

November 21, 2016

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Cont. No.:VA16-01536



Mr. Jim Newton  
Mining Engineer  
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530 - 1130 West Pender Street  
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Canada, V6E 4A4

Dear Jim,

**Re: Mill Site Area Geotechnical Characterization**

## 1 – INTRODUCTION

This letter presents a summary of the available information on geotechnical conditions for the Mill Site Area for the Kudz Ze Kayah Project (the Project). The Project is a proposed copper-zinc-lead-gold mine, located approximately 250 km northeast of Whitehorse, Yukon Territory, Canada. BMC Minerals (No.1) Ltd. (BMC) is currently developing the Project to a prefeasibility level design. Figure A1, attached, shows the current mine site general arrangement, including the Mill Site location.

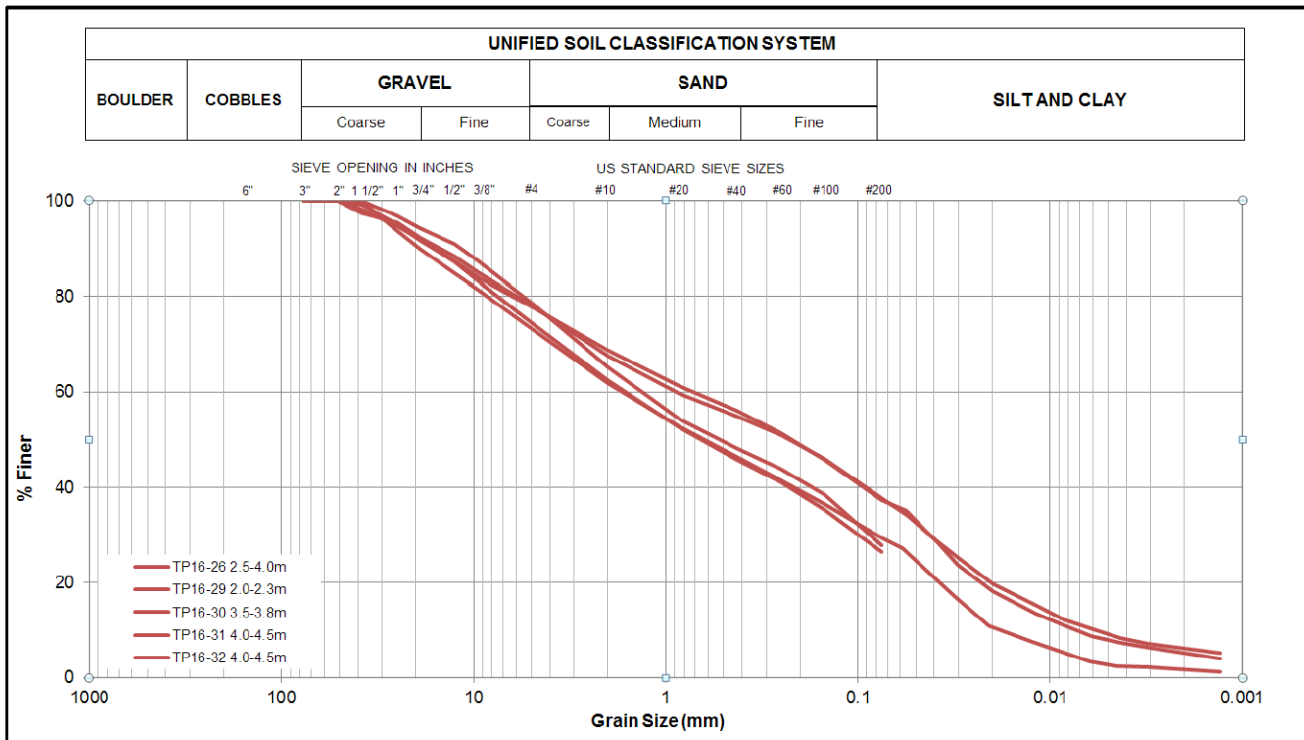
## 2 – MILL SITE AREA GEOTECHNICAL CHARACTERIZATION

A plan view of the current proposed Mill Site Area overlain with the locations of all test pits and drillholes completed in the area is shown in Figure A2, attached. Geotechnical site investigations were conducted by Cominco Ltd. (Cominco) in 1995 and 1996, and Knight Piésold Ltd. (KP) in 2015 and 2016. A total of 13 test pits and seven drillholes have been completed in the vicinity of the proposed Mill Site Area, and are summarized in Table A1, attached.

Surficial deposits in the Mill Site area are shallow with depths ranging from 1.2 to 5.0 meters below ground surface (mbgs). The typical overburden profile consists of an organic layer ranging from 10 to 60 cm overlying silty SAND and sandy SILT deposits with varying amounts of gravel and cobbles. The soils are generally well graded, low to medium plasticity, light to medium greyish brown, massive, and wet. The deposits can be described as “compact” with field SPT N values ranging from 9 to 19 and typically increasing with depth. Many SPTs in the KP 2016 site investigation resulted in refusal on cobbles or boulders.

Five overburden samples from the KP 2016 site investigation of the Mill Site area were sent for laboratory testing. Cobbles and boulders (material greater than 76 mm diameter) were excluded from the samples. The lab results indicate a well graded material with the following geotechnical properties:

- Natural Moisture Content: Average of 11% (range of 5 to 14%).
- Particle Size Distribution (See Figure 1):
  - Gravel: Average of 23% (range of 17 to 27%)
  - Sand: Average of 46% (range of 40 to 52%)
  - Silt: Average of 29% (range of 27 to 33%)
  - Clay: Average of 4% (range of 2 to 6%)
  - Note: the PSD has not been adjusted to include oversize material (cobbles and boulders)



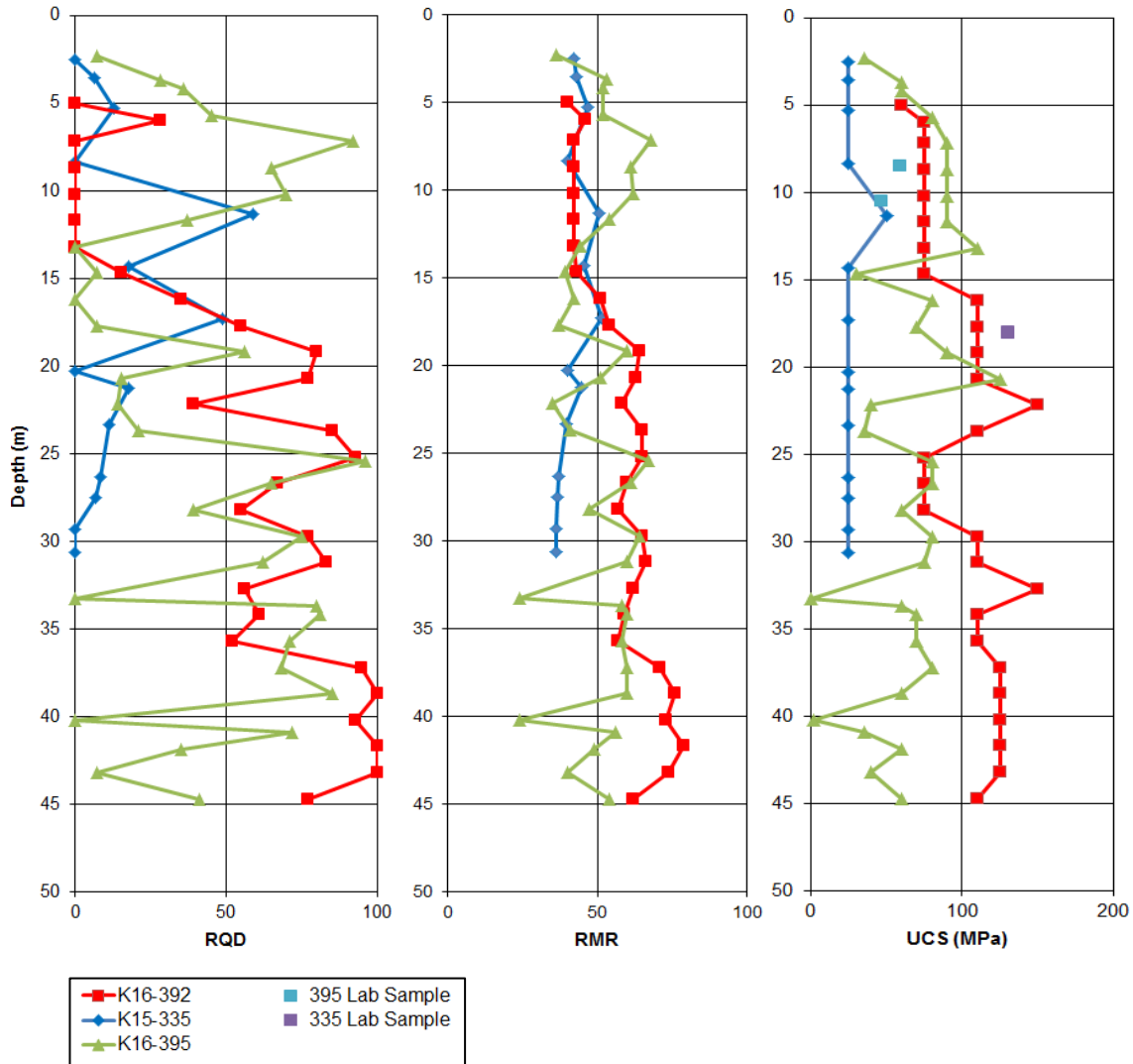
**Figure 1 PSD Results in Mill Site Area (KP, 2016b)**

Bedrock in the Mill Site Area is described as weathered and fractured interbedded argillite mudstone, mafic volcanoclastic, and chlorite calcite schist. The mudstone is typically dark grey and greenish grey to black, fine grained, moderately to highly fractured, and fresh to slightly weathered. The volcanoclastics are light to medium grey and brownish grey, fine grained, moderately to highly fractured, and slightly to moderately weathered. Both units host zones of massive quartz and are cut by vuggy calcite veins and pyrite veinlets. KP drillhole K16-395 encountered multiple clay-filled rubble zones that were also often associated with dissolution features.

The geotechnical properties for the bedrock material in the Mill Site area are as follows:

- A mean RQD value of 48.
- A rock strength classification of STRONG with UCS laboratory test results ranging from 23 to 59 MPa. Field UCS estimates ranging from 0.5 to 150 MPa with a mean value of 83 MPa.
- $RMR_{89}$  values ranging from 24 to 79, with a mean  $RMR_{89}$  of 53 which corresponds to FAIR quality rock.

A summary of RQD,  $RMR_{89}$  and field estimated UCS results for the Mill Site area, are shown on Figure 2.



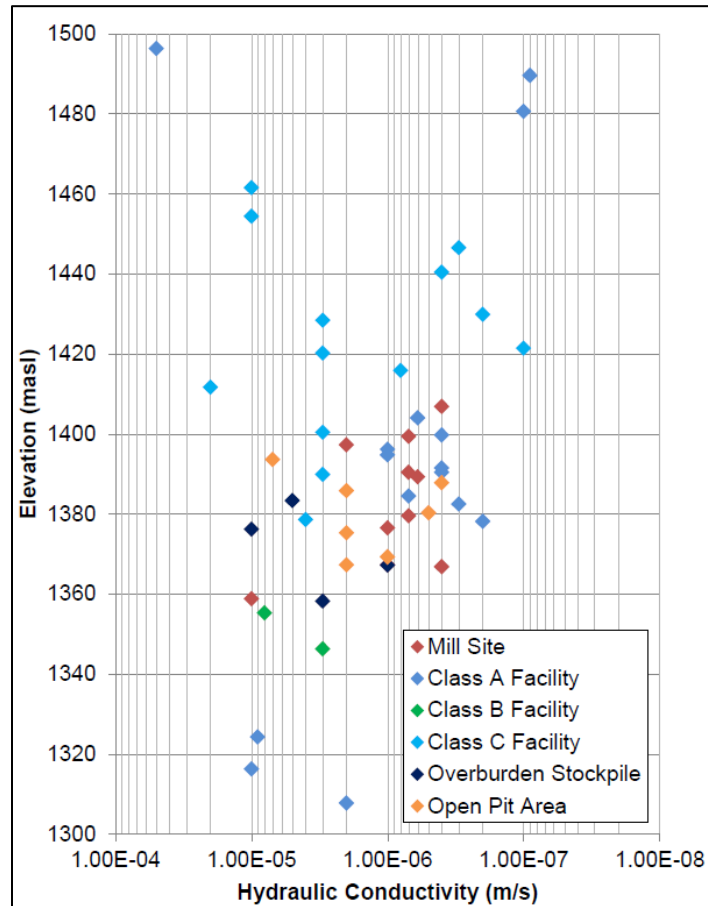
**Figure 2 RQD, RMR<sub>89</sub> and UCS vs Depth (KP, 2016b)**

Groundwater conditions ranged from 10 meters below ground surface (mbgs) to artesian conditions. Table A.1 contains groundwater depth information for the test pits and drillholes.

Eleven bedrock hydraulic conductivity packer tests were performed in the Mill Site area at depths ranging from 4.2 to 46.2 mbgs during the 2016 site investigation (KP, 2016b).

The results of the packer testing are shown in Figure 3, and summarized as follows:

- Min:  $4 \times 10^{-7}$  m/s
- Max:  $1 \times 10^{-5}$  m/s
- Geometric Mean:  $1 \times 10^{-6}$  m/s



**Figure 3 Bedrock Hydraulic Conductivity (KP, 2016b)**

Test pits completed within the Mill Site Area did not encounter permafrost. Two test pits encountered an active layer generally between 0.1 and 1.0 m depth described as frozen ice lenses, coatings, and inclusions.

Thermistors were installed in drillholes K15-335, K16-392, and K16-395 during the 2016 site investigation program. None of the thermistors in the Mill Site area indicate the presence of frozen ground between the months of February and September 2016 (KP, 2016b).

### 3 – CONCLUSIONS

The Mill Site foundation preparation will include removal of the overburden material (approximately 3 m depth on average). Unsuitable bedrock will be removed until competent bedrock is established. Select granular fill material will then be placed up to the final elevation of the foundation.

The bedrock quality is generally considered FAIR, with a mean RMR89 of 53 and generally increases with depth. The water table is typically near or at surface, and the mean hydraulic conductivity is in the order of  $1 \times 10^{-6}$  m/s. There have been no observations of permafrost conditions in the test pits and drillholes completed in the area. The preliminary design bearing capacity of the bedrock is likely in the order of 1,000 to 5,000 kPa (Canadian Foundation Engineering Manual 4<sup>th</sup> Edition, 2006 and Peck, et al. 1974).

Additional studies may be required for future design phases of the Mill Site Area. Additional studies may include:

- Targeted drilling and test pitting program beneath key Mill Site infrastructure.
- Seismic refraction testing (surface and borehole).

- Additional UCS testing of rock core to provide more accurate strength estimates for each rock type and to determine a conversion factor “k” for PLT results (KP, 2016b).

We trust this provides you with the information required at this time. Please to not hesitate to contact the undersigned if you have any questions or require additional information.


Yours truly,  
**Knight Piésold Ltd.**



Prepared:

  
\_\_\_\_\_  
Madeline Pease, E.I.T  
Staff Engineer

Reviewed:

 Nov. 21/16  
\_\_\_\_\_  
Les Galbraith, P.Eng.  
Specialist Engineer | Associate

Approval that this document adheres to Knight Piésold Quality Systems:



Attachments:

Table A1 Rev A      Geotechnical Site Characterization Processing Plant Drillhole and Test Pit Summary  
Figure A1 Rev A      General Arrangement Ultimate Layout  
Figure A2 Rev A      Mill Site General Arrangement with Geotechnical Investigation Locations

References:

Golder Associates, 1995., *Kudz Ze Kayah Project – Geotechnical Study*. Ref. No. 952-1523I, October 17, 1995.  
Knight Piésold Ltd., 2016a. *2015 Geotechnical Site Investigation Data Report*, Ref. No. VA101-640/2-1, October 5, 2016.  
Knight Piésold Ltd., 2016b. *2016 Geotechnical Site Investigation Data Report*, Ref. No. VA101-640/3-1, October 20, 2016.

**TABLE A1**

**BMC MINERALS (NO.1) LTD.  
KUDZ ZE KAYAH PROJECT**

**GEOTECHNICAL SITE CHARACTERIZATION  
PROCESSING PLANT DRILLHOLE AND TEST PIT SUMMARY**

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Drillhole / Test Pit ID	Northing	Easting	Elevation	End of Test Pit / Drillhole	Bedrock Depth	Permafrost Depth	Active Layer / Seasonal Permafrost	Groundwater Depth	Geotechnical Description	Permafrost Description
	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)		
TP 112	6,817,299	414,702	1,418	5.30	-	-	-	4.00	0 - 2.0 m: Sandy SILT some gravel 2.0 - 4.6 m: Sandy SILT and GRAVEL 4.6 - 5.3 m: Weathered bedrock	
TP95-06	6,817,261	414,773	1,410	4.00	4.00	-	0.10	1.00	0 - 4.0 m: Silty SAND some gravel 4.0 m: Weak metasediments	Frozen at 0.1 to 0.15 m in thin ice lenses
TP95-07	6,817,540	414,680	1,414	2.80	1.20	-	-	2.30	0 - 0.6 m: ORGANICS 0.6 - 1.2 m: GRAVEL and SAND 1.2 - 2.8 m: Weak metasediments	
TP95B-12	6,817,427	414,631	1,419	2.50	1.80	-	-	-	0 - 0.25 m: TOPSOIL 0.25 - 1.8 m: Silty SAND 1.8 - 2.5 m: Weathered bedrock	
TP95B-13	6,817,428	414,850	1,390	3.00	-	-	-	-	0 - 0.5 m: TOPSOIL 0.5 - 3.0 m: SAND	
TP95B-16	6,817,719	414,930	1,362	3.80	-	-	-	-	0 - 0.3 m: TOPSOIL 0.3 - 3.8 m: Silty SAND and GRAVEL	
TP95B-20	6,817,199	414,848	1,404	2.90	-	-	-	-	0 - 0.05 m: TOPSOIL 0.05 - 2.9 m: Silty SAND	
TP-96-B17	6,817,537	414,650	1,415	3.60	-	-	-	2.70	0 - 0.55 m: Organic silt 0.55 - 0.8 m: SAND and GRAVEL 0.8 - 3.6 m: Silty SAND some gravel	
TP-96-B18	6,817,610	414,800	1,393	5.00	-	-	0.80	-	0 - 0.5 m: Organic silt 0.5 - 0.8 m: SAND and GRAVEL 0.8 - 5.0 m: Silty SAND	0.8 - 1.0 m frozen ice lenses (Vs) 1 - 2 mm thick
TP-96-B19	6,817,690	414,890	1,375	2.60	-	-	-	1.0 and 2.5 m		
TP16-28	6,817,432	414,783	1,401	2.70	2.2	-	-	2.70	0 - 0.1 m: ORGANICS 0.1 - 2.2 m: Silty SAND and GRAVEL 2.2 - 2.7 m: Argillite	
TP16-29	6,817,465	414,894	1,386	2.30	2.3	-	-	-	0 - 0.2 m: ORGANICS and SILT 0.2 - 0.5 m: GRAVEL 0.5 - 2.3 m: Silty, gravelly SAND	Groundwater at 0.5 m, potential thawing active layer
TP16-31	6,817,555	414,605	1,412	4.50	-	-	-	-	0 - 0.5 m: ORGANICS and SILT 0.5 - 4.5 m: Silty SAND and GRAVEL	
BH95G-36	6,817,449	414,628	1,418	10.08	3.35	-	-	N/A	0 - 3.35 m: Silty SAND and GRAVEL 3.35 - 10.08 m: Mafic volcanoclastic bedded chlorite-calcite schist with argillite	
BH95G-37	6,817,454	414,584	1,425	13.11	3.81	-	-	9.90	0 - 3.81 m: Silty SAND and GRAVEL, cobbles 3.81 - 13.11 m: Interbedded mafic volcanoclastic and argillite	
BH95G-20M	6,817,263	414,725	1,416	12.5	3.81	-	-	N/A	0 - 3.81 m: Silty, sandy GRAVEL 3.81 - 5.64 m: Bedrock quartz vein 5.64 - 12.5 m: Chlorite carbonate schist	
K15-335	6,817,327	414,667	1,421	32.33	2.5	-	-	N/A	0 - 2.5 m: GRAVEL and COBBLES 2.5 - 32.33 m: Mudstone	
K16-392	6,817,471	414,852	1,390	46.2	5	-	-	Artesian (~10 PSI)	0 - 5.0 m: Silty SAND 5.0 - 46.2 m: Mafic volcanoclastic	
K16-395	6,817,251	414,822	1,406	46.2	2.3	-	-	0	0 - 2.3 m: Sandy SILT 2.3 - 46.2 m: Mudstone	
MW16-17	6,817,489.00	414,634.00	1,418.00	31.1	1.6	-	-	0.6	0 - 1.6 m: CLAY and SILT 1.6 - 15.2 m: Mafic volcanoclastic 15.2 - 31.1 m: Mudstone	

\\KPL\VA-Prj\S1\01\00640\02\A\Correspondence\VA16-01536 - Mill Site Area Geotechnical Characterization\Tables\Table A1 Test Pit and Drillhole Summary.xlsx\Table 1\_Processing Plant

**NOTES:**

1. ALL COORDINATES TAKEN WITH HANDHELD GPS.

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REV	DATE	DESCRIPTION	PREP'D	RW'D







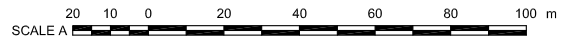
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- NOTES:**
- COORDINATE GRID IS UTM NAD 83 9N.
  - TOPOGRAPHIC DETAIL BASED ON INFORMATION PROVIDED BY BMC FEBRUARY 02, 2016.
  - CONTOUR INTERVAL IS 5 METRES.
  - ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
  - MILL SITE DETAILS PROVIDED BY ALLNORTH OCTOBER 14, 2016.

- LEGEND:**
- GROUNDWATER MONITORING WELL (TETRA TECH)
  - GEOTECHNICAL DRILLHOLE (KNIGHT PIESOLD)
  - TEST PIT (KNIGHT PIESOLD)
  - PREVIOUS DRILLHOLE (GOLDER)
  - PREVIOUS TEST PIT (GOLDER)
  - PREVIOUS TEST PIT (GOLDER 1995)

**PLAN**  
SCALE A



**ISSUED FOR INFORMATION**

BMC MINERALS (NO. 1) LTD.	
KUDZ ZE KAYAH PROJECT	
<b>MILL SITE GENERAL ARRANGEMENT WITH GEOTECHNICAL INVESTIGATION LOCATIONS</b>	
P/A NO. VA101-640/2	REF NO. VA16-01536
<b>FIGURE A2</b>	
<b>Knight Piesold CONSULTING</b>	
REV 0	REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	21NOV'16	ISSUED WITH REPORT	MAP	KJM	LJG