

APPENDIX 34-A
MEMORANDUM - KSM GROUND TEMPERATURES
POTENTIAL PERMAFROST OCCURRENCE





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BGC Project Memorandum

To:	Seabridge Gold Inc.	Doc. no:	
Attention:	Brent Murphy, Jim Smolik	cc:	Elizabeth Miller
From:	Lukas Arenson	Date:	December 20, 2012
Subject:	KSM Ground Temperatures – Potential Permafrost Occurrence		
Project no:	0638-006		

1.0 INTRODUCTION

As a part of BGC’s ongoing support of Pre-Feasibility level engineering studies at Seabridge Gold’s Kerr-Sulphurets-Mitchell (KSM) site, two thermistor cables were installed during the 2010 field season. The purpose of these instruments was to determine whether or not there was wide-spread permafrost within the immediate vicinity of the proposed open pits, in order to assess any potential impacts to the hydrogeological model being developed for the project site. The sites were chosen to correspond with drilling work being completed as a part of the open pit slope design investigations.

The drillholes K-10-07 and IC-10-015 were completed on August 17 and 24, 2010, respectively. Borehole K-10-07 is located in the proposed Kerr Pit and borehole IC-10-015 is located within the proposed Iron Cap Pit. The locations of these installations are shown on Drawing 1 and summarized in Table 1. Open one-inch PVC was installed in the drillholes and the annulus between the PVC and borehole walls backfilled with sand and bentonite.

Table 1. Locations of Thermistor String Installations

Borehole	Easting ¹	Northing ¹	Elevation	Cable Length	Comments
K-10-07 (Kerr)	422,106	6,259,159	1610 m asl	50 m	<ul style="list-style-type: none"> • 15 thermistor beads • Situated on a ridge (~N-facing), no overburden • Borehole inclination: 70°
IC-10-015 (Iron Cap)	424,202	6,267,339	1616 m asl	50 m	<ul style="list-style-type: none"> • 15 thermistor beads • Situated on SE-facing slope, no overburden • Borehole inclination 70°

¹NAD 1983 UTM Zone 9N. Coordinates surveyed using differential GPS.

On September 17, 2010, each 50 m long thermistor string was installed in the previously prepared open PVC-cased hole, as built instrument schematics can be found on the summary borehole logs in Appendix A. In addition to ground temperatures, the thermistor strings measured air temperature. Each thermistor string was connected to a data logger for automated measurements. Photographs of the installation sites and details are provided at the end of the memorandum.

On September 18, 2010, an initial temperature reading was taken. On February 8, 2011, the sites were visited and data downloaded from the loggers. Borehole IC-10-015 was buried by over 4 m of snow. The housing and the thermistor string for K-10-07 were damaged and the data logger could not be found (Photos 5 & 6). Therefore only the initial data were available.

2.0 GROUND TEMPERATURE DATA

Drawings 2 and 3 show the ground temperature measurements for boreholes IC-10-015 and K-10-07, respectively. Because of the loss of the data logger from K-10-07, no temperature trends, contour plots or repeated temperatures are presented for the second hole.

The temperature data presented on Drawing 2 (IC-10-015) shows the following:

- Coldest ground temperature below the depth of zero annual amplitude¹ is +0.5°C; there is no permafrost.
- Geothermal gradient at depth: 1.5°C / 100 m.
- Depth of frost penetration as of early-February 2011 is 6 m and is expected to increase further during the winter.
- Through the winter of 2010/11, the ground surface has been insulated by thick snow cover, which is reflected by the surface temperatures since December being no colder than -5°C, even when ambient air temperatures dropped below -25°C.

Even though only the initial temperature data are available for thermistor K-10-07, the data from thermistor IC-10-015 showed that the initial temperature readings taken the day following thermistor installation were fairly close to thermal equilibrium. Furthermore, the initial ground temperatures measured at K-10-07 were similar to those from IC-10-015. Therefore, similar ground temperatures are expected at the location of borehole K-10-07, i.e., no permafrost.

3.0 DISCUSSION

Ground temperatures recorded at two discrete locations within the KSM project at elevations of approximately 1600 m asl did not show any permafrost conditions. However, in mountainous terrain, the existence of permafrost is not only a function of elevation, but also aspect, slope angle and local topography (solar radiation / shadows). South-facing slopes

¹ The depth at which seasonal temperature variations are no longer recorded.

show the highest lower elevation boundary of permafrost, whereas north-facing slopes show the lowest lower elevation boundary. Depending on the local conditions, the difference in the lower elevation at which permafrost exists between north- and south-facing slopes can be several hundreds of meters. Snow cover also plays an important role in the development of permafrost since thick snow cover insulates the ground from the cold winter air temperatures. Similarly, a glacier cover also affects the cooling of the ground and permafrost is more likely to form outside the glacier boundary than beneath a glacier at the same elevation. The temperature data from the two boreholes are therefore insufficient to draw firm conclusions about permafrost distribution in the area, e.g. carry out a permafrost distribution model.

Borehole IC-10-015 is located at a site that is probably not conducive for permafrost formation because of the thick snow accumulation, in contrast with borehole K-10-07, where strong winds prevent any accumulation of snow. Because both sites did not indicate permafrost, it is estimated that the lowest elevation that permafrost may occur on wind-protected, north-facing slopes is in the order of 1600 m asl. On south-facing slopes, this lower boundary is estimated to be in the range of 1750 to 1900 m asl. Local microclimatic effects and ground surface conditions may allow for permafrost to exist at elevations lower than these approximate values. Based on our assessment of the available ground temperature data, assuming a lapse rate of 5 – 10°C / km, and considering the influence of slope aspect and elevation, Drawing 4 presents a first-order approximation of permafrost distribution in the project site.

Permafrost thicknesses are estimated to range from only several meters at the lower elevation boundary to potentially more than 150 m thick at elevations of 2000 m asl. However, the complex topography at the high mountain ridges likely also result in complex permafrost distribution with depth, such that the elevation of the permafrost base may vary significantly, even within short distances.

4.0 CLOSURE

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Yours sincerely,

BGC ENGINEERING INC.
per:

Lukas Arenson, Dr.Sc.Techn.ETH, P.Eng.
Senior Geotechnical Engineer

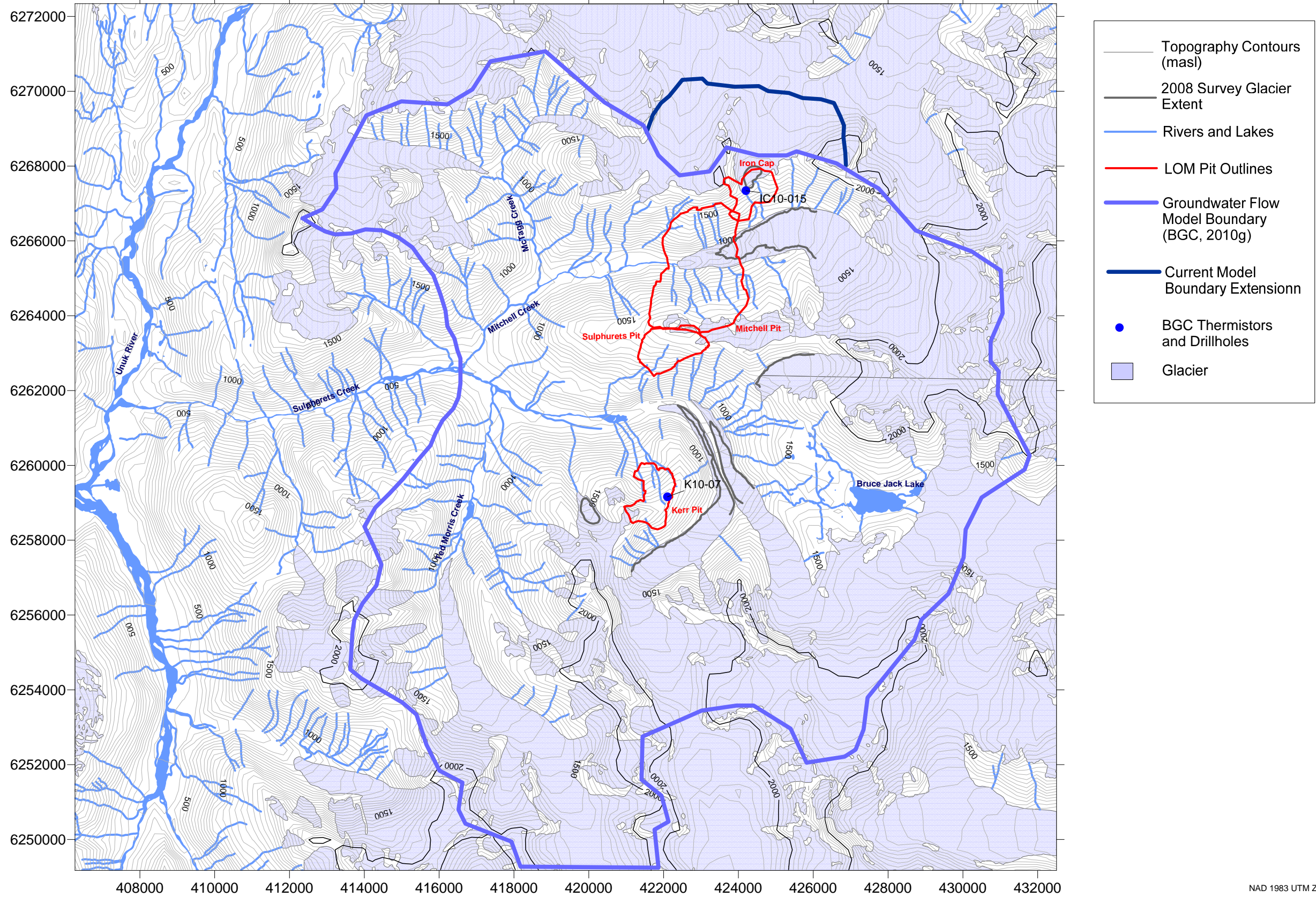
Reviewed by:

Jack Seto, M.Sc., P.Eng.
Senior Geotechnical Engineer

Michael Porter, M.Eng., P.Eng., LEG
Senior Geological Engineer

DRAWINGS

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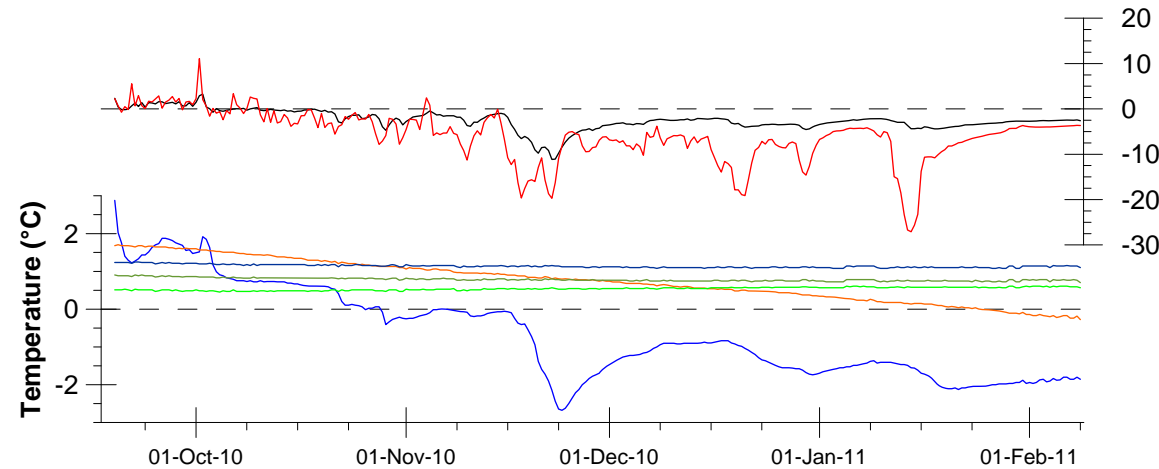
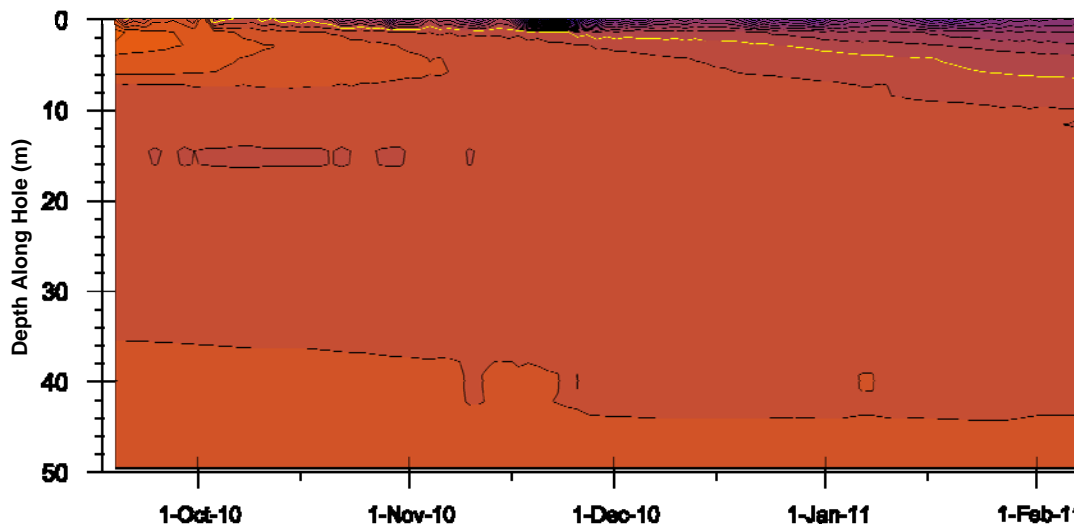
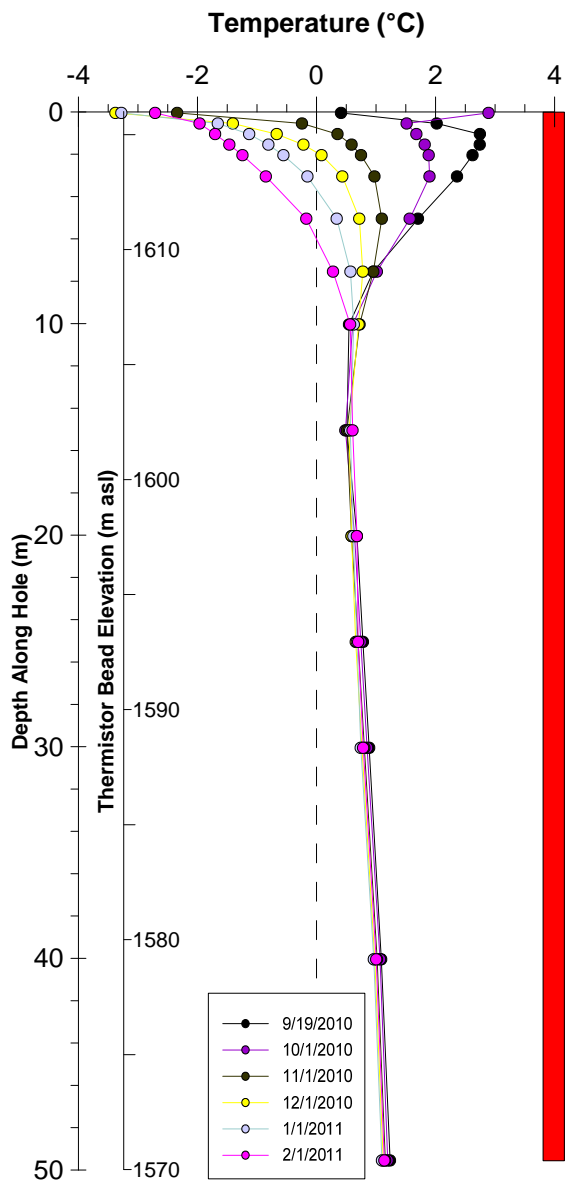
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CLIENT: SEABRIDGE GOLD INC.

PROJECT: KSM PRE-FEASIBILITY STUDY UPDATE OPEN PIT DEPRESSURIZATION ANALYSES		
TITLE: SITE PLAN		
PROJECT No.: 0638-006	DWG No.: 1	REV.:

NAD 1983 UTM Zone 9N

IC-10-15



Stratigraphy
 Rock (cased for top 3 m)

- Notes:**
1. Thermistor installed: Sept 17, 2010
 2. Drilling completed: Aug 24, 2010
 3. Thermistor ID: IC10-015
 4. Logger ID: 09100135
 5. Coordinates: 6267338.72 N, 424201.89 E
 6. Elevation: 1616 m ASL
 7. Hole is inclined at -70°

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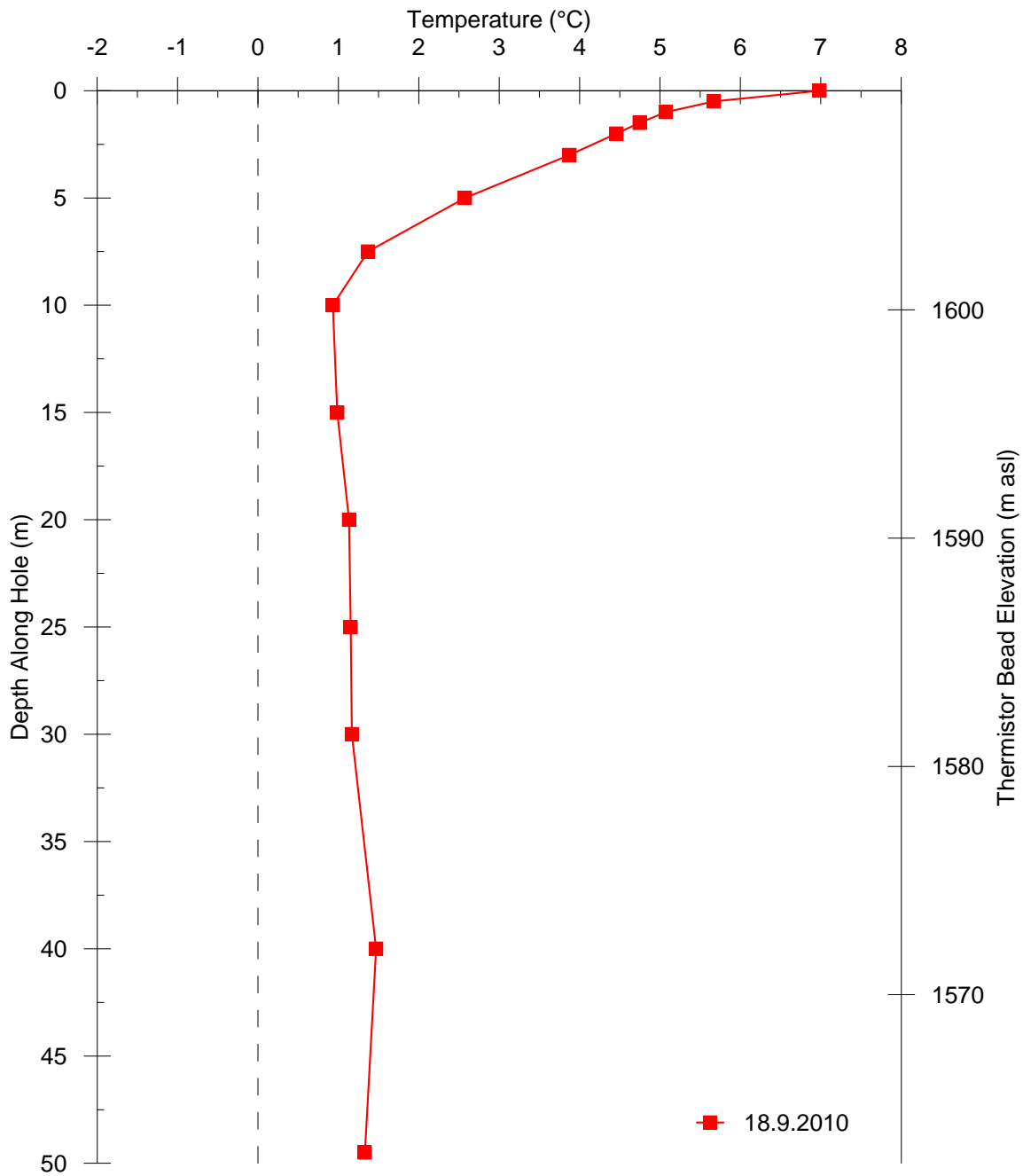
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PROJECT: KSM PRE-FEASIBILITY STUDY UPDATE OPEN PIT DEPRESSURIZATION ANALYSES		
TITLE: GROUND TEMPERATURE DATA IC-10-015		
PROJECT No.:	0638 - 006	FIG No.:
		2
REV:		



- NOTES:
1. DRILLING COMPLETED ON 8/17/2010, THERMISTOR INSTALLED 9/17/2010.
 2. DATA COLLECTED 9/18/2010.
 3. GROUND TEMPERATURES HAVE NOT STABILIZED
 4. HOLE: 422,106 N / 6,259,159 W (UTM WGS84), ELEVATION: 1,610 m asl
 5. HOLE IS INCLINED AT -70°.

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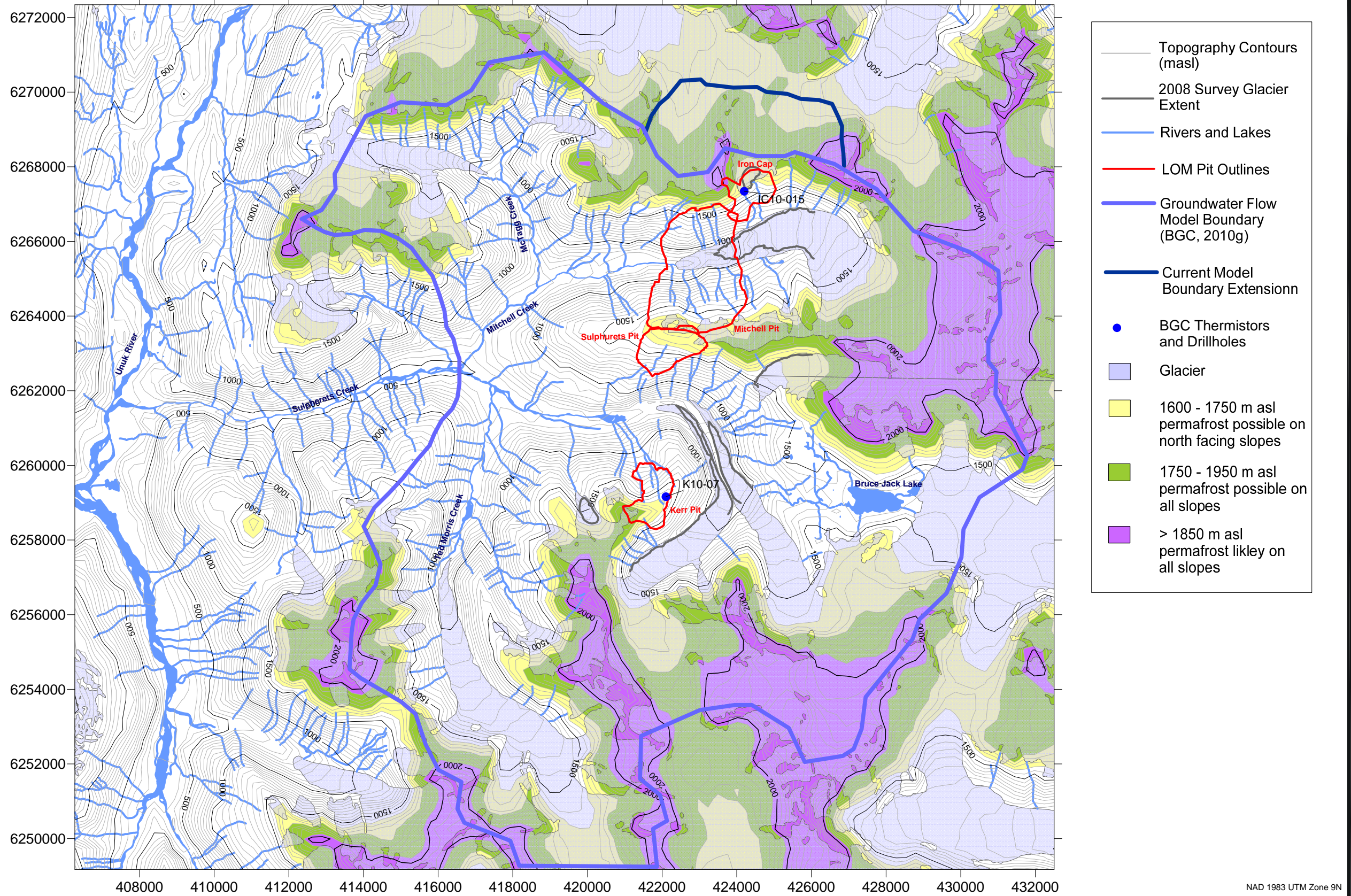
SEABRIDGE GOLD INC.

PROJECT: KSM PRE-FEASIBILITY STUDY UPDATE
OPEN PIT DEPRESSURIZATION ANALYSES

TITLE: THERMISTOR DATA
K-10-07

PROJECT No.:	0638-009	FIG No.:	3	REV:	
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TITLE: APPROXIMATED PERMAFROST LIMITS		
PROJECT No.: 0638-006	DWG No.: 4	REV.:

NAD 1983 UTM Zone 9N

PHOTOS



Photo 1: Thermistor and housing installed at IC-10-015



Photo 2: Thermistor and Housing Installed at K-10-07



Photo 3: Air Temperature Sensor attached to outside of housing.



Photo 4: Datalogger connected to Thermistor within housing.



Photo 5: Damaged borehole cover for borehole K-10-07. Little snow cover indicates that high winds are most likely the cause for the damage.

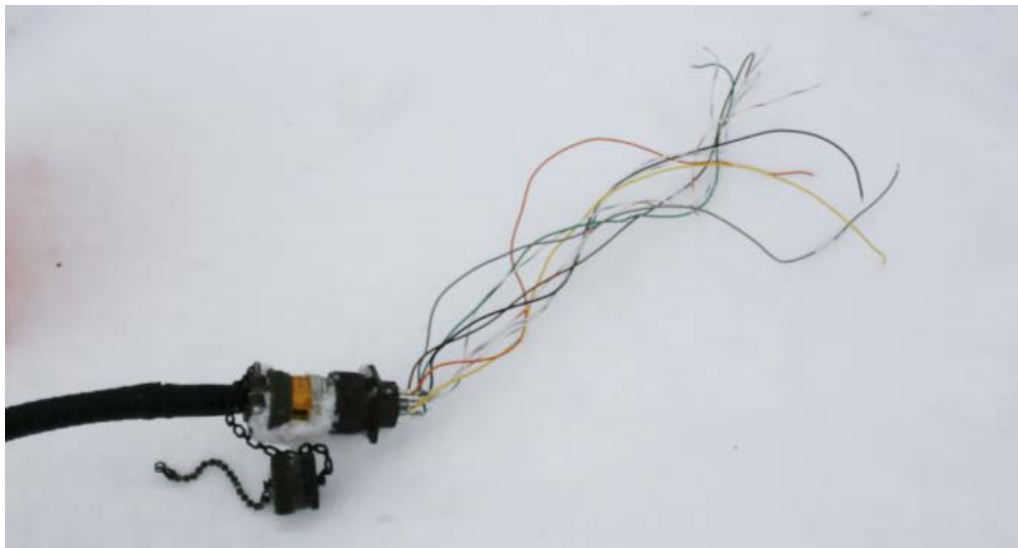


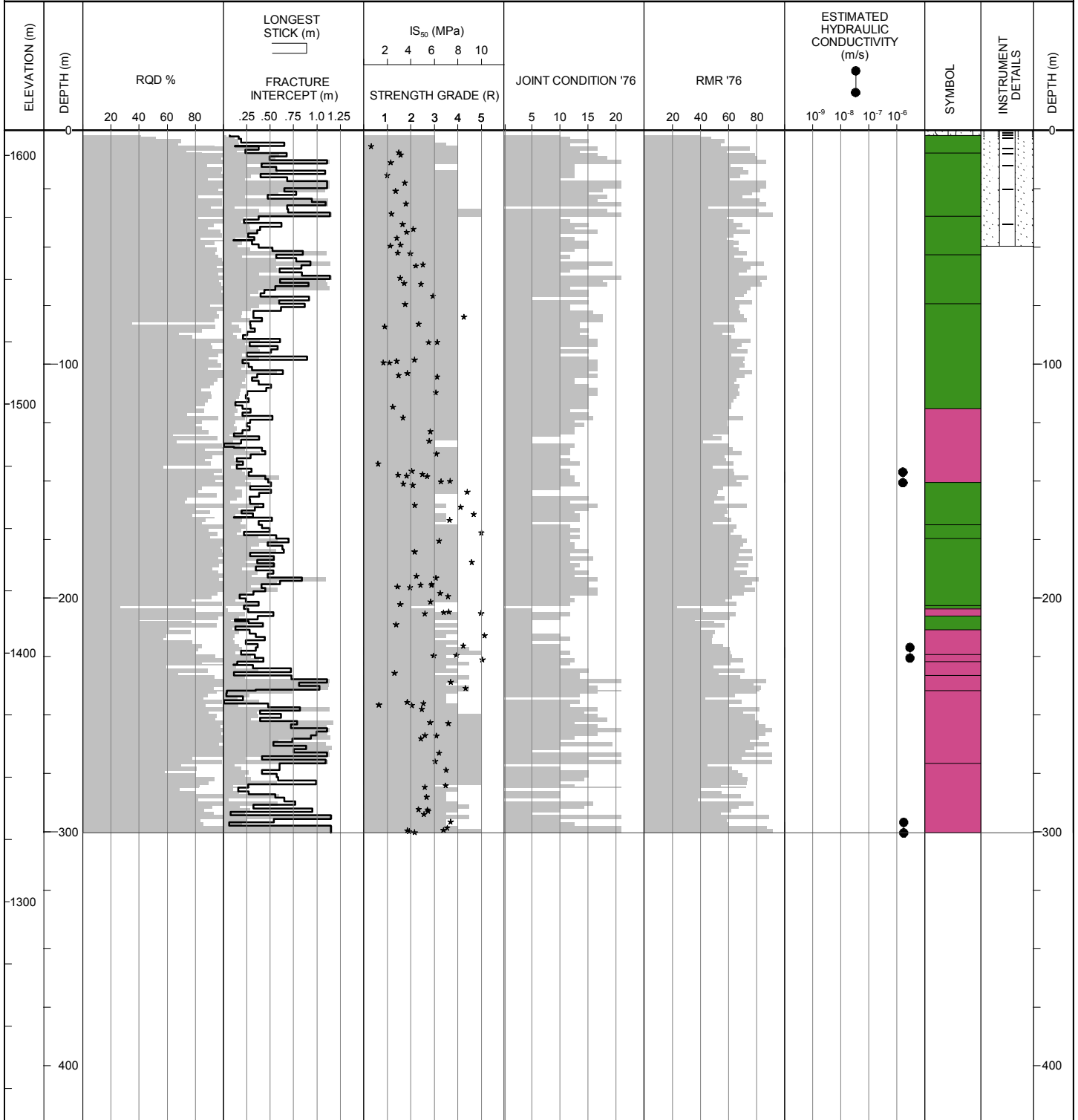
Photo 6: Damaged thermistor cable for borehole K10-07.

APPENDIX A BOREHOLE SUMMARY LOGS

CO-ORDINATES (m) : 422,106.E, 6,259,159.N
 GROUND ELEVATION (m) : 1610.0
 SURVEY METHOD : DGPS
 DATUM : NAD 83 ZN 9
 PLUNGE (°) : -70
 TREND (°) : 337

DRILL DESIGNATION : Boyse B-20
 DRILLING CONTRACTOR : Hy-Tech
 DRILL METHOD : Core
 CORE SIZE : NQ3
 FLUID : Polymer
 CASED TO (m) : 3

START DATE : 04 Aug 10
 FINISH DATE : 17 Aug 10
 FINAL DEPTH (m) : 300.5
 DEPTH TO TOP OF ROCK : 0.0
 LOGGED BY : LT/DS/AWMK
 REVIEWED BY : MAB



KSM SUMMARY LOG KSM SUMMARY LOG.GDL BGC.GDT 6/13/11



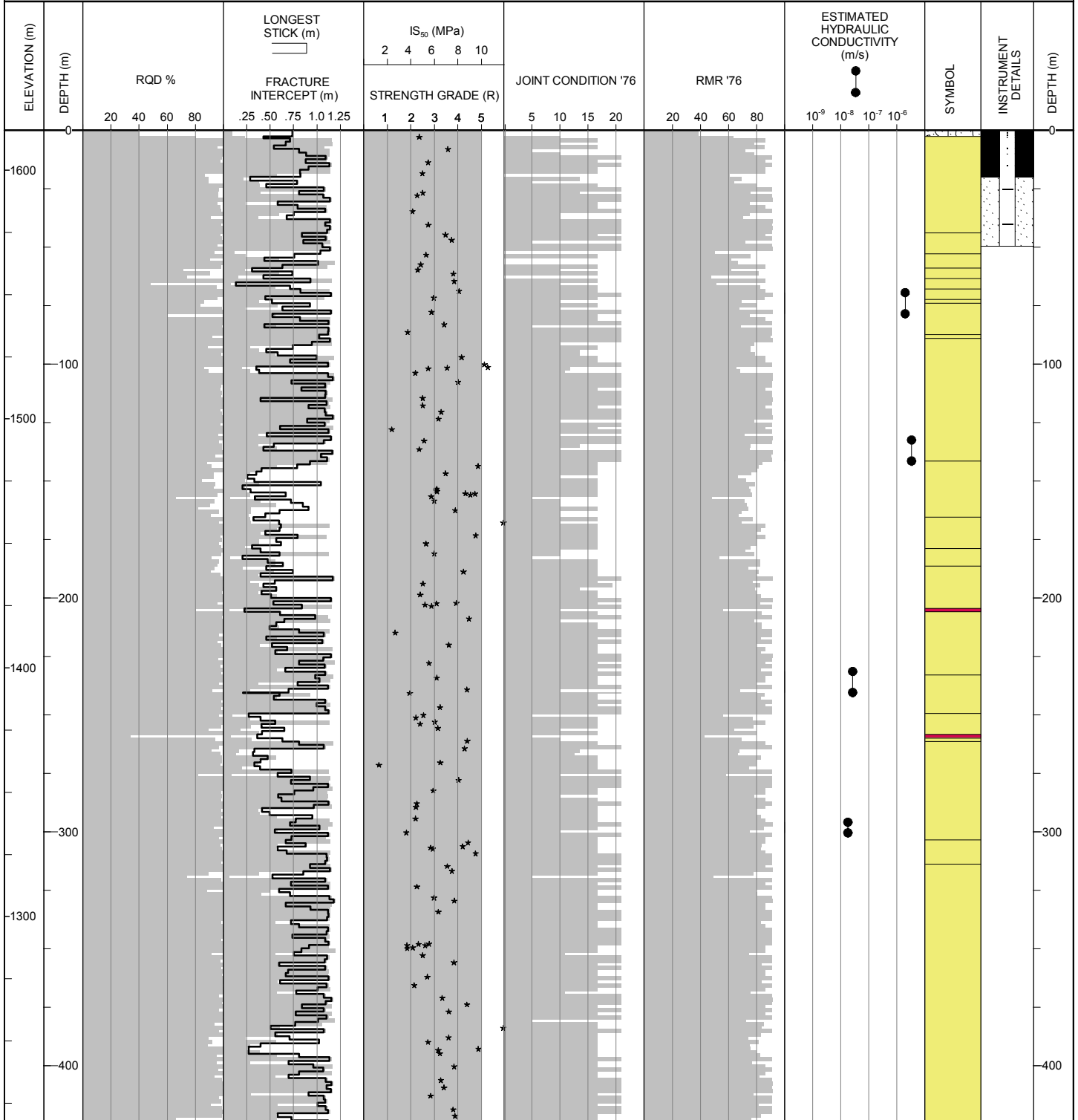
SCALE: 1:2,500

CLIENT: SEABRIDGE GOLD INC.
 PRINT DATE: : 6/13/2011

CO-ORDINATES (m) : 424,202.E, 6,267,339.N
 GROUND ELEVATION (m) : 1616.0
 SURVEY METHOD : DGPS
 DATUM : NAD 83 ZN 9
 PLUNGE (°) : -70
 TREND (°) : 298

DRILL DESIGNATION : Boyse B-20
 DRILLING CONTRACTOR : Hy-Tech
 DRILL METHOD : Core
 CORE SIZE : NQ3
 FLUID : Polymer
 CASED TO (m) : 3

START DATE : 18 Aug 10
 FINISH DATE : 24 Aug 10
 FINAL DEPTH (m) : 471.4
 DEPTH TO TOP OF ROCK : 0.0
 LOGGED BY : SDR/DKR
 REVIEWED BY : MAB



KSM SUMMARY LOG KSM SUMMARY LOG.GDL BGC.GDT 6/13/11



SCALE: 1:2,500

CLIENT: SEABRIDGE GOLD INC.
 PRINT DATE : 6/13/2011

CO-ORDINATES (m) : 424,202.E, 6,267,339.N
 GROUND ELEVATION (m) : 1616.0
 SURVEY METHOD : DGPS
 DATUM : NAD 83 ZN 9
 PLUNGE (°) : -70
 TREND (°) : 298

DRILL DESIGNATION : Boyse B-20
 DRILLING CONTRACTOR : Hy-Tech
 DRILL METHOD : Core
 CORE SIZE : NQ3
 FLUID : Polymer
 CASED TO (m): 3

START DATE : 18 Aug 10
 FINISH DATE : 24 Aug 10
 FINAL DEPTH (m) : 471.4
 DEPTH TO TOP OF ROCK : 0.0
 LOGGED BY : SDR/DKR
 REVIEWED BY : MAB

ELEVATION (m)	DEPTH (m)	RQD %	LONGEST STICK (m)	FRACTURE INTERCEPT (m)	IS ₅₀ (MPa)					JOINT CONDITION '76	RMR '76	ESTIMATED HYDRAULIC CONDUCTIVITY (m/s)	SYMBOL	INSTRUMENT DETAILS	DEPTH (m)										
					2	4	6	8	10																
						STRENGTH GRADE (R)																			
						1	2	3	4	5	5	10	15	20	20	40	60	80	10 ⁻⁹	10 ⁻⁸	10 ⁻⁷	10 ⁻⁶			
-1200						*	*	*	*	*															
500																									
-1100																									
600																									
-1000																									
700																									
-900																									
800																									

KSM SUMMARY LOG KSM SUMMARY LOG.GDL BGC.GDT 6/13/11



SCALE: 1:2,500

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