BS4)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.1	0.10 mg/L	16.0		101	90-110			
Fluoride	4.00	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	3.99	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.02	0.010 mg/L	2.00		101	85-115			
Sulfate	16.1	1.0 mg/L	16.0		101	90-110			
LCS (B9K0914-BS5)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.14	0.10 mg/L	4.00		103	88-108			
Nitrate (as N)	4.11	0.010 mg/L	4.00		103	90-110			
Nitrite (as N)	2.01	0.010 mg/L	2.00		100	85-115			
Sulfate	16.0	1.0 mg/L	16.0		100	90-110			
LCS (B9K0914-BS6)					Prepared: 2019-11-07, Analyzed: 2019-11-07				
Chloride	16.2	0.10 mg/L	16.0		101	90-110			
Fluoride	4.09	0.10 mg/L	4.00		102	88-108			
Nitrate (as N)	4.08	0.010 mg/L	4.00		102	90-110			
Nitrite (as N)	2.00	0.010 mg/L	2.00		100	85-115			
Sulfate	15.9	1.0 mg/L	16.0		99	90-110			

Dissolved Metals, Batch B9K1679

Blank (B9K1679-BLK1)					Prepared: 2019-11-18, Analyzed: 2019-11-18				
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Dissolved Metals, Batch B9K1679, Continued

Blank (B9K1679-BLK1), Continued

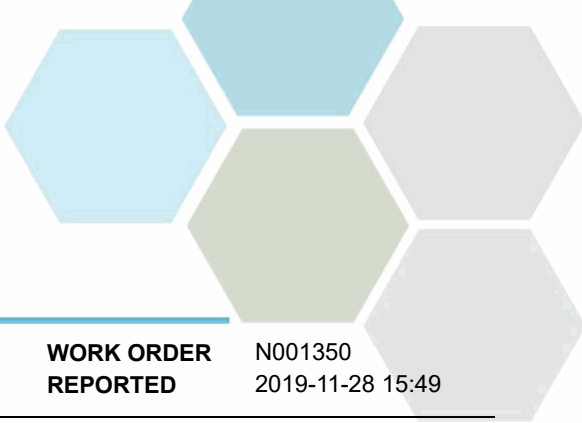
Prepared: 2019-11-18, Analyzed: 2019-11-18

Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							
Zirconium, dissolved	< 0.00010	0.00010 mg/L							

LCS (B9K1679-BS1)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Lithium, dissolved	0.0202	0.00010 mg/L	0.0200		101	80-120			
Aluminum, dissolved	0.0224	0.0050 mg/L	0.0199		112	80-120			
Antimony, dissolved	0.0195	0.00020 mg/L	0.0200		97	80-120			
Arsenic, dissolved	0.0201	0.00050 mg/L	0.0200		100	80-120			
Barium, dissolved	0.0195	0.0050 mg/L	0.0198		99	80-120			
Beryllium, dissolved	0.0206	0.00010 mg/L	0.0198		104	80-120			
Bismuth, dissolved	0.0203	0.00010 mg/L	0.0200		102	80-120			
Boron, dissolved	0.0197	0.0050 mg/L	0.0200		98	80-120			
Cadmium, dissolved	0.0196	0.000010 mg/L	0.0199		98	80-120			
Calcium, dissolved	2.13	0.20 mg/L	2.02		106	80-120			
Chromium, dissolved	0.0194	0.00050 mg/L	0.0198		98	80-120			
Cobalt, dissolved	0.0196	0.00010 mg/L	0.0199		99	80-120			
Copper, dissolved	0.0204	0.00040 mg/L	0.0200		102	80-120			
Iron, dissolved	1.86	0.010 mg/L	2.02		92	80-120			
Lead, dissolved	0.0203	0.00020 mg/L	0.0199		102	80-120			
Magnesium, dissolved	1.86	0.010 mg/L	2.02		92	80-120			
Manganese, dissolved	0.0192	0.00020 mg/L	0.0199		96	80-120			
Molybdenum, dissolved	0.0193	0.00010 mg/L	0.0200		97	80-120			
Nickel, dissolved	0.0201	0.00040 mg/L	0.0200		101	80-120			
Phosphorus, dissolved	1.88	0.050 mg/L	2.00		94	80-120			
Potassium, dissolved	1.80	0.10 mg/L	2.02		89	80-120			
Selenium, dissolved	0.0200	0.00050 mg/L	0.0200		100	80-120			
Silicon, dissolved	1.8	1.0 mg/L	2.00		92	80-120			



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Dissolved Metals, Batch B9K1679, Continued

LCS (B9K1679-BS1), Continued

Prepared: 2019-11-18, Analyzed: 2019-11-18

Silver, dissolved	0.0193	0.000050 mg/L	0.0200		96	80-120			
Sodium, dissolved	1.87	0.10 mg/L	2.02		93	80-120			
Strontium, dissolved	0.0197	0.0010 mg/L	0.0200		98	80-120			
Sulfur, dissolved	4.0	3.0 mg/L	5.00		81	80-120			
Tellurium, dissolved	0.0197	0.00050 mg/L	0.0200		98	80-120			
Thallium, dissolved	0.0203	0.000020 mg/L	0.0199		102	80-120			
Thorium, dissolved	0.0196	0.00010 mg/L	0.0200		98	80-120			
Tin, dissolved	0.0199	0.00020 mg/L	0.0200		99	80-120			
Titanium, dissolved	0.0195	0.0050 mg/L	0.0200		98	80-120			
Tungsten, dissolved	0.0196	0.0010 mg/L	0.0200		98	80-120			
Uranium, dissolved	0.0198	0.000020 mg/L	0.0200		99	80-120			
Vanadium, dissolved	0.0195	0.0010 mg/L	0.0200		98	80-120			
Zinc, dissolved	0.0217	0.0040 mg/L	0.0200		109	80-120			
Zirconium, dissolved	0.0193	0.00010 mg/L	0.0200		97	80-120			

Reference (B9K1679-SRM1)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Lithium, dissolved	0.100	0.00010 mg/L	0.100		100	77-127			
Aluminum, dissolved	0.210	0.0050 mg/L	0.235		89	79-114			
Antimony, dissolved	0.0453	0.00020 mg/L	0.0431		105	89-123			
Arsenic, dissolved	0.435	0.00050 mg/L	0.423		103	87-113			
Barium, dissolved	2.95	0.0050 mg/L	3.30		89	85-114			
Beryllium, dissolved	0.218	0.00010 mg/L	0.209		104	79-122			
Boron, dissolved	1.40	0.0050 mg/L	1.65		85	79-117			
Cadmium, dissolved	0.216	0.000010 mg/L	0.221		98	89-112			
Calcium, dissolved	6.96	0.20 mg/L	7.72		90	85-120			
Chromium, dissolved	0.419	0.00050 mg/L	0.434		96	87-113			
Cobalt, dissolved	0.121	0.00010 mg/L	0.124		98	90-117			
Copper, dissolved	0.811	0.00040 mg/L	0.815		99	90-115			
Iron, dissolved	1.19	0.010 mg/L	1.27		94	86-112			
Lead, dissolved	0.110	0.00020 mg/L	0.110		100	90-113			
Magnesium, dissolved	6.13	0.010 mg/L	6.59		93	84-116			
Manganese, dissolved	0.319	0.00020 mg/L	0.342		93	85-113			
Molybdenum, dissolved	0.398	0.00010 mg/L	0.404		99	87-112			
Nickel, dissolved	0.824	0.00040 mg/L	0.835		99	90-114			
Phosphorus, dissolved	0.476	0.050 mg/L	0.499		95	74-119			
Potassium, dissolved	2.66	0.10 mg/L	2.88		92	78-119			
Selenium, dissolved	0.0336	0.00050 mg/L	0.0324		104	89-123			
Sodium, dissolved	16.4	0.10 mg/L	18.0		91	81-117			
Strontium, dissolved	0.877	0.0010 mg/L	0.935		94	82-111			
Thallium, dissolved	0.0393	0.000020 mg/L	0.0385		102	90-113			
Uranium, dissolved	0.246	0.000020 mg/L	0.258		95	87-113			
Vanadium, dissolved	0.824	0.0010 mg/L	0.873		94	85-110			
Zinc, dissolved	0.883	0.0040 mg/L	0.848		104	88-114			

Dissolved Metals, Batch B9K1873

Blank (B9K1873-BLK1)

Prepared: 2019-11-18, Analyzed: 2019-11-19

Mercury, dissolved	< 0.000010	0.000010 mg/L							
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Blank (B9K1873-BLK2)

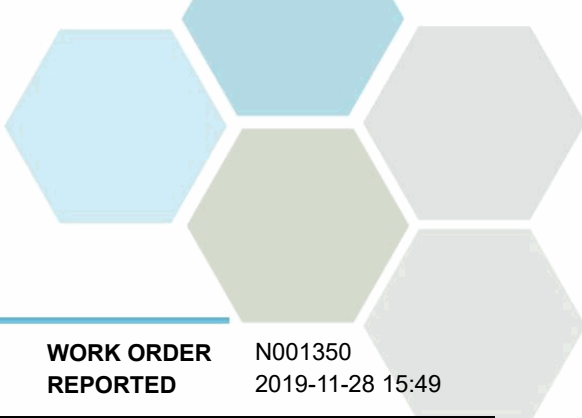
Prepared: 2019-11-18, Analyzed: 2019-11-19

Mercury, dissolved	< 0.000010	0.000010 mg/L							
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Reference (B9K1873-SRM1)

Prepared: 2019-11-18, Analyzed: 2019-11-19

Mercury, dissolved	0.00496	0.000010 mg/L	0.00489		101	80-120			
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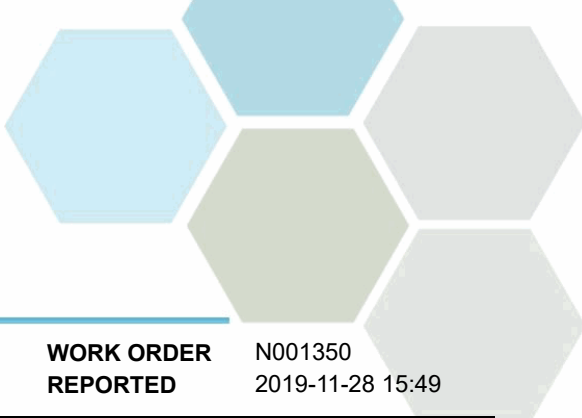


APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9K1873, Continued									
Reference (B9K1873-SRM2)			Prepared: 2019-11-18, Analyzed: 2019-11-19						
Mercury, dissolved	0.00458	0.000010 mg/L	0.00489		94	80-120			
General Parameters, Batch B9K0963									
Blank (B9K0963-BLK1)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
Blank (B9K0963-BLK2)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
Blank (B9K0963-BLK3)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	< 0.50	0.50 mg/L							
LCS (B9K0963-BS1)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	10.5	0.50 mg/L	10.0		105	78-116			
LCS (B9K0963-BS2)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	10.3	0.50 mg/L	10.0		103	78-116			
LCS (B9K0963-BS3)			Prepared: 2019-11-12, Analyzed: 2019-11-12						
Carbon, Dissolved Organic	10.1	0.50 mg/L	10.0		101	78-116			
General Parameters, Batch B9K1238									
Blank (B9K1238-BLK1)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Suspended	< 2.0	2.0 mg/L							
Blank (B9K1238-BLK2)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Suspended	< 2.0	2.0 mg/L							
LCS (B9K1238-BS1)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Suspended	85.0	10.0 mg/L	100		85	85-115			
LCS (B9K1238-BS2)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Suspended	101	10.0 mg/L	100		101	85-115			
General Parameters, Batch B9K1274									
Blank (B9K1274-BLK1)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Dissolved	< 15	15 mg/L							
LCS (B9K1274-BS1)			Prepared: 2019-11-14, Analyzed: 2019-11-14						
Solids, Total Dissolved	243	15 mg/L	240		101	85-115			
General Parameters, Batch B9K1313									
Blank (B9K1313-BLK1)			Prepared: 2019-11-13, Analyzed: 2019-11-14						
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
Blank (B9K1313-BLK2)			Prepared: 2019-11-13, Analyzed: 2019-11-14						
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
LCS (B9K1313-BS1)			Prepared: 2019-11-13, Analyzed: 2019-11-14						
Nitrogen, Total Kjeldahl	1.07	0.050 mg/L	1.00		107	85-115			



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO SNC-Lavalin Inc. (Nelson)
PROJECT 666768

WORK ORDER N001350
REPORTED 2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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General Parameters, Batch B9K1313, Continued

LCS (B9K1313-BS2)

Prepared: 2019-11-13, Analyzed: 2019-11-14

Nitrogen, Total Kjeldahl	1.02	0.050 mg/L	1.00		102	85-115			
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General Parameters, Batch B9K1503

Blank (B9K1503-BLK1)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0 mg/L							

Blank (B9K1503-BLK2)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0 mg/L							

Blank (B9K1503-BLK3)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0 mg/L							

LCS (B9K1503-BS1)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	98.8	1.0 mg/L	100		99	80-120			
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LCS (B9K1503-BS2)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	95.0	1.0 mg/L	100		95	80-120			
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LCS (B9K1503-BS3)

Prepared: 2019-11-15, Analyzed: 2019-11-15

Alkalinity, Total (as CaCO3)	94.9	1.0 mg/L	100		95	80-120			
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Reference (B9K1503-SRM1)

Prepared: 2019-11-15, Analyzed: 2019-11-15

pH	7.01	0.10 pH units	7.01		100	98-102			
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Reference (B9K1503-SRM2)

Prepared: 2019-11-15, Analyzed: 2019-11-15

pH	7.01	0.10 pH units	7.01		100	98-102			
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Reference (B9K1503-SRM3)

Prepared: 2019-11-15, Analyzed: 2019-11-15

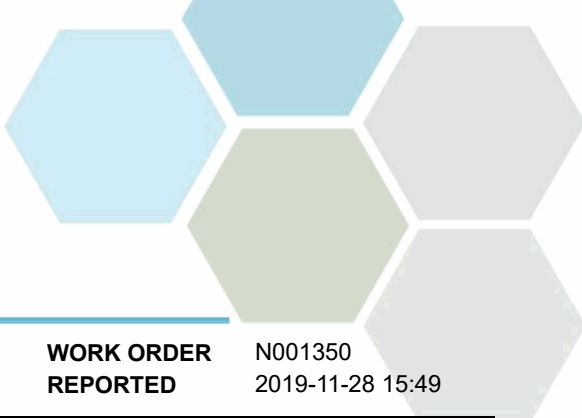
pH	6.99	0.10 pH units	7.01		100	98-102			
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Total Metals, Batch B9K1678

Blank (B9K1678-BLK1)

Prepared: 2019-11-16, Analyzed: 2019-11-18

Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Beryllium, total	< 0.00010	0.00010 mg/L							
Bismuth, total	< 0.00010	0.00010 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Total Metals, Batch B9K1678, Continued

Blank (B9K1678-BLK1), Continued

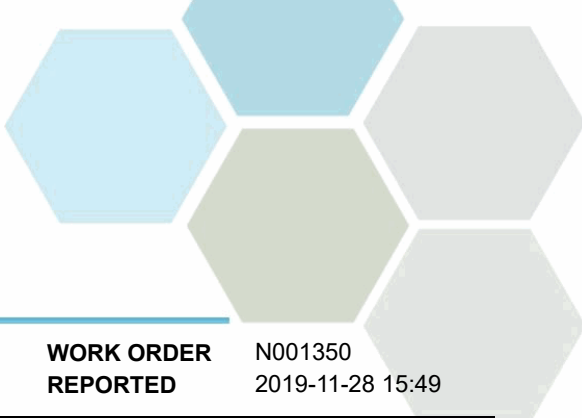
Prepared: 2019-11-16, Analyzed: 2019-11-18

Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Lithium, total	< 0.00010	0.00010 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Phosphorus, total	< 0.050	0.050 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Silicon, total	< 1.0	1.0 mg/L							
Silver, total	< 0.000050	0.000050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Sulfur, total	< 3.0	3.0 mg/L							
Tellurium, total	< 0.00050	0.00050 mg/L							
Thallium, total	< 0.000020	0.000020 mg/L							
Thorium, total	< 0.00010	0.00010 mg/L							
Tin, total	< 0.00020	0.00020 mg/L							
Titanium, total	< 0.0050	0.0050 mg/L							
Tungsten, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Vanadium, total	< 0.0010	0.0010 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Zirconium, total	< 0.00010	0.00010 mg/L							

LCS (B9K1678-BS1)

Prepared: 2019-11-16, Analyzed: 2019-11-18

Aluminum, total	0.0217	0.0050 mg/L	0.0199		109	80-120			
Antimony, total	0.0218	0.00020 mg/L	0.0200		109	80-120			
Arsenic, total	0.0217	0.00050 mg/L	0.0200		109	80-120			
Barium, total	0.0205	0.0050 mg/L	0.0198		104	80-120			
Beryllium, total	0.0225	0.00010 mg/L	0.0198		113	80-120			
Bismuth, total	0.0229	0.00010 mg/L	0.0200		114	80-120			
Boron, total	0.0217	0.0050 mg/L	0.0200		108	80-120			
Cadmium, total	0.0213	0.000010 mg/L	0.0199		107	80-120			
Calcium, total	2.29	0.20 mg/L	2.02		113	80-120			
Chromium, total	0.0210	0.00050 mg/L	0.0198		106	80-120			
Cobalt, total	0.0212	0.00010 mg/L	0.0199		106	80-120			
Copper, total	0.0219	0.00040 mg/L	0.0200		110	80-120			
Iron, total	2.01	0.010 mg/L	2.02		100	80-120			
Lead, total	0.0226	0.00020 mg/L	0.0199		113	80-120			
Lithium, total	0.0224	0.00010 mg/L	0.0200		112	80-120			
Magnesium, total	2.07	0.010 mg/L	2.02		102	80-120			
Manganese, total	0.0208	0.00020 mg/L	0.0199		105	80-120			
Molybdenum, total	0.0208	0.00010 mg/L	0.0200		104	80-120			
Nickel, total	0.0218	0.00040 mg/L	0.0200		109	80-120			
Phosphorus, total	2.08	0.050 mg/L	2.00		104	80-120			
Potassium, total	1.98	0.10 mg/L	2.02		98	80-120			
Selenium, total	0.0214	0.00050 mg/L	0.0200		107	80-120			
Silicon, total	2.1	1.0 mg/L	2.00		104	80-120			
Silver, total	0.0211	0.000050 mg/L	0.0200		105	80-120			
Sodium, total	2.09	0.10 mg/L	2.02		103	80-120			
Strontium, total	0.0207	0.0010 mg/L	0.0200		104	80-120			
Sulfur, total	4.4	3.0 mg/L	5.00		88	80-120			



APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT SNC-Lavalin Inc. (Nelson)
666768

WORK ORDER REPORTED N001350
2019-11-28 15:49

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Total Metals, Batch B9K1678, Continued

LCS (B9K1678-BS1), Continued

Prepared: 2019-11-16, Analyzed: 2019-11-18

Tellurium, total	0.0213	0.00050 mg/L	0.0200		106	80-120			
Thallium, total	0.0229	0.000020 mg/L	0.0199		115	80-120			
Thorium, total	0.0223	0.00010 mg/L	0.0200		112	80-120			
Tin, total	0.0215	0.00020 mg/L	0.0200		108	80-120			
Titanium, total	0.0218	0.0050 mg/L	0.0200		109	80-120			
Tungsten, total	0.0212	0.0010 mg/L	0.0200		106	80-120			
Uranium, total	0.0224	0.000020 mg/L	0.0200		112	80-120			
Vanadium, total	0.0216	0.0010 mg/L	0.0200		108	80-120			
Zinc, total	0.0233	0.0040 mg/L	0.0200		116	80-120			
Zirconium, total	0.0205	0.00010 mg/L	0.0200		102	80-120			

Reference (B9K1678-SRM1)

Prepared: 2019-11-16, Analyzed: 2019-11-18

Aluminum, total	0.300	0.0050 mg/L	0.303		99	82-114			
Antimony, total	0.0567	0.00020 mg/L	0.0511		111	88-115			
Arsenic, total	0.131	0.00050 mg/L	0.118		111	88-111			
Barium, total	0.844	0.0050 mg/L	0.823		103	83-110			
Beryllium, total	0.0554	0.00010 mg/L	0.0496		112	80-119			
Boron, total	3.14	0.0050 mg/L	3.45		91	80-118			
Cadmium, total	0.0528	0.000010 mg/L	0.0495		107	90-110			
Calcium, total	10.9	0.20 mg/L	11.6		94	85-113			
Chromium, total	0.266	0.00050 mg/L	0.250		107	88-111			
Cobalt, total	0.0418	0.00010 mg/L	0.0377		111	90-114			
Copper, total	0.553	0.00040 mg/L	0.486		114	90-117			
Iron, total	0.516	0.010 mg/L	0.488		106	90-116			
Lead, total	0.218	0.00020 mg/L	0.204		107	90-110			
Lithium, total	0.441	0.00010 mg/L	0.403		109	79-118			
Magnesium, total	3.95	0.010 mg/L	3.79		104	88-116			
Manganese, total	0.113	0.00020 mg/L	0.109		103	88-108			
Molybdenum, total	0.211	0.00010 mg/L	0.198		107	88-110			
Nickel, total	0.273	0.00040 mg/L	0.249		110	90-112			
Phosphorus, total	0.246	0.050 mg/L	0.227		108	72-118			
Potassium, total	7.35	0.10 mg/L	7.21		102	87-116			
Selenium, total	0.133	0.00050 mg/L	0.121		110	90-122			
Sodium, total	7.66	0.10 mg/L	7.54		102	86-118			
Strontium, total	0.400	0.0010 mg/L	0.375		107	86-110			
Thallium, total	0.0883	0.000020 mg/L	0.0805		110	90-113			
Uranium, total	0.0324	0.000020 mg/L	0.0306		106	88-112			
Vanadium, total	0.410	0.0010 mg/L	0.386		106	87-110			
Zinc, total	2.74	0.0040 mg/L	2.49		110	90-113			

Total Metals, Batch B9K1818

Blank (B9K1818-BLK1)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Mercury, total	< 0.000010	0.000010 mg/L							
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Blank (B9K1818-BLK2)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Mercury, total	< 0.000010	0.000010 mg/L							
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Reference (B9K1818-SRM1)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Mercury, total	0.00475	0.000010 mg/L	0.00489		97	80-120			
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Reference (B9K1818-SRM2)

Prepared: 2019-11-18, Analyzed: 2019-11-18

Mercury, total	0.00450	0.000010 mg/L	0.00489		92	80-120			
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QUANTITATIVE PHASE ANALYSIS OF FOUR POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

**Global Project #: 1964
Global COC/PO #: GL19-380**

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December 20, 2019

EXPERIMENTAL METHOD

The four samples of **Project: 1964** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone Micronizing Mill for 10 minutes. Continuous-scan X-ray powder-diffraction data were collected over a range $3-80^{\circ}2\theta$ with $\text{CoK}\alpha$ radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe filter foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6° .

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 – 4.

Table 1. Results of quantitative phase analysis (wt.%)

Mineral	Ideal Formula	1_TH118-SA2	3_BH19-SM4L-01-SA2	6_BH19-SM4L-02-SA2	7_BH19-SM4L-02-SA3
Clinocllore	$(\text{Mg,Al})_6(\text{Si,Al})_4\text{O}_{10}(\text{OH})_8$			0.6	1.0
Illite-Muscovite 1M	$\text{K}_{0.65}\text{Al}_{2.0}\text{Al}_{0.65}\text{Si}_{3.35}\text{O}_{10}(\text{OH})_2$ - $\text{KAl}_2\text{AlSi}_3\text{O}_{10}(\text{OH})_2$			2.5	7.0
Illite-Muscovite 2M1	$\text{K}_{0.65}\text{Al}_{2.0}\text{Al}_{0.65}\text{Si}_{3.35}\text{O}_{10}(\text{OH})_2$ - $\text{KAl}_2\text{AlSi}_3\text{O}_{10}(\text{OH})_2$	17.5	6.4	18.4	38.5
Kaolinite	$\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$		0.6	0.7	1.6
K-feldspar (Microcline)	KAlSi_3O_8	10.2	17.0	15.5	13.3
Plagioclase (Albite)	$\text{NaAlSi}_3\text{O}_8 - \text{CaAl}_2\text{Si}_2\text{O}_8$		4.8	3.6	
Pyrite	FeS_2	0.4	0.4		
Quartz	SiO_2	71.9	70.8	58.2	37.5
Rutile	TiO_2			0.5	1.1
Total		100.0	100.0	100.0	100.0

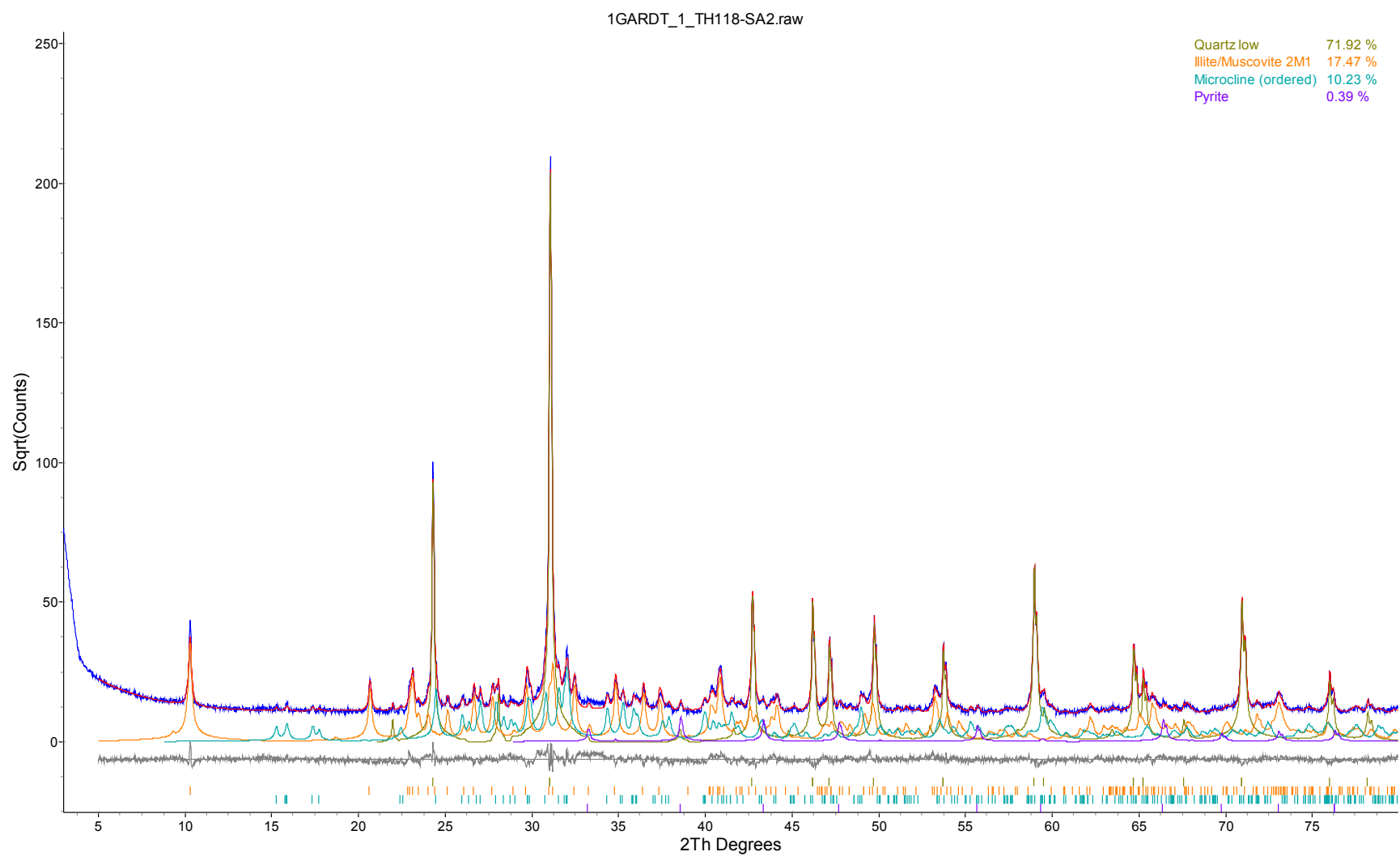


Figure 1. Rietveld refinement plot of sample **Global ARD Testing Services Inc. 1_TH118-SA2** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

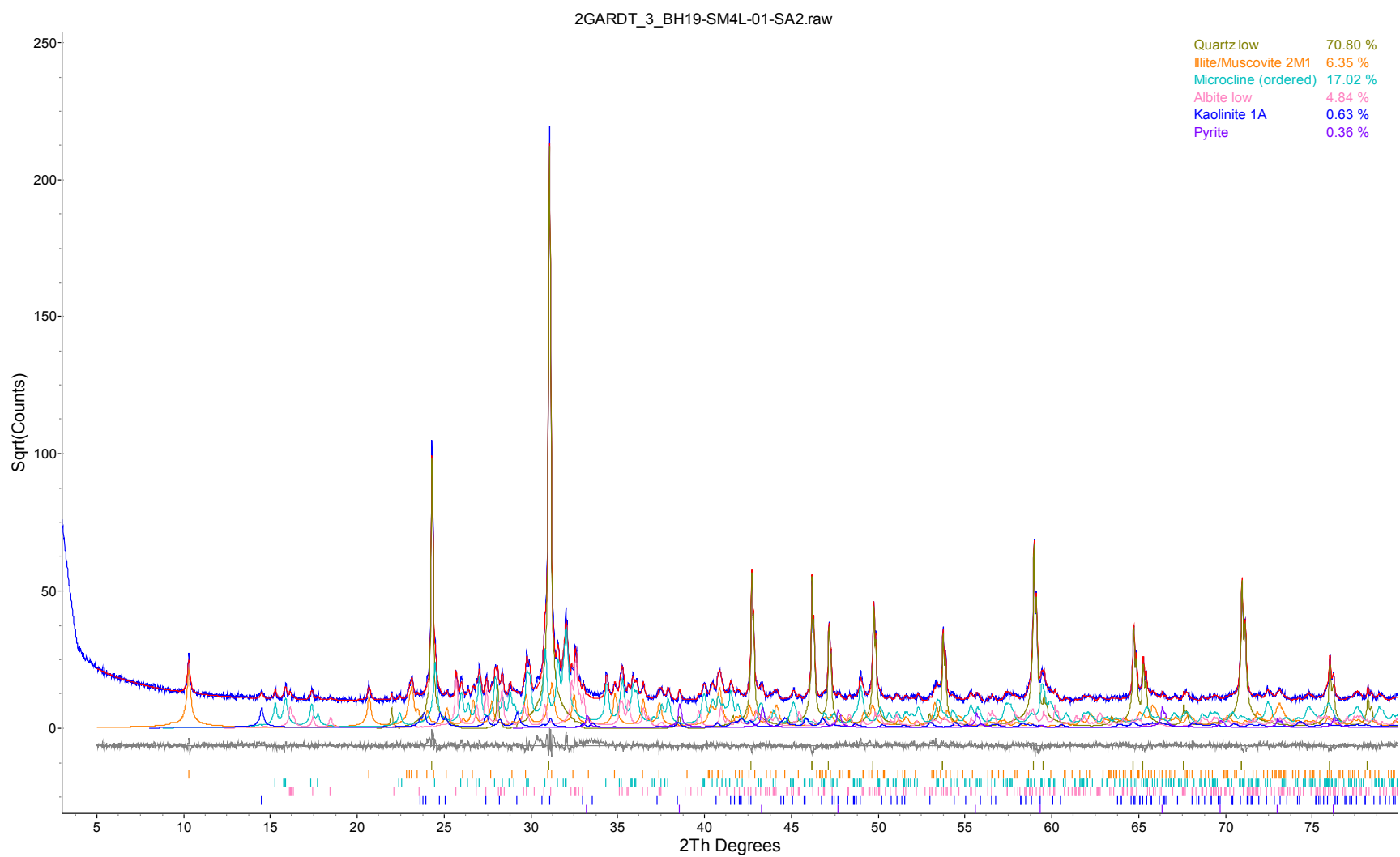


Figure 2. Rietveld refinement plot of sample **Global ARD Testing Services Inc. 3_BH19-SM4L-01-SA2** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

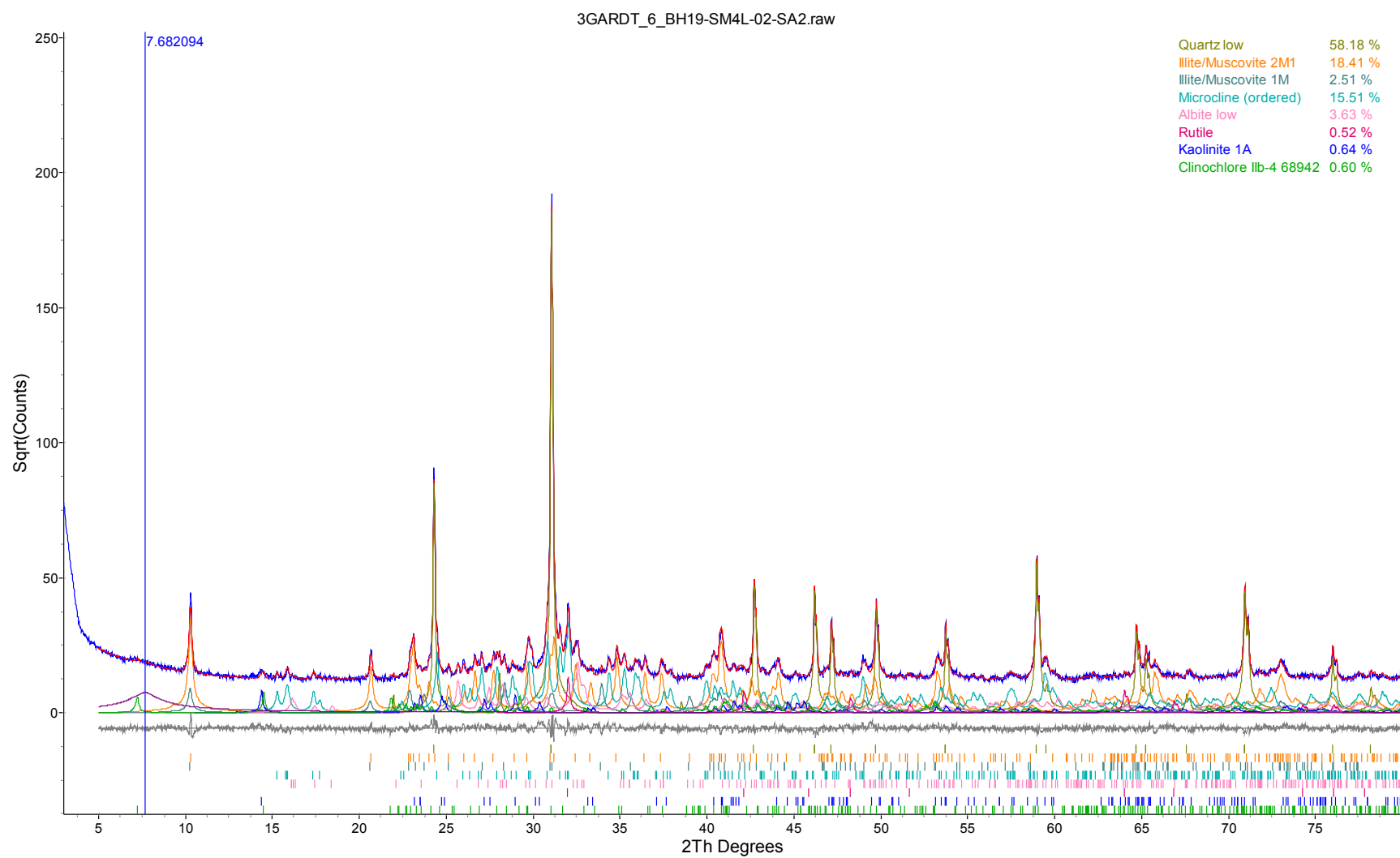


Figure 3. Rietveld refinement plot of sample **Global ARD Testing Services Inc. 6_BH19-SM4L-02-SA2** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

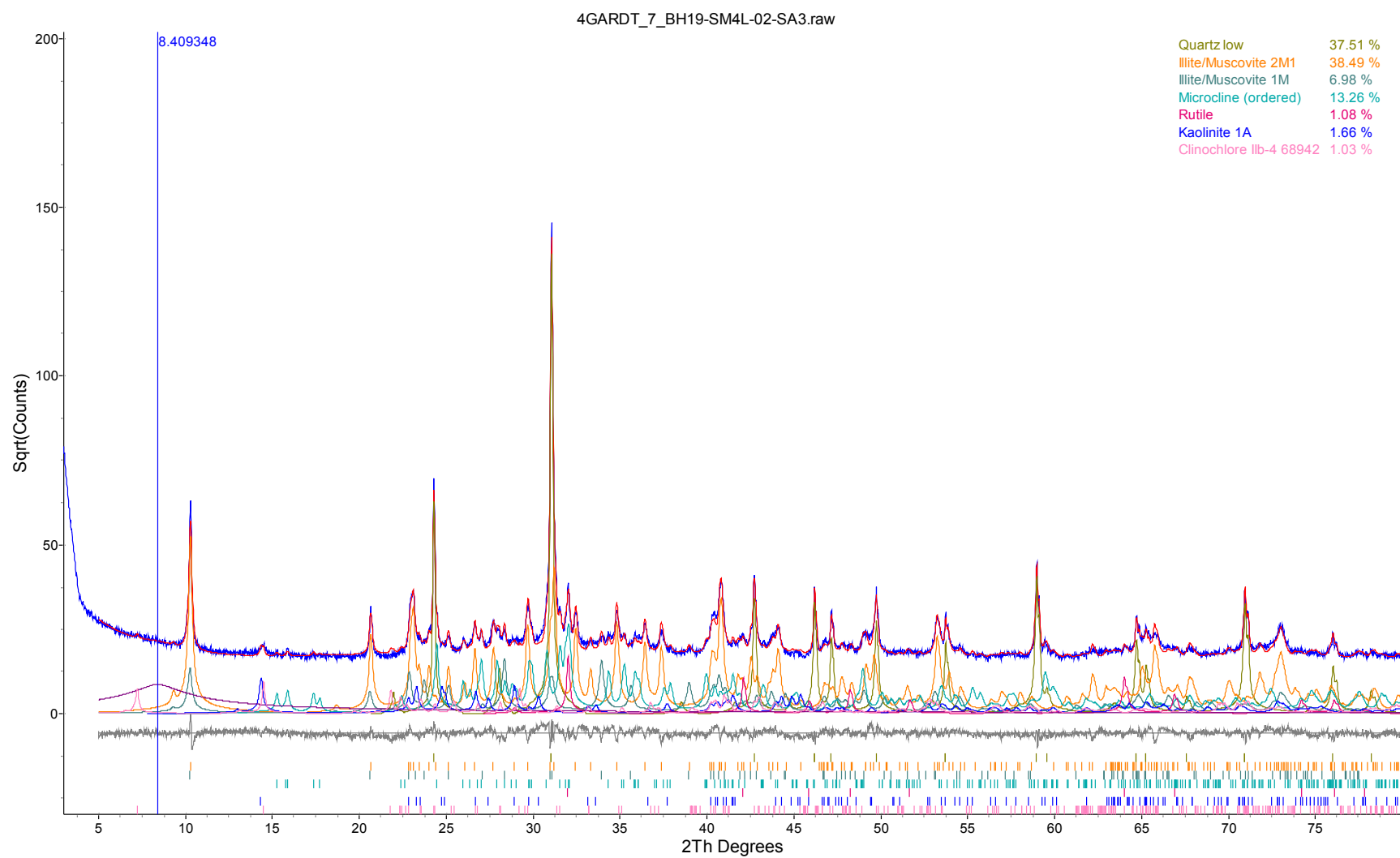


Figure 4. Rietveld refinement plot of sample **Global ARD Testing Services Inc. 7_BH19-SM4L-02-SA3** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.