APPENDIX 4-L
IRON CAP DEPOSIT
GEOTECHNICAL CHARACTERIZATION

December 13, 2012

REPORT ON

Iron Cap Deposit Geotechnical Characterization

Submitted to:
Seabridge Gold Inc.
Suite 400, 106 Front Street East
Toronto, ON   M5A 1E1

Attention: Mr. Jim Smolik

REPORT

Project Number: 1114390002-006-R-Rev0-10000

Distribution:

2 Hard Copies - Golder Associates Ltd.

2 Hard Copies - Seabridge Gold Inc.

Golder Associates

Study Limitations

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by Golder for the sole benefit of Seabridge Gold Inc. It represents Golder's professional judgement based on the knowledge and information available at the time of completion. Golder is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to Golder by Seabridge Gold Inc., and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. Seabridge Gold Inc. may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Seabridge Gold Inc.'s (Seabridge) KSM project involves several major gold-copper deposit located in northwest British Columbia (BC), approximately 40 kilometres southwest of the Bell II lodge on Highway 37, and 21 km south-southeast of the Eskay Creek Mine (Figure 1.1). An aerial view looking to the east is shown in Figure 1.2. The site characteristics are described in detail in the KSM pre-feasibility study (PFS) report (Seabridge 2011).

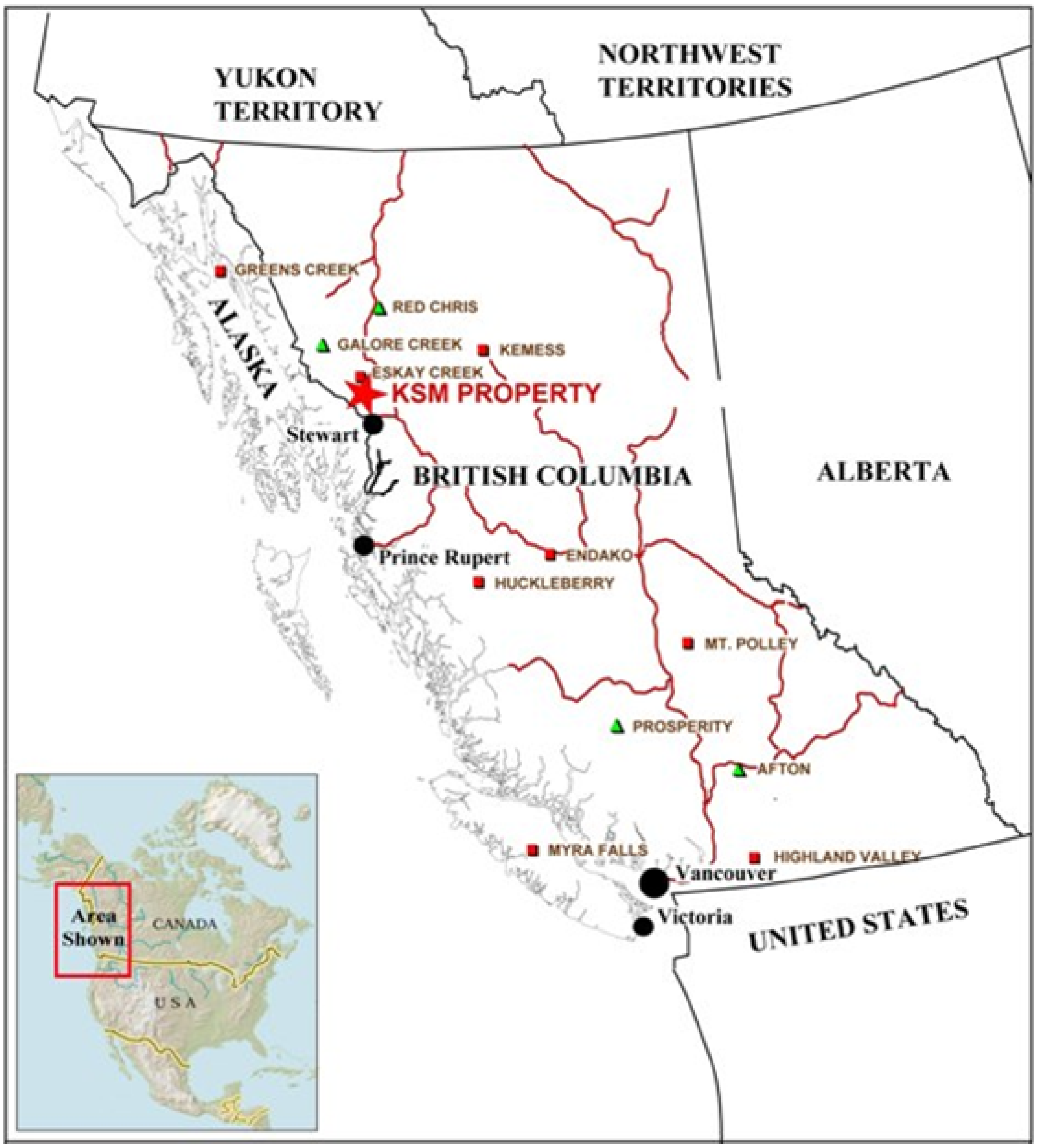


Figure 1.1: Location of the Mitchell, Kerr and Sulphurets (KSM) property

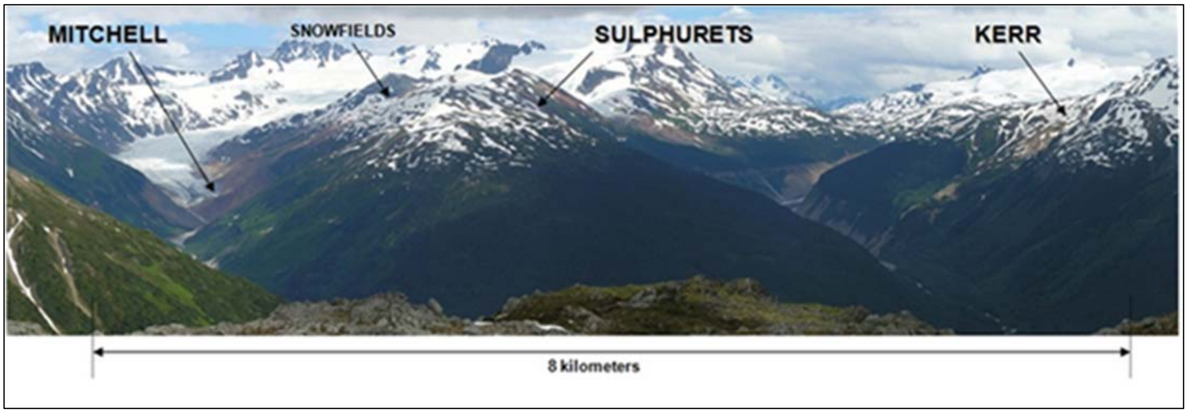


Figure 1.2: Aerial view of the general area of the Mitchell deposit (looking east)

The KSM property contains the Kerr, Sulphurets, Mitchell, and Iron Cap deposits. The deposits will be mined by a combination of open pit and underground mining methods. Golder Associates Ltd. (Golder) has completed the pre-feasibility level assessment to block cave mine for the Mitchell and Iron Cap deposits. This report presents a compilation of all available geological and geotechnical data for the Iron Cap Deposit, and the geotechnical characterization of the rock mass for the block cave mine design. A similar evaluation for the Mitchell Deposit is presented under separate cover.

The Iron Cap deposit is a porphyry type intrusion that has been deformed by subsequent tectonic processes. The deposit outcrops in the north slope of the Mitchell Creek Valley, east of the Mitchell deposit and above the current Mitchell Glacier. A small portion to the north-east is covered by an ice cap. The site terrain is shown in Figure 1.3.

Figure 1.3: Iron Cap site terrain (looking north)

The proposed mine plan for the Iron Cap Deposit involves block cave mining from underground. The focus of this study is limited to the mineralized rock above the block cave extraction level. The extraction level elevation was established in preliminary studies at 1210 m. Detailed designs of the block caving mine, based in part on the geotechnical characterization contained in this report, are presented under separate cover.

A plan view and cross-section showing the topography, gold mineralization, and proposed block cave extraction level are shown in Figure 1.4 and Figure 1.5, respectively.

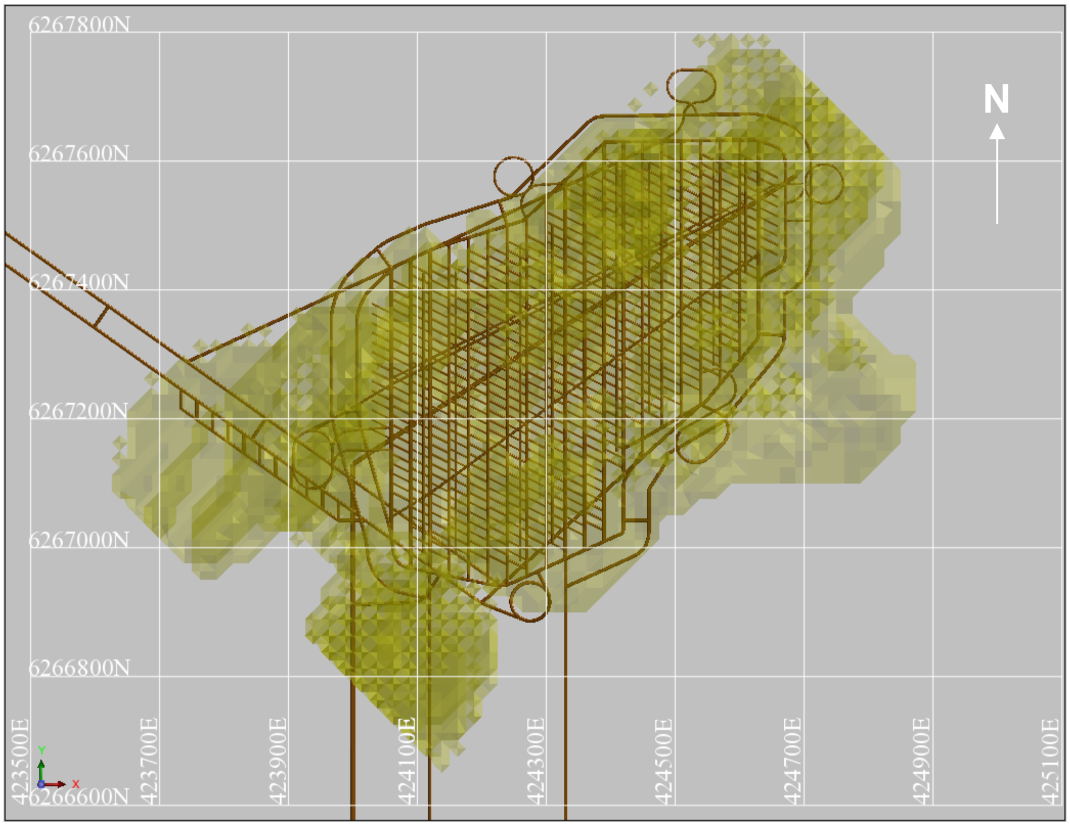


Figure 1.4: Plan view showing Iron Cap 0.25 g/t Au grade shell and proposed block cave extraction level footprint

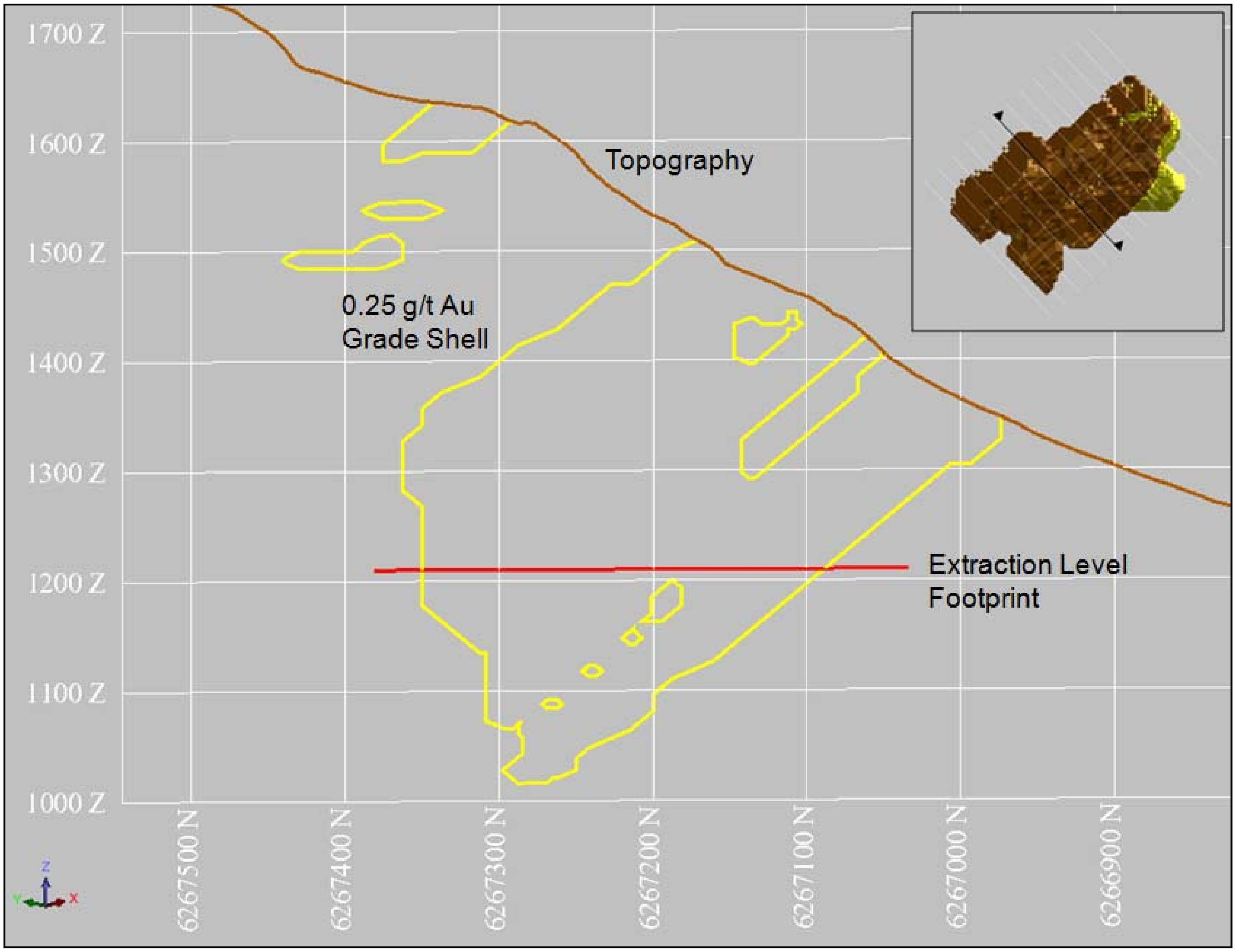


Figure 1.5: Vertical cross-section showing topography, Iron Cap 0.25 g/t Au grade shell and proposed block cave extraction level footprint

Note that the 0.25 g/t Au grade shell provided by Seabridge is presented in Figure 1.4 and Figure 1.5 to provide a general reference of the location of the deposit.

2.0 AVAILABLE DATA

A significant amount of geotechnical and geological data have been collected for the Iron Cap deposit since exploration began in 2005. These data consist of core photographs, geotechnical core logs, geological core logs, televiewer survey data, and results of the laboratory strength testing program. A summary of the data used in this geotechnical characterization is described in this section.

2.1 Exploration Drilling

A total of 41 exploration boreholes, drilled and logged geologically by Seabridge in 2010, were used in this study (IC-10-006 to IC-10-046).

A plan view of the exploration boreholes overlain on the 0.25% Au ore grade shell are shown in Figure 2.1.

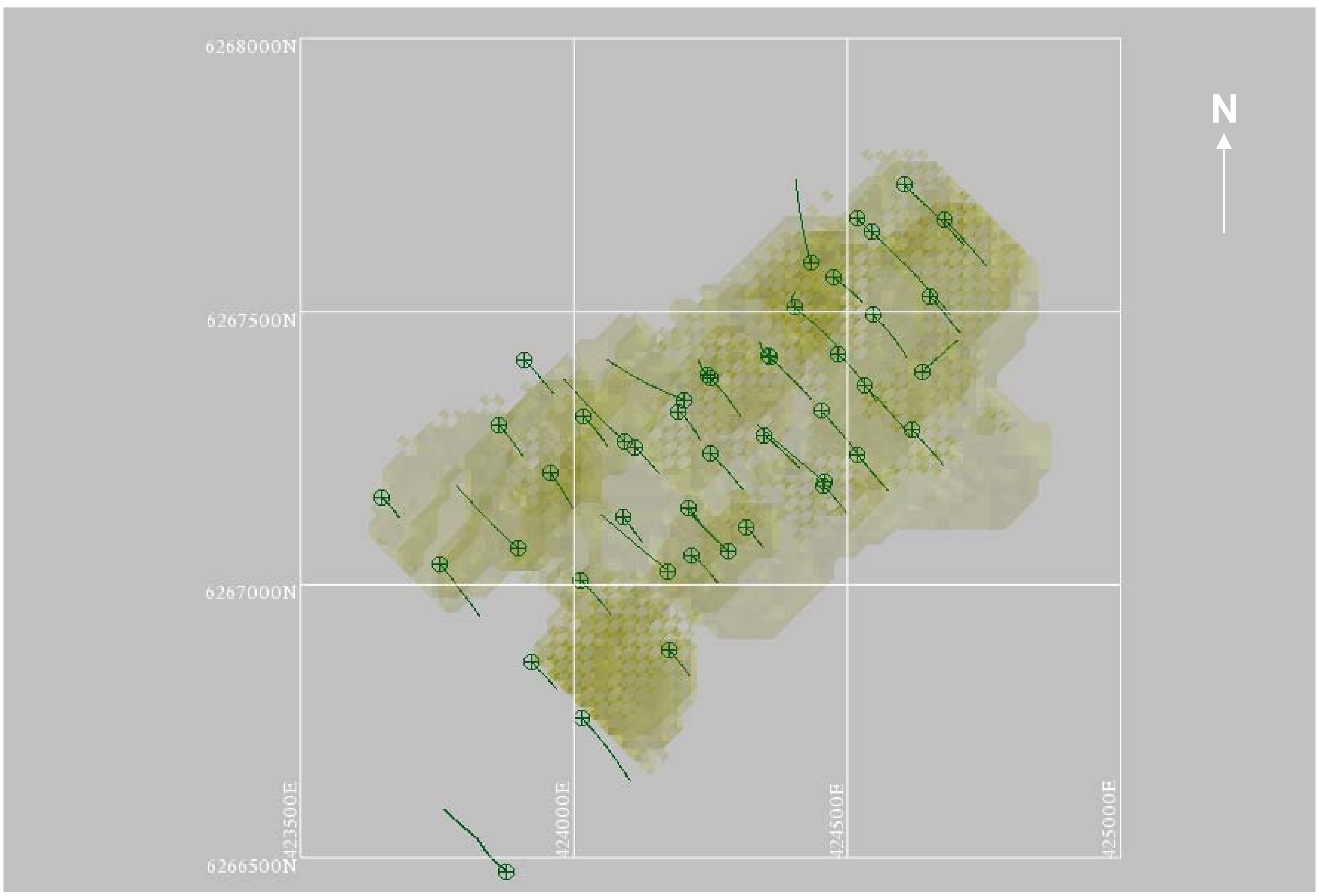


Figure 2.1: Exploration boreholes and Iron Cap 0.25% g/t Au grade shell

The information available from these boreholes includes a count of natural fractures per core run, lithology, alteration type and intensity, and Rock Quality Designation (RQD). RQD (Deere et al. 1967) is a common parameter describing fracture intensity and is defined as follows:

$$\mathrm{RQD} = \frac{\sum \text{Length of core pieces}}{\text{Total length of core run}} \times 100\%$$

Core photographs for all exploration holes were provided to Golder by Seabridge.

2.2 Geotechnical Drilling

In 2010, BGC Engineering Inc. (BGC) logged three boreholes (IC-10-014, IC-10-015 and IC-10-016) in the Iron Cap project area for geotechnical parameters to be used in preliminary open pit design studies. The data collected by BGC in 2010 have been used in the current study to characterize the rock mass for the underground block cave mine design.

Borehole details for IC-10-014, IC-10-015 and IC-10-016 are summarized in Table 2.1, and locations are shown in Figure 2.2.

Table 2.1: Summary of Iron Cap Geotechnical Boreholes

Hole ID	Easting[1] (m)	Northing[1] (m)	Elevation[1] (m)	Total Depth (m)
IC-10-014	424,638	6,267,391	1,510	251.2
IC-10-015	424,202	6,267,339	1,616	471.4
IC-10-016	424,433	6,267,589	1,612	300.4

Notes:

1) NAD83, UTM Zone 9 Grid North. Collar surveys were completed by Seabridge Gold Inc.

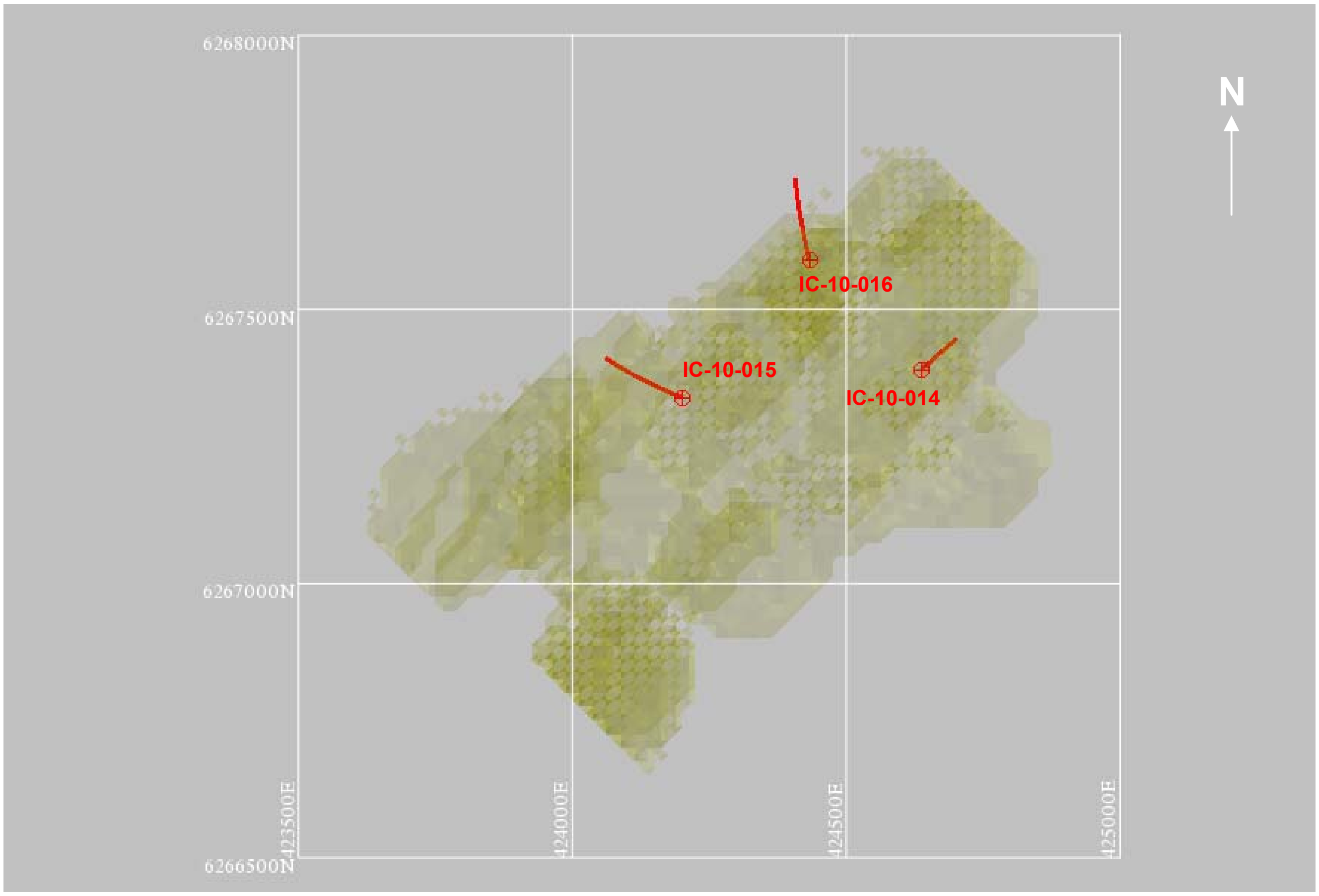


Figure 2.2: Geotechnical boreholes and Iron Cap 0.25 g/t Au grade shell

The geotechnical parameters logged by BGC are described in the Pre-Feasibility Study (PFS) Report titled 'Iron Cap Zone Open Pit Slope Design – FINAL', dated June 15, 2011 (BGC 2011). These include the following parameters for the characterization of rock mass properties according to the Rock Mass Rating (RMR) system by Bieniawski (1976):

- Core recovery;
- RQD;
- Number of discontinuities per interval;
- Strength rating (ISRM); and
- Weathering.

Acoustic and optical televiewer survey data were collected in all three boreholes and reconciled with core logging discontinuity data to provide fracture orientations.

Core photographs were provided to Golder by BGC and used in the geotechnical characterization.

2.3 Geological Model

Seabridge developed an interpreted geological model based on geological logging data. Three-dimensional surfaces representing topography and faults, and three-dimensional interpreted shapes for lithology, alteration and ore grade shells were incorporated into the model.

2.4 Laboratory Data

In 2010, laboratory testing of rock core samples was performed at the Golder laboratory in Burnaby, BC. Detailed laboratory test results are available in BGC's report (BGC 2011).

Uniaxial Compressive Strength (UCS) tests were performed on eight core samples obtained from the Iron Cap 2010 geotechnical boreholes (BGC 2011).

3.0 GEOLOGY

The Iron Cap deposit is a porphyry type intrusion. A general view of the outcrop of the Iron Cap deposit and the surface expressions the Sulphurets Thrust Faukt (STF) are shown in Figure 1.3. The country rock is comprised mostly of deformed sediments (e.g., sandstones, siltstones), volcaniclastics (e.g., tuffs, pyroclastic breccias), and volcanics (e.g., basalts, andesite flows). The ore zone is located in the Hazelton Group rocks in the footwall of the STF.

The geological information for the Iron Cap deposit provided by Seabridge included the following;

- Lithology;
- Alteration;
- Major faulting; and
- Au and Cu grade shells of 0.25 g/t Au and 0.1% Cu.

Quartz-sericite-pyrite alteration appears to be more intense at Iron Cap than at Mitchell.

Major geological structures and rock fabric of the study area include the following:

- North-south striking, steeply dipping faults;
- Gently dipping thrust faults striking east-west; and
- Moderate to steeply dipping foliation/schistosity.

The geometrical shapes of the 0.25 g/t Au and 0.1% Cu grade shells are very similar and superimpose one another, as shown in Figure 3.1. The deposit extends approximately 1,200 m SW-NE (along strike) and 700 m NW-SE (in plan in the down dip direction), and approximately 700 m vertically (Figure 3.1). The deposit is massive and reasonably continuous, and in general geometrically suitable to mine by block caving. It is understood that the deposit remains unexplored at depth.

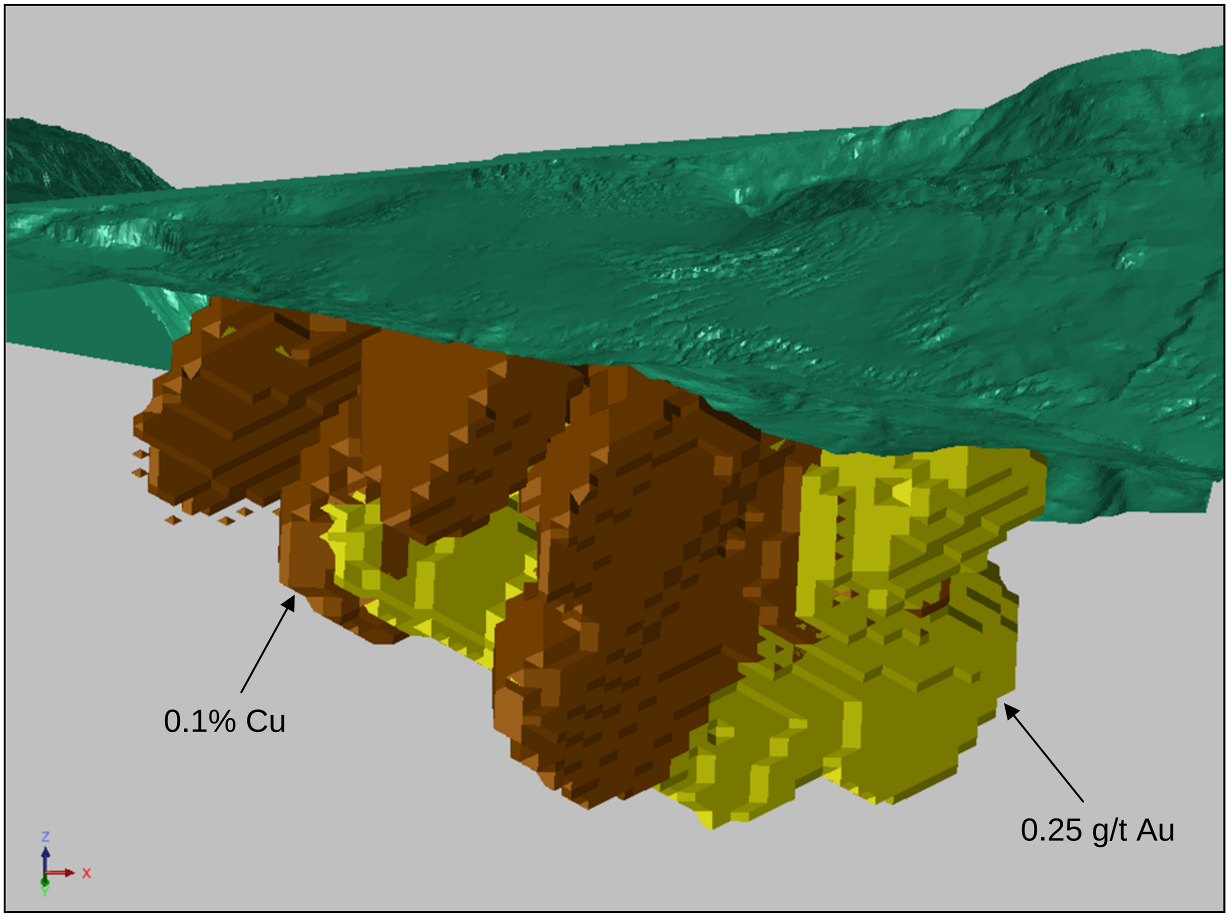


Figure 3.1: Isometric view showing 0.25 g/t Au and 0.1% Cu grade shells of the Iron Cap deposit (looking north)

A vertical cross-section towards the center of the deposit showing lithology, alteration, structure and grade shells is presented in Figure 3.2. The lithological units within the area of potential block cave mining (above the underground extraction level) are primarily altered volcanics that lie beneath the STF.

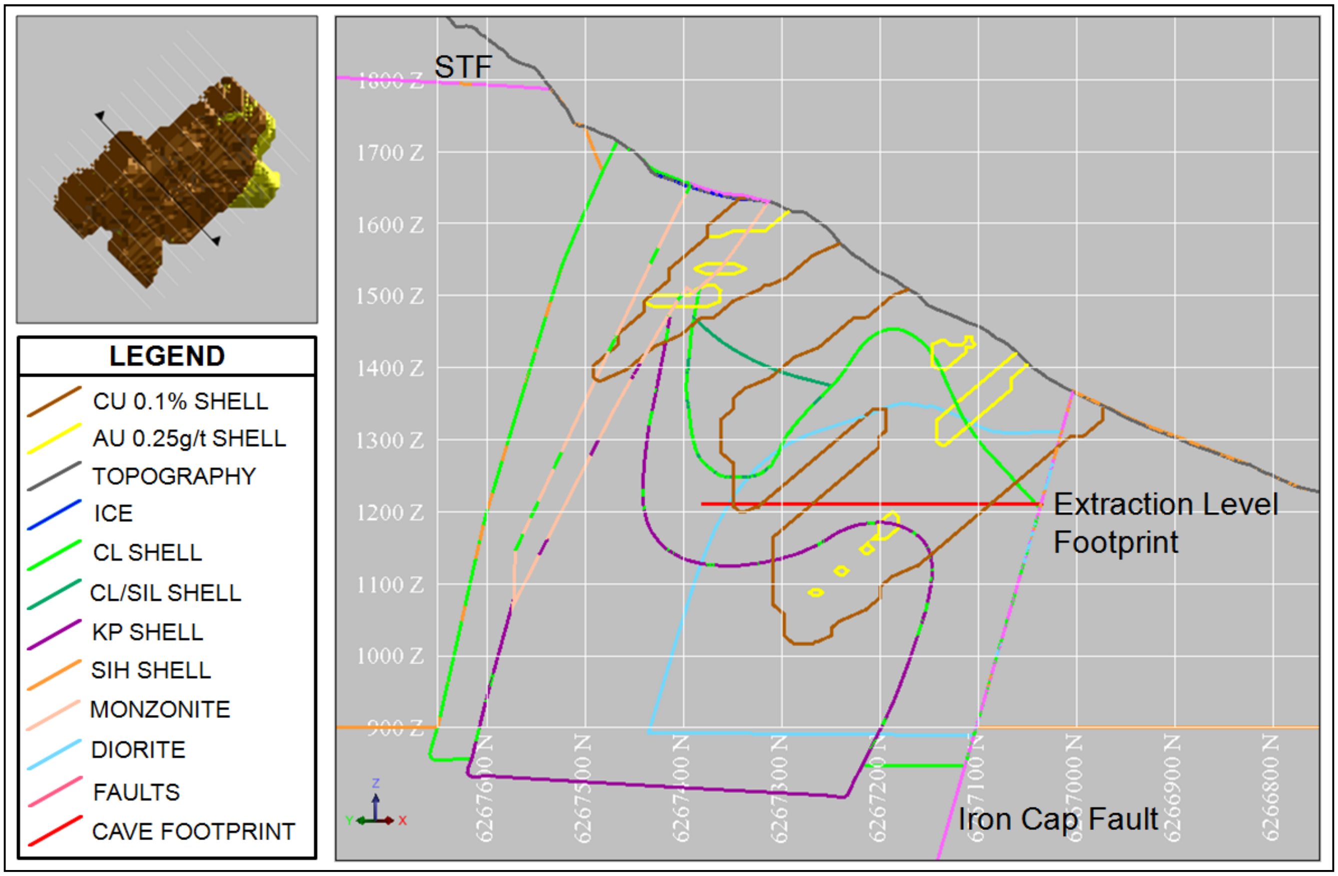


Figure 3.2: Vertical cross-section of the Iron Cap deposit showing lithology, alteration, faults, and 0.25 g/t Au and 0.1% Cu grade shells

Primary alteration types in the Iron Cap zone are phyllic or quartz-sericite-pyrite (QSP) and chloritic, with overprinting from silica flooding and hydrothermal brecciation. These alteration types are generally associated with the mineralized zone and immediately surrounding rock.

Outside of the mineralized and QSP altered area of the Iron Cap zone, the alteration types are dominantly potassic, siliceous, and hornfels. Geotechnical studies carried out by Bruce Geotechnical Consultants (BGC 2011) for preliminary pit design did not identify any correlations between these alteration types and rock mass quality.

A summary of the lithological units and primary alteration types in the Iron Cap zone is contained in Table 3.1.

Table 3.1: Iron Cap Lithological Units and Primary Alteration Types

Geologic Unit	Lithology	Alteration Types	Comments
"Mitchell Intrusives" (Jurassic)	Feldspar Porphyry, Monzonite, Andesite, Diorite	Potassic, Hornfels	Above the core of the Iron Cap zone, there is a relatively large intrusive body located within the Hazelton Group volcanic. The upper slope of the Mitchell Valley has a large percentage of volcanic rocks. There are also intrusives located within the mineralized zone of the Iron Cap deposit.
Hazelton Group (Jurassic)	Volcaniclastic, Tuff, Volcanics, Sedimentary	Phyllic (QSP), Hydrothermal Brecciation, Intermediate Argillic, Chloritic, Silicic	The mineralized zone of the Iron Cap deposit is a mixture of highly altered and mineralized volcanics and intrusives belonging stratigraphically to the Hazelton Group.
		Chloritic, Propylitic, Hornfels, Potassic, Silicic	The Hazelton Group rocks are located in the footwall of the STF. Alteration in this unit can be intense, as the core of the deposit is located in it.
Stuhini Group (Triassic)	Volcaniclastic, Tuff, Volcanics,	Phyllic (QSP), , Intermediate Argillic, Chloritic, Propylitic, Silicic	The Stuhini Group is located in the STF hangingwall. It represents a back-arc basin package and is the host rock of the intrusives. Alteration in this unit can be intense close to the STF, where the core of the Sulphurets zone begins.

Taken from BGC (2011).

There are a number of regionally significant structures identified in the Iron Cap zone. These include the STF and the Iron Cap normal fault, as well as bedding and foliation. An isometric view of the deposit showing the surface topography, mineralization, STF, and Iron Cap fault is shown in Figure 3.3.

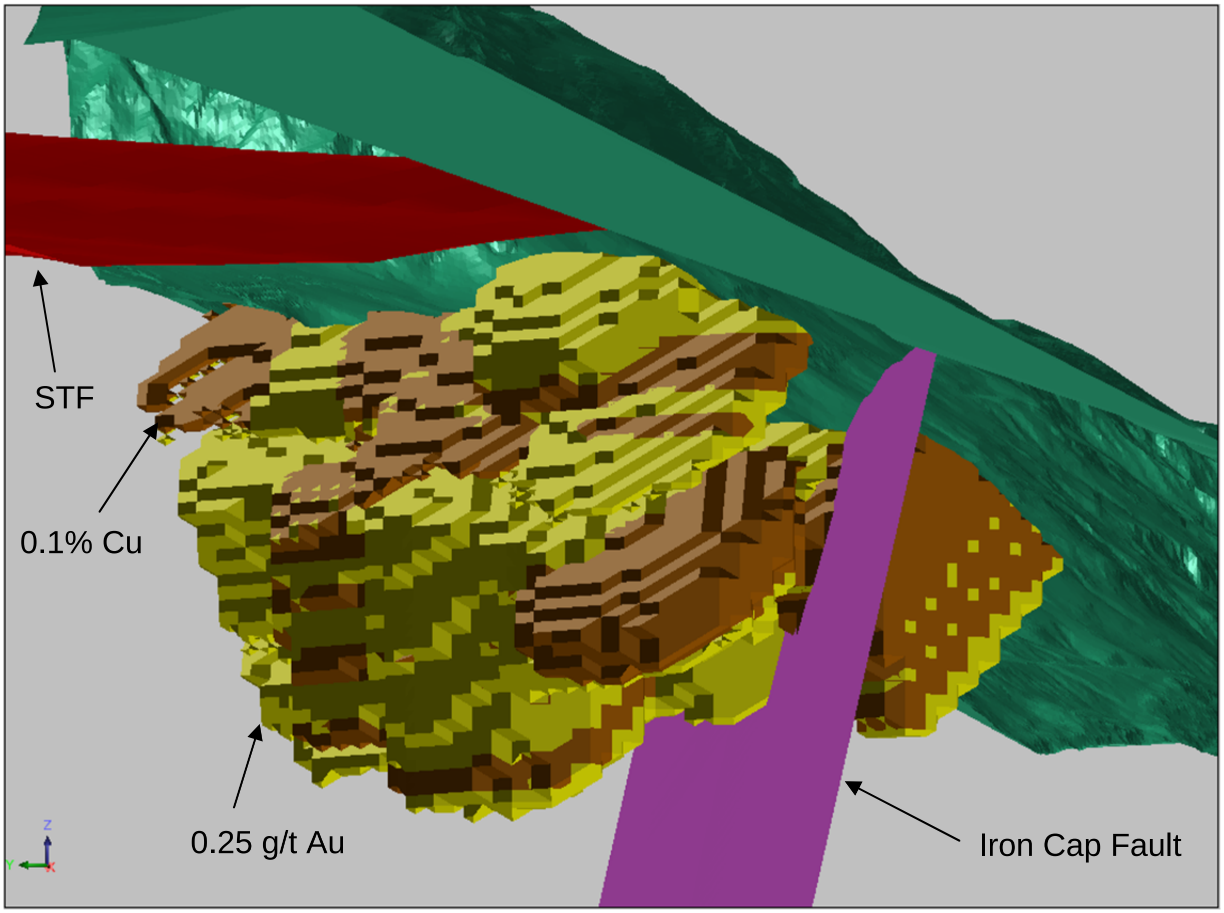


Figure 3.3: Isometric view showing 0.25 g/t Au and 0.1% Cu grade shells, Sulphurets Thrust Fault and Iron Cap Fault (looking east)

The Iron Cap fault dips steeply to the north and is located at the south end of the proposed block cave footprint. Based on rock quality data from exploration borehole IC-10-034, which intersects the fault at an elevation of approximately 1210 m, this structure is not anticipated to be geotechnically significant and does not require additional design considerations.

Bedding is not very evident in the Hazelton Group rocks which contain the mineralization. The orientation of the foliation is variable, and typically dips to the south at moderate to steep angles.

4.0 GEOTECHNICAL CHARACTERIZATION

The characterization of the rock mass has focused on the rock in and around the extraction and undercut levels of the proposed block cave mine and the mineralized rock above this that will be caved. Rock within 50 m of the ground surface is expected to be of poorer quality due to weathering. This rock will not have a significant impact on the caving response of the mineralized rock and geotechnical information from this rock has not been included in the characterization of the rock mass that will be block caved.

Characterization of the rock was based on core photographs and data collected for exploration drillholes, detailed geotechnical data collected for drilling programs carried out by BGC in 2010 (BGC 2011), and the interpreted geological model provided to Golder by Seabridge. Details on the data used for this study were discussed in detail in Section 2.0.

As indicated earlier, there are a total of 41 exploration holes in the Iron Cap deposit and three geotechnical holes. The borehole locations are shown in Figure 4.1. Only those holes that are near, or intersect, the mineralized rock above the proposed block cave extraction level (El. 1210 m) has been considered here. Geotechnical boreholes are shown in red.

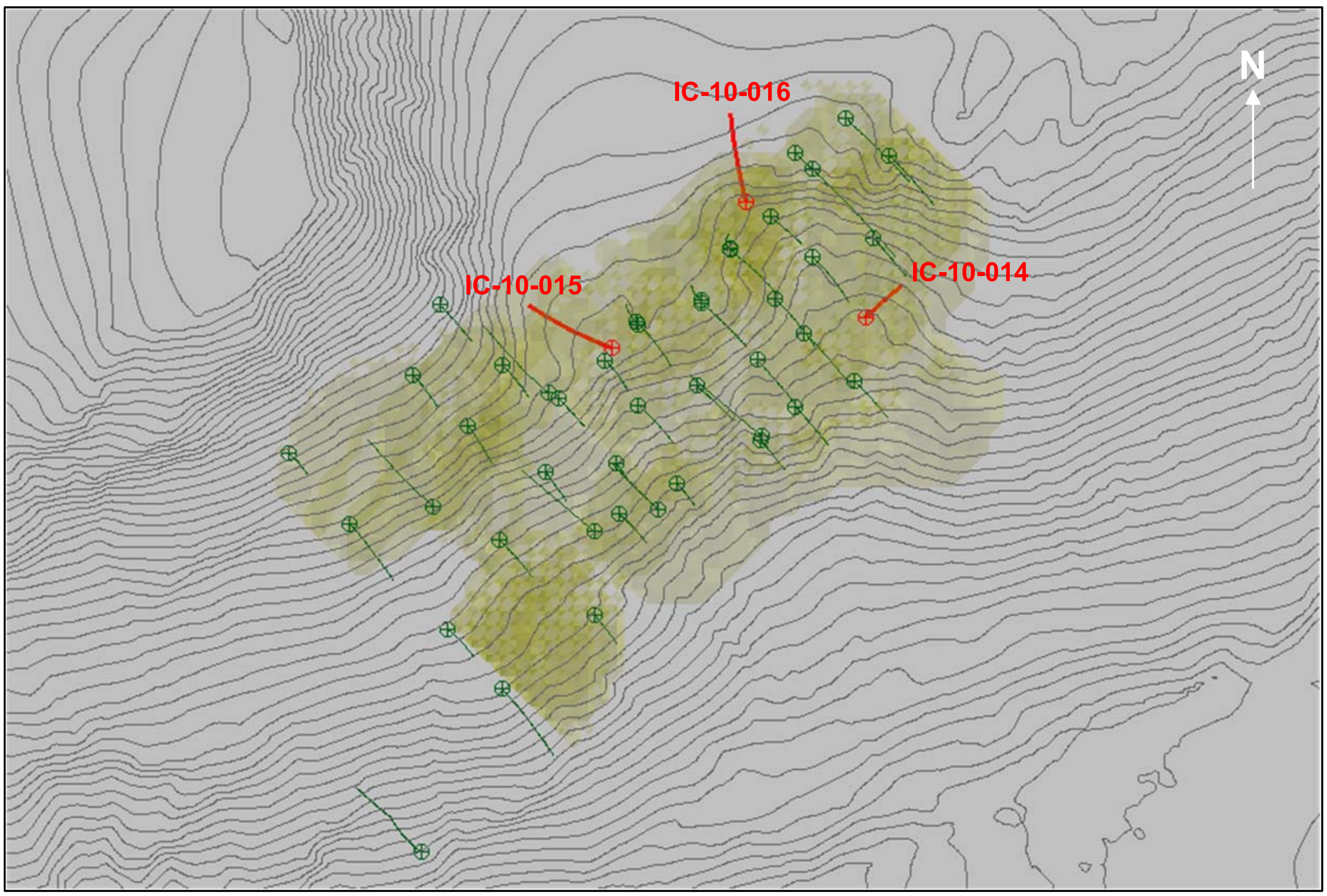


Figure 4.1: Iron Cap exploration and geotechnical boreholes and 0.25 g/t Au grade shell

Some of the block cave mine infrastructure will be located outside of the immediate area of mineralization (i.e., ramps, raises, conveyor drifts, etc.). This infrastructure, including the access ramp, main conveyor, and ventilation drifts, are shown in Figure 4.2. For the purpose of this report, the rock outside the immediate area of mineralization where some of the infrastructure is located is referred to as 'host' rock. The host rock that the mine infrastructure will be excavated in has been assessed based on data collected from nearby drillholes.

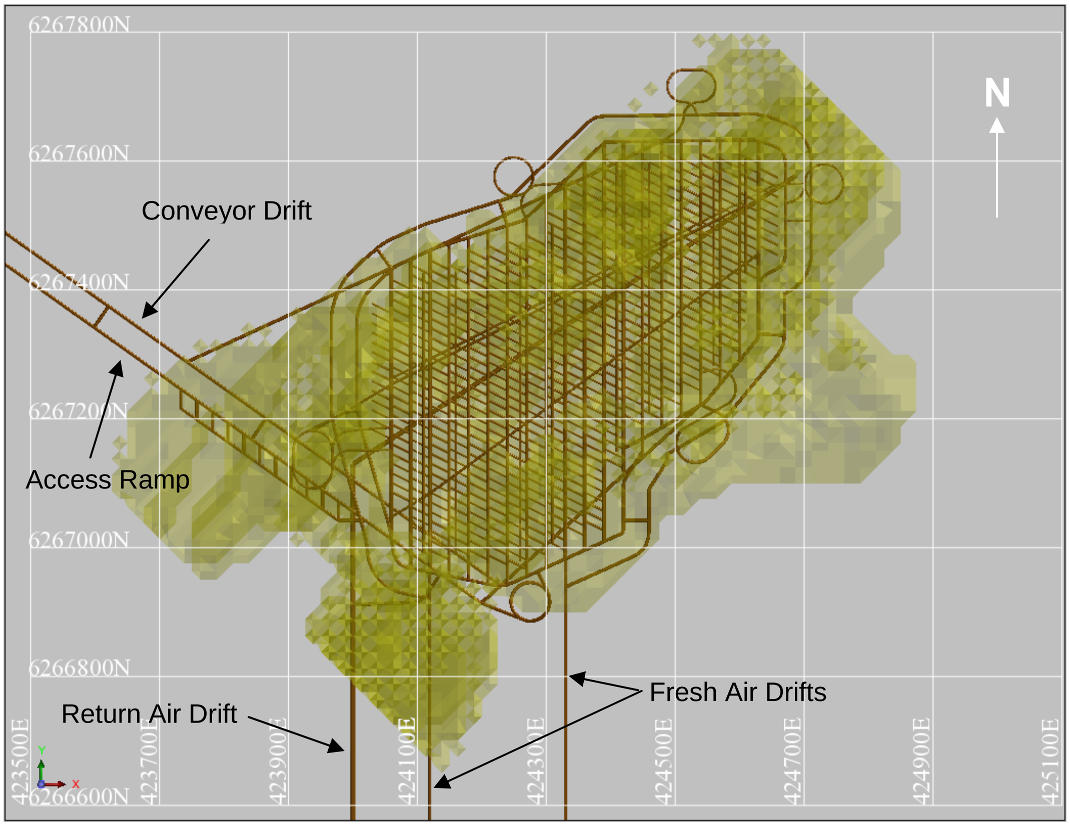


Figure 4.2: Plan showing mine infrastructure and 0.25 g/t Au grade shell

Figure 4.2 is included here for illustration purposes only to indicate where the mine infrastructure is planned relative to the orebody. Details on the mine design are presented under separate cover.

4.1 Rock Mass Rating

The geotechnical boreholes were logged for rock quality according to the Rock Mass Rating (RMR_{76}) system (Bieniawski 1976). Details of the rating system are presented in Appendix A, along with example core photographs for each of the categories listed in Table 4.1 below.

Table 4.1: Rock Mass Rating System (Bieniawski 1976)

Rating	Description
0 – 20	Very poor rock
20 – 40	Poor rock
40 – 60	Fair rock
60 – 80	Good rock
80 – 100	Very good rock

The exploration boreholes were only logged for RQD data, while the geotechnical boreholes were logged for both RQD and RMR. Comparison between RQD and RMR data for the geotechnical boreholes indicated a good correlation between RQD and RMR. Since the rock is generally strong and fractures are fresh and unaltered, RMR is most strongly influenced by the degree of fracturing (i.e., RQD). Using the RQD and RMR data from the 2010 geotechnical boreholes (IC-10-014, IC-10-015 and IC-10-016), an exponential relationship was established as a correlation between RMR and RQD (Figure 4.3). This was then applied to the exploration boreholes to estimate correlated RMR values from RQD.

Figure 4.4 shows a typical cross-section with both correlated and logged RMR data. A complete set of cross-sections is contained in Appendix B.

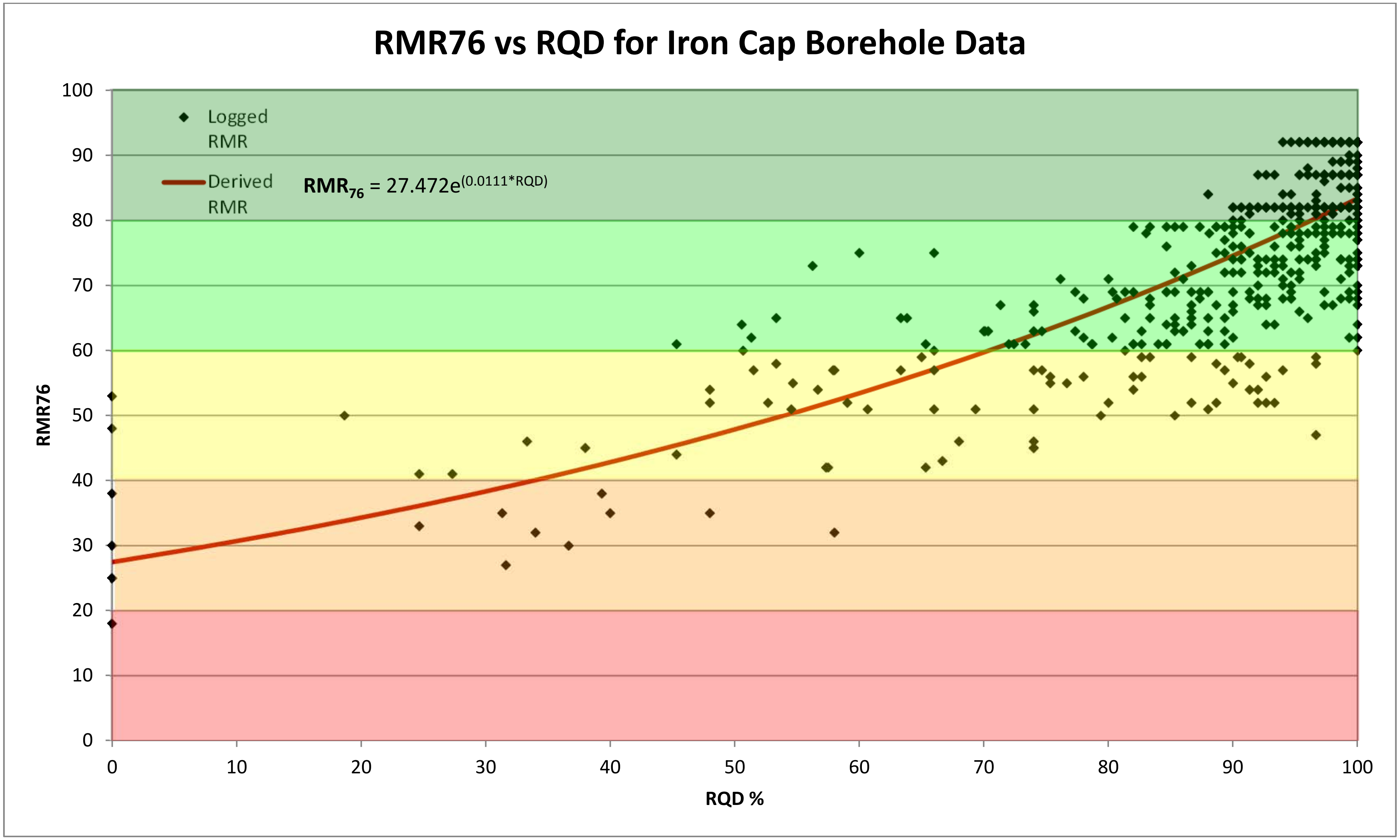


Figure 4.3: Iron Cap RQD-RMR correlation derived from 2010 geotechnical core logging data

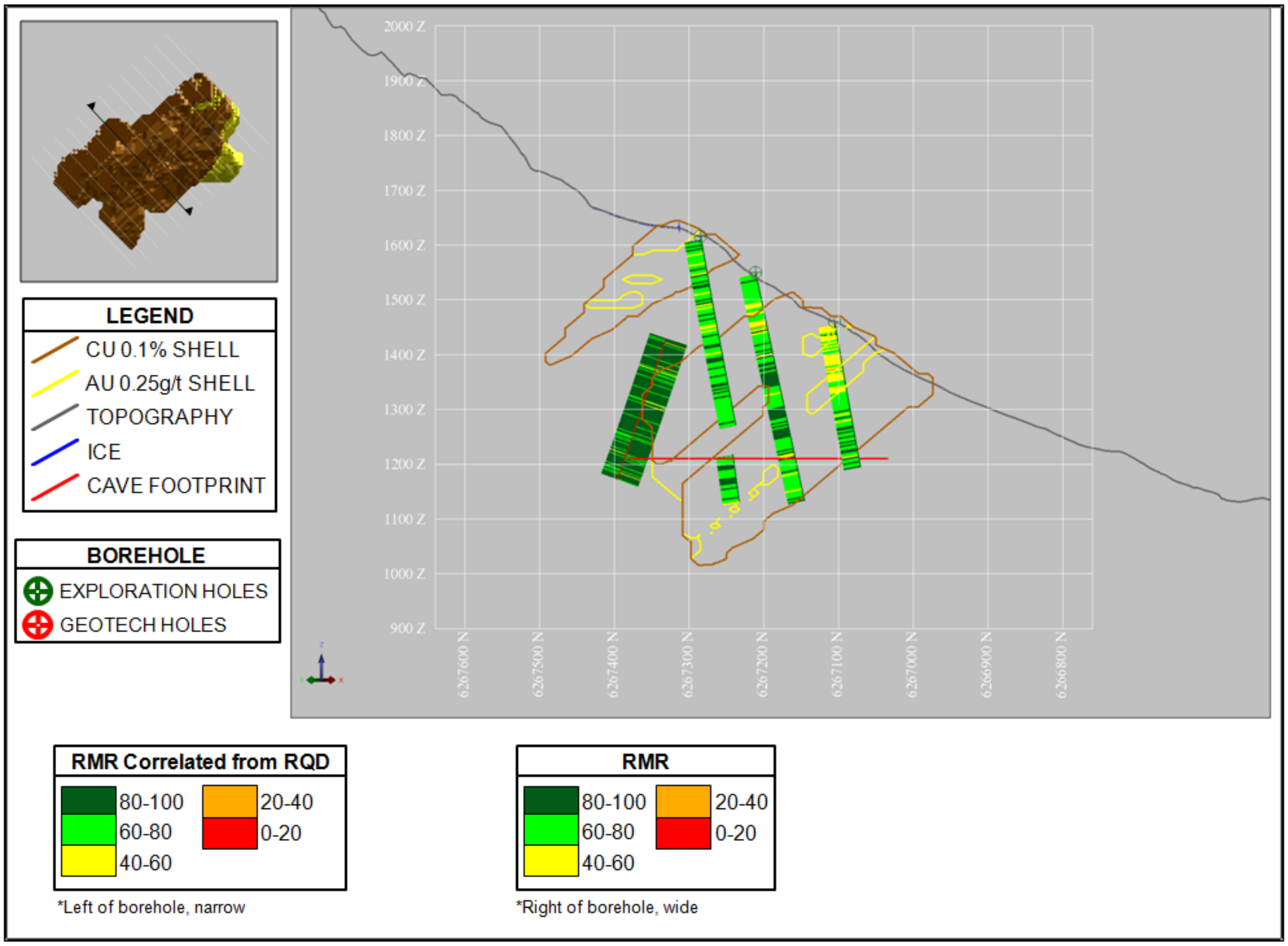


Figure 4.4: Vertical cross-section showing correlated RMR and logged RMR

The average RMR for the mineralized rock above the extraction level (El. 1210 m) is approximately 70. This is in general agreement with the average RMR values reported for the STF footwall rock in BGC's report (BGC 2011). The rock conditions are classified as 'good', as indicated in Table 4.1. RMR values are higher for geotechnical holes IC-10-015 and IC-10-016 (average RMR value of approximately 82), than for IC-10-014 (average RMR value of 64). This is evident in the down-hole plots showing RMR values estimated for the three geotechnical boreholes, contained in Appendix C.

The host rock adjacent to the ventilation drifts to the south of the proposed block cave footprint appears to be of good quality, based on correlated RMR data from exploration borehole IC-10-044 and core photographs from exploration borehole IC-05-05. There are no geotechnical data available to assess the quality of the rock mass that the access ramp and conveyor drift will be excavated in to the northwest to connect to the Mitchell-Tiegan tunnel. However, geological interpretations suggest that the rock is good quality volcanics and sediments that are fresh and geotechnically unaltered. Figure 4.5 and Figure 4.6 show a plan and cross-section, respectively, with the Iron Cap infrastructure and available drillhole information.

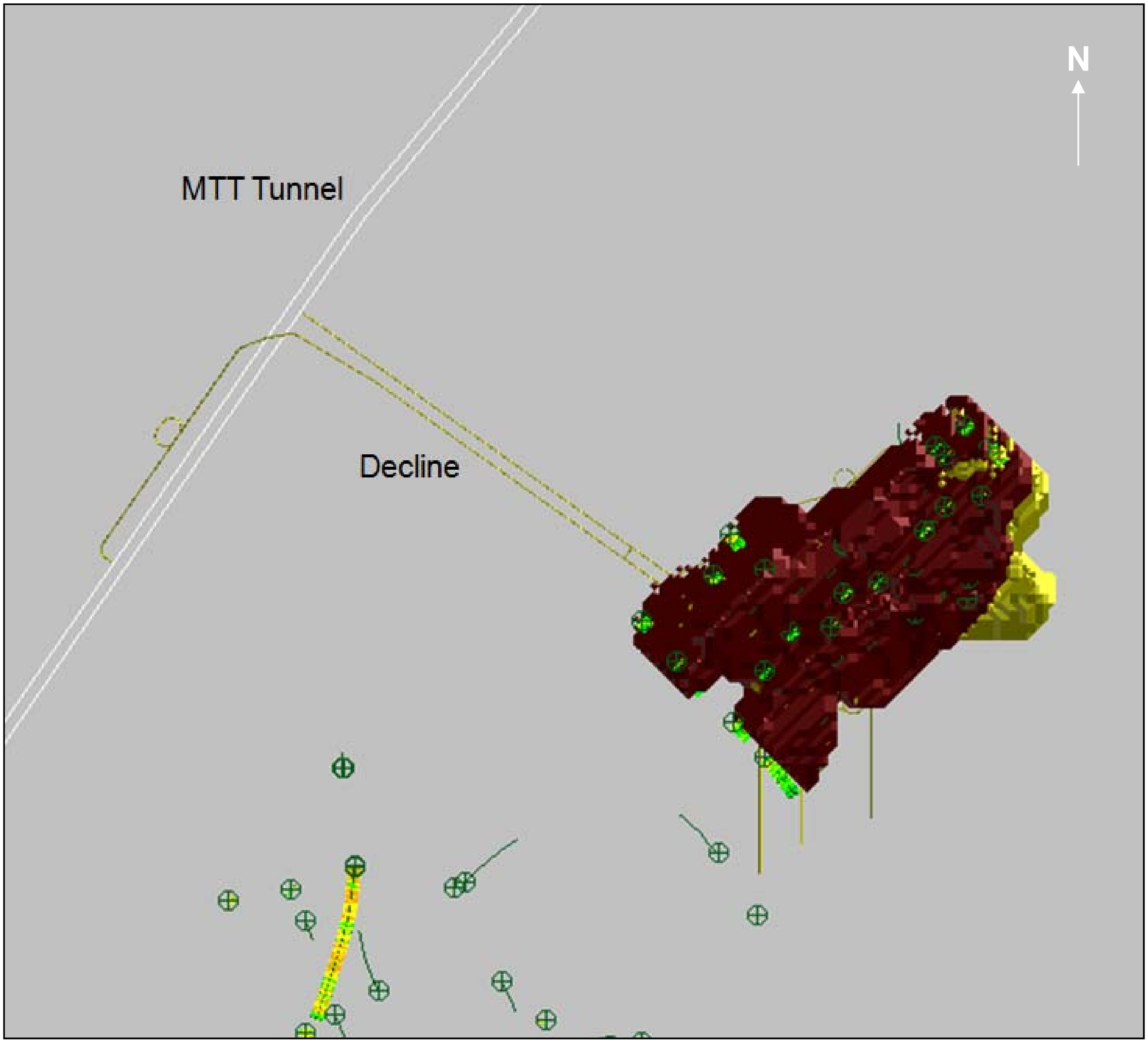


Figure 4.5: Plan showing mine infrastructure and available drillhole information

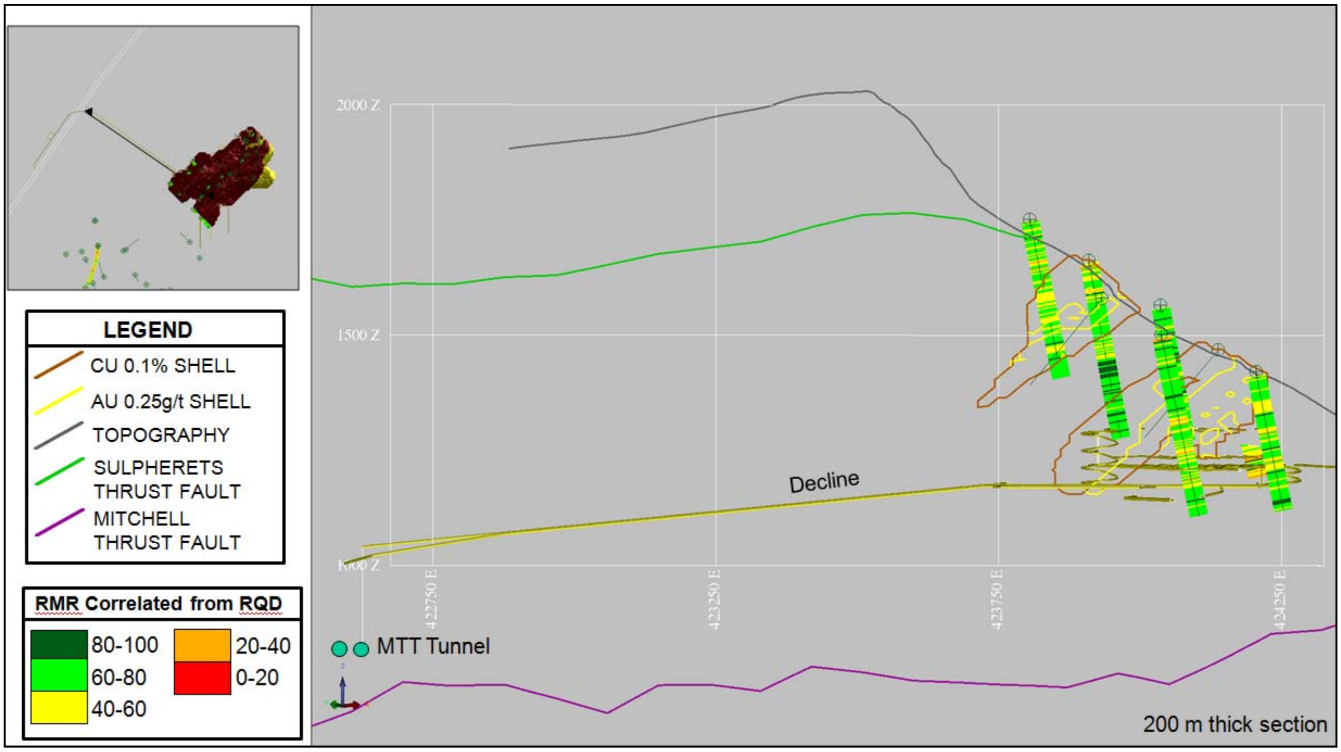


Figure 4.6: Vertical cross-section showing mine infrastructure and available drillhole information

4.2 Intact Strength

Intact rock strength parameters were estimated from laboratory testing results and field estimated strength data, as described in the following section.

4.2.1 Laboratory Testing

A total of eight UCS tests were conducted as part of the Open Pit Slope Design PFS (BGC 2011). All eight samples were collected from the Iron Cap mineralized zone. UCS values ranged from 63 to 155 MPa (equivalent to ISRM field strength ratings of R4 to R5), with an average UCS of 102 MPa. Detailed test results are presented in BGC's report (BGC 2011). These UCS values are in good agreement with UCS values obtained from laboratory testing performed on samples from the Mitchell project area, as described in the Golder report titled '2011 Geotechnical and Hydrogeological Field Investigations, Mitchell Project' (Golder 2012).

4.2.2 Field Estimated Strength

Field intact rock strength estimates were logged by BGC for the 2010 geotechnical boreholes using the International Society for Rock Mechanics standard field identification methods (ISRM 1981). A description of each strength category is described in Table 4.2.

Table 4.2: Field Identification Methods for Description of Rock Strength (ISRM 1981)

Grade	Description	Field Identification	Approximate Range of UCS (MPa)
R0	Extremely weak rock	Indented by thumbnail.	0.25 – 1.0
R1	Very weak rock	Crumbles under firm blows with point of a geological hammer, can be peeled by a pocket knife.	1.0 – 5.0
R2	Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0 – 25
R3	Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	25 – 50
R4	Strong rock	Specimen requires more than one blow of geological hammer to fracture it.	50 – 100
R5	Very strong rock	Specimen requires many blows of geological hammer to fracture it.	100 – 250
R6	Extremely strong rock	Specimen can only be chipped with geological hammer.	> 250

The logged ISRM strength estimates are generally consistent with laboratory test results (BGC 2011). Down-hole plots showing logged ISRM strength ratings for the three geotechnical holes are contained in Appendix C.

4.3 Fracture Orientations

Acoustic and optical televiewer survey data were reconciled with discontinuities logged in the geotechnical boreholes to develop stereographic projections of fracture orientations. Detailed descriptions and stereographic projections of fracture orientations are available in BGC's report (BGC 2011).

Figure 4.7 shows a stereographic projection of combined structural orientation data from the geotechnical boreholes. Data are referenced to true north. The plot indicates a prominent joint set steeply dipping to the south-southeast, and a less prominent joint set dipping at intermediate angles to the west. Note that these plots may display some data bias due to the orientation of the boreholes. The bias may have resulted in fewer northeast dipping structures being identified than are representative of the deposit.

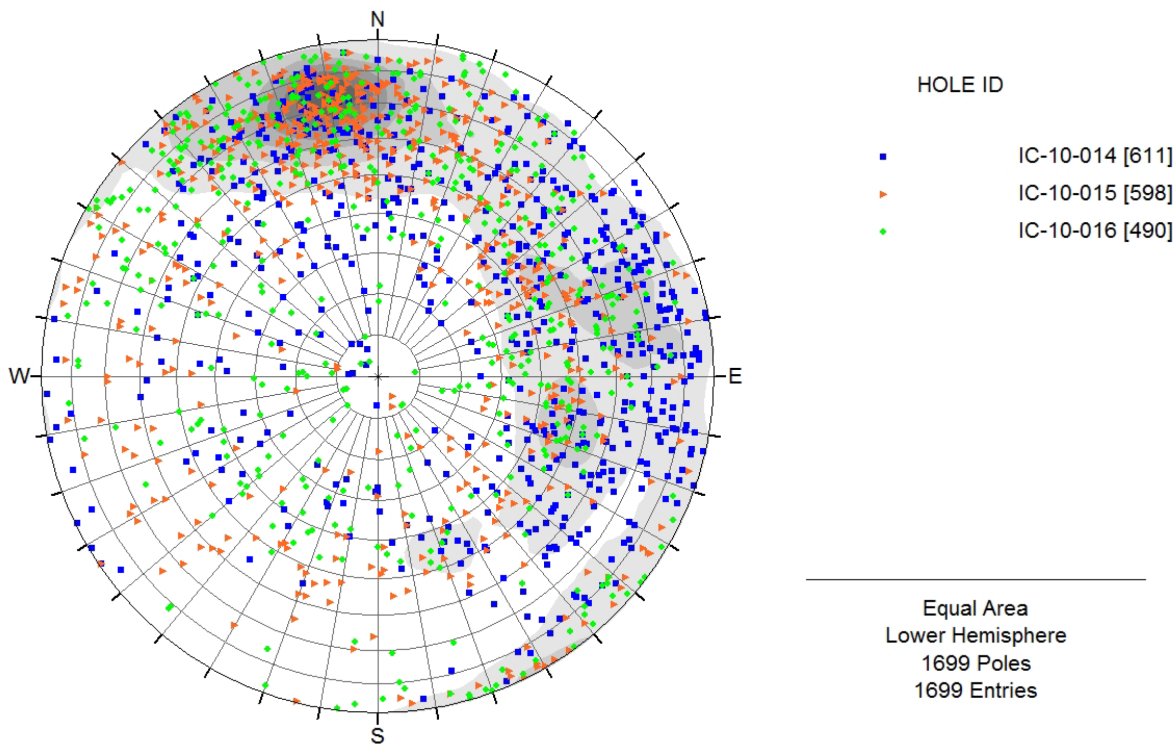


Figure 4.7: Stereographic projection showing open features classified by borehole

4.4 Fracture Intensity

Fracture intensity is characterized by the fracture frequency logged per interval, defined as:

$$\text{Fracture Frequency } (/m) = \frac{\text{Number of Fractures in Interval}}{\text{Length of Interval}}$$

Only data from the geotechnical boreholes (IC-10-014, IC-10-015 and IC-10-016) were included in the fracture intensity characterization. Two of the holes (IC-10-015 and IC-10-016) have a relatively low fracture frequency, while the other geotechnical hole (IC-10-014) has a higher fracture frequency. The median fracture frequency for the mineralized rock above the extraction level (El. 1,210 m) in IC-10-015 and IC-10-016 is approximately 1.3 fractures per metre. The median fracture frequency for IC-10-014 alone is approximately 4.7 fractures per metre. Down-hole plots showing fracture frequency for the geotechnical boreholes are presented in Appendix C.

In general, the exploration boreholes exhibit high fracture frequencies similar to IC-10-014. However, there is a low level of confidence in the fracture frequency data collected from these holes. Of particular significance is the fact that logging data from exploration holes at the Mitchell deposit suggested a much higher fracture frequency than the geotechnical holes indicated. The reason for this is uncertain, but the fracture frequency recorded for exploration holes may have been affected by drilling procedures, core handling, and logging methods. It is uncertain whether this is also the case at Iron Cap, but for the present, the fracture frequencies from the exploration holes are not being relied on.

A plot showing cumulative fracture count for the geotechnical boreholes is presented in Figure 4.8. Note that only the portions of the boreholes below 50 m depth are included in this plot.

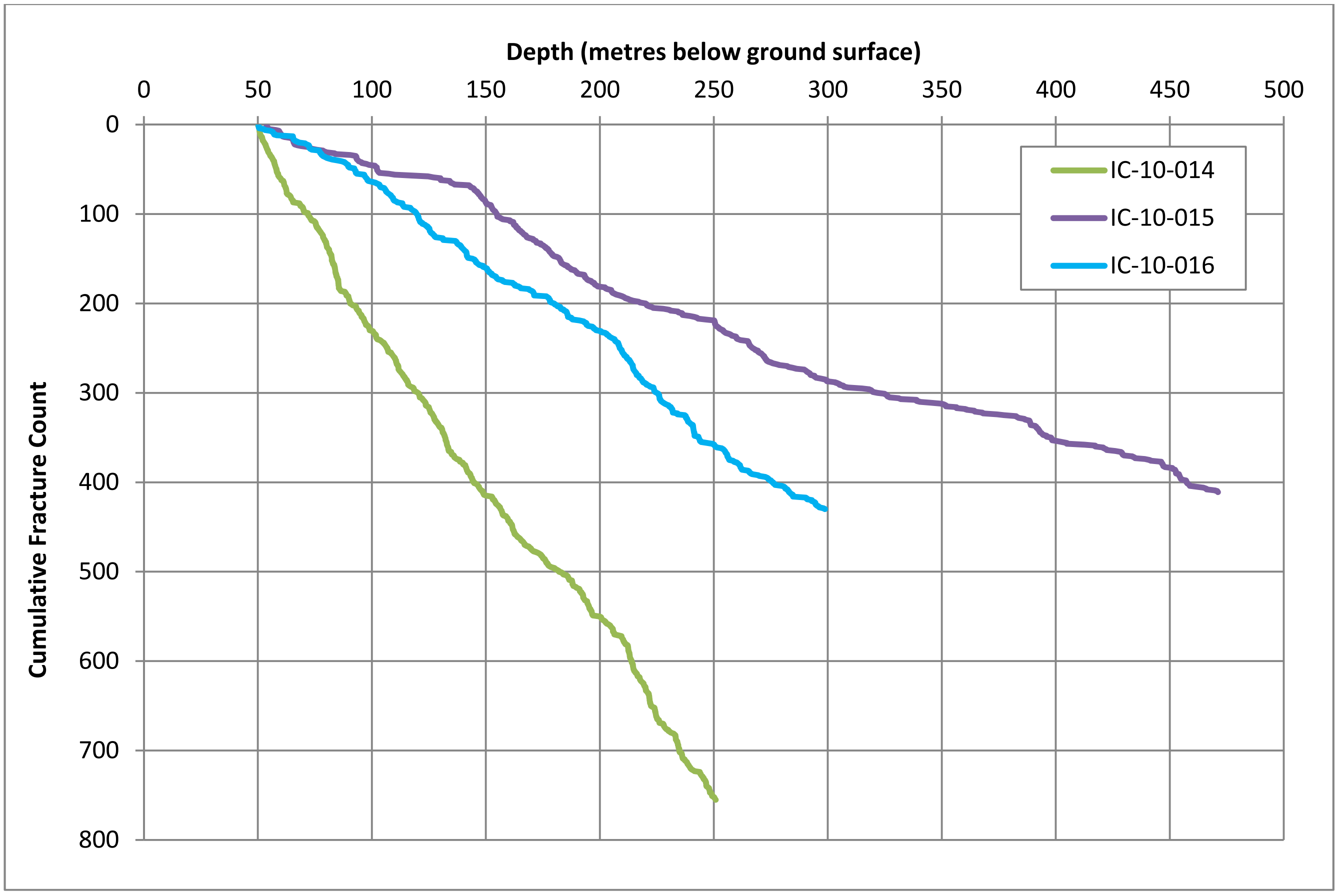


Figure 4.8: Cumulative fracture count vs. depth for 2010 geotechnical boreholes

4.4.1 Effect of Alteration

The percentages of alteration types logged in the geotechnical boreholes are shown in Table 4.3.

Table 4.3: Alteration Type by Borehole

Alteration Type	Alteration Description [1]	Percentage by Length [2] (%)
CL-PR	Chloritic-Propylitic	1.5
PSBX	Silicic Hydrothermal Breccia	32.5
QSP	Phyllic (Quartz-Sericite-Pyrite)	9.8
SIL	Pervasive Silicification	51.8
Other	Potassic Hydrothermal Breccia (PKBX) Late Quartz Veins (QTVN)	4.3

Notes:

1) Alteration descriptions provided by Seabridge Gold Inc.

2) Data above 50 m depth along hole excluded.

Cross-sections showing alteration type and fracture frequency are presented in Appendix D. The cumulative plot presented in Figure 4.9 indicates that rock with pervasive silicification (SIL) is more fractured than rock exhibiting other types of alteration. Note that this plot only includes data from the three geotechnical boreholes, and data from within 50 m of the ground surface have been excluded.

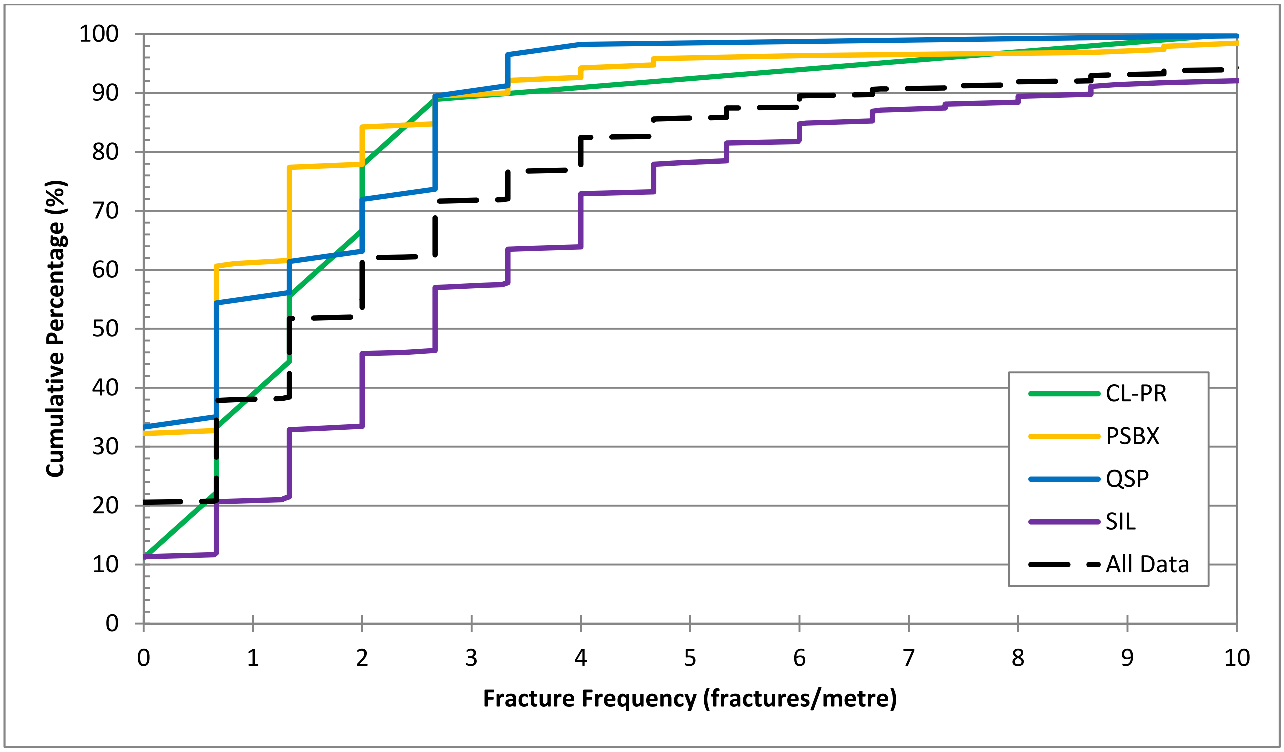


Figure 4.9: Cumulative percentage of fracture frequency by alteration types for IC-10-014, IC-10-015 and IC-10-016

Given that the rock is considerably more fractured in IC-10-014 relative to the other two geotechnical boreholes, and that approximately 94% of the rock in IC-10-014 has pervasive silicification (SIL), a second cumulative plot was produced without the IC-10-014 data to assess potential biases in the data presented in Figure 4.9. The cumulative plot excluding IC-10-014 data is shown in Figure 4.10. Note that only data below 50 m depth are included in this plot.

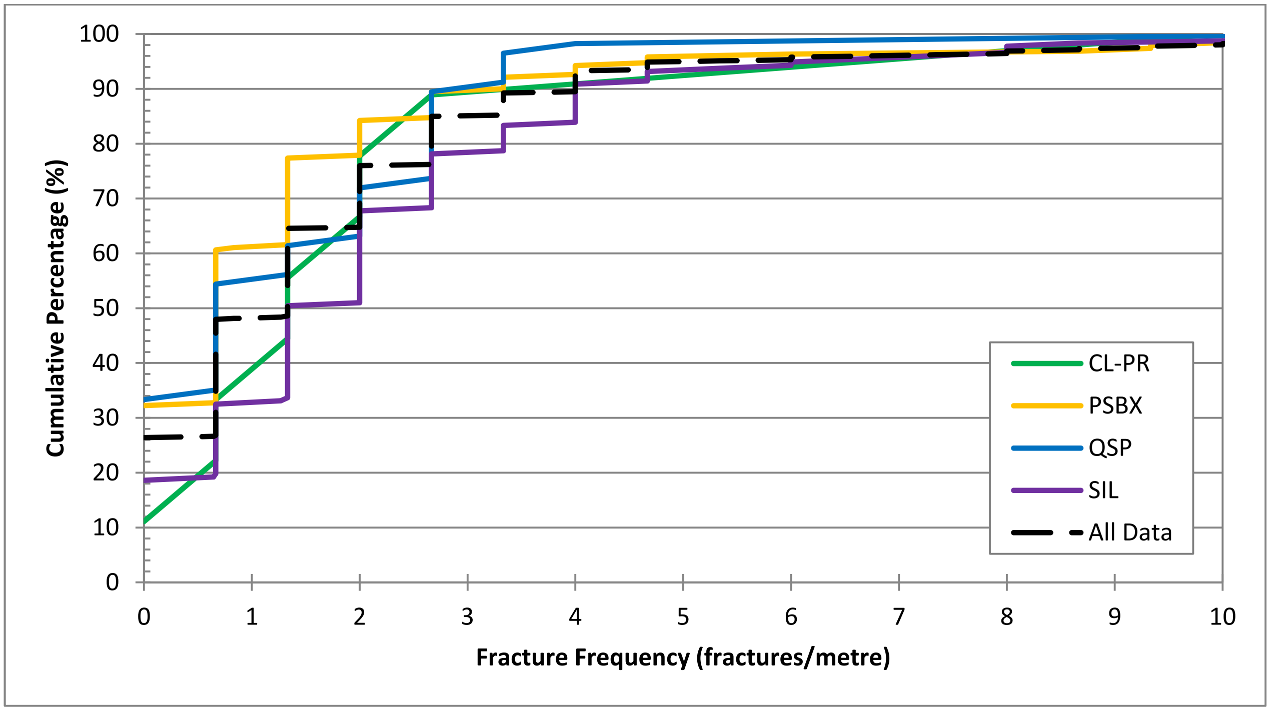


Figure 4.10: Cumulative percentage of fracture frequency by alteration types for IC-10-015 and IC-10-016

As in Figure 4.9, the plot shown in Figure 4.10 indicates that rock with pervasive silicification is more fractured than other alteration types, but the difference between the alteration types is less pronounced when data from IC-10-14 are excluded. At this stage, there is insufficient data available to assess whether the high fracture frequency in IC-10-014 is anomalous or whether it is representative of the rock mass above the proposed block cave mine footprint. Additional data will need to be collected as part of future studies to confirm the quality of the rock mass in the Iron Cap deposit.

4.5 Fracture Persistence

No fracture persistence data have been collected at Iron Cap. However, Golder conducted geotechnical mapping along four traverses on rock outcrops near the Mitchell deposit in June 2011. Detailed methodology, analyses and results are provided in the Mitchell field investigation report (Golder 2012).

Two of the traverses had dominant phyllic (QSP) alteration, and two had dominant phyllic alteration with stockwork quartz veining (QSPSTW). Mapped features were characterized by the number of termination ends visible in the outcrop (i.e., 0, 1 or 2). Most features had a persistence of 3 m or less, as shown in Figure 4.11. However, the data are limited and strongly influenced by the size of the outcrops that were mapped (approximately 12 m by 2 m). It is recognized that there may be more continuous structures in the rock mass than indicated by the data, particularly intermediate or steeply dipping structures that would have been truncated by the mapping window. An allowance was made for this in developing the fracture model of the rock mass discussed in Section 6.2. The distribution of features for which either no terminations were visible (termination = 0), one end of the structure was visible (termination = 1), or both ends of the structure were visible in the mapping window (termination = 2) is summarized in Table 4.4.

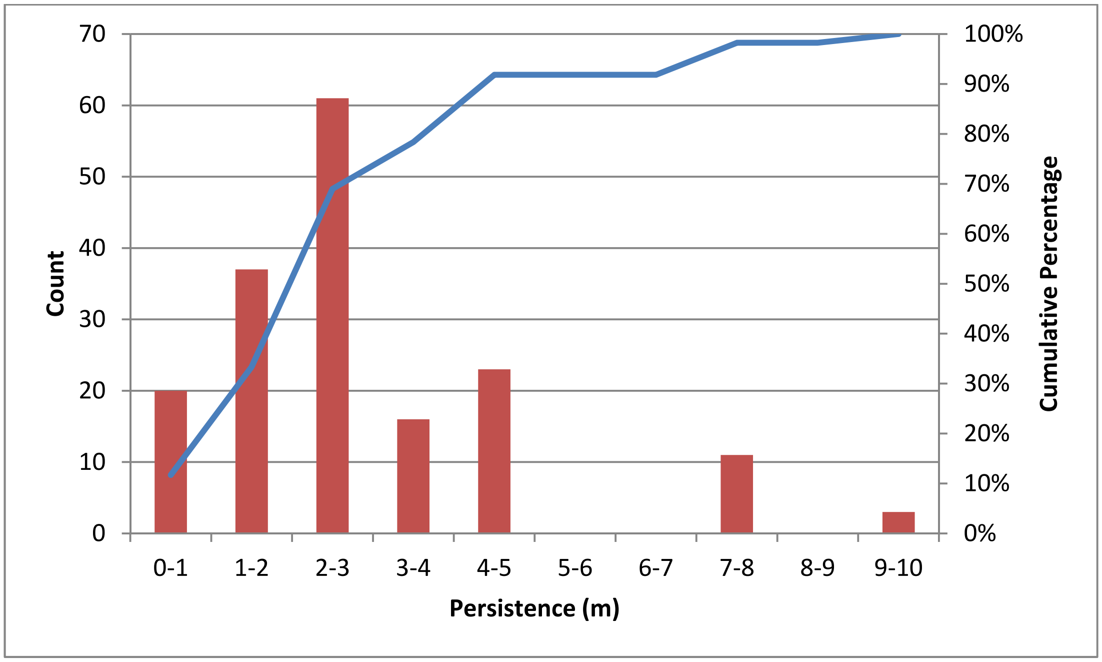


Figure 4.11: Persistence distribution of all mapped features

Table 4.4: Distribution of Termination of Mapped Features

Termination	Number of Mapped Features
0	12
1	30
2	26

5.0 IN SITU STRESS

No in situ stress testing has been conducted at Iron Cap. However, hydraulic fracturing testing was performed in borehole M-11-122 to evaluate the in-situ stresses at Mitchell. Detailed methodology, analyses and test results are provided in the Mitchell field investigation report (Golder 2012).

A summary of estimated in situ stresses is presented in Table 5.1.

Table 5.1: Summary of In Situ Stress Values from Hydraulic Fracturing in Borehole M-11-122

Field Test No.	Depth (m)	Alteration[1]	σ_{HMax} (MPa)	σ_{HMin} (MPa)	σ_v[2] (MPa)	Tensile Strength[3] (MPa)	Pore Pressure[4] (MPa)
7	158.0	QSP	19.5	8.6	4.4	11.2	1.6
6	384.5	CL-PR	47.2	20.5	10.7	11.6	3.8
5	442.0	CL-PR	34.8	16.0	12.3	13.3	4.5
4	511.0	CL-PR	37.7	16.5	14.2	13.1	5.2
3	570.9	CL-PR	39.3	19.5	15.9	12.1	5.8
2	604.4	CL-PR	30.3	15.0	16.8	12.4	6.1
1	608.9	CL-PR	37.9	20.3	16.9	10.9	6.1

Notes:

1) Alteration types were provided by Seabridge.

2) Vertical stress was calculated based on the average overburden thickness over the test interval using an estimated density of 2781 kg/m^3.

3) Determined from laboratory testing.

4) Pore pressure was calculated based on the column of water at each test interval depth.

Hydraulic fractures were identified in three intervals using impression packers. The orientations of these hydraulic fractures are summarized in Table 5.2.

Table 5.2: Summary of Fracture Orientation in Borehole M-11-122

Field Test No.	Fracture Depth (m)	Alteration[1]	Fracture Configuration	
			Strike Orientation[2] (°)	Dip (°)
7	157.6	QSP	26	75
7	158.2	QSP	20	80
7	158.4	QSP	33	47
5	442.1	CL-PR	29	81
5	442.3	CL-PR	20	76
4	510.7	CL-PR	36	69
4	510.8	CL-PR	48	63

Notes:

1) Alteration types were provided by Seabridge.

2) Fracture orientations are referenced to true north.

Hydraulic fracture orientations suggest that principal stresses are oriented approximately vertical and horizontal and calculations were carried out based on this assumption for all intervals in the borehole. Although it is considered unlikely, in some cases stress orientations may vary in discrete areas as a result of geological influences such as faults. If that is the case here, some of the estimates of stress magnitudes presented above may be unreliable.

Note that these tests were carried out to estimate the in-situ stresses at the Mitchell deposit and were therefore carried out in a borehole located in the valley floor. It is likely that stresses at the Iron Cap will be affected by the topography (i.e., Iron Cap mineralization is located on the mountainside rather than in a valley) and that stresses may be somewhat less concentrated than in the case of the Mitchell deposit.

6.0 ESTIMATE OF IN SITU BLOCK SIZE

6.1 Discrete Fracture Network Modelling

A Discrete Fracture Network (DFN) model was developed from the structural information collected on site using the proprietary Golder DFN code FracMan. Detailed methodology and results are shown in Appendix E. The model provides a depiction of the structural features within the rock mass developed from a combination of larger deterministic structures mapped in outcrops and smaller stochastically-inferred fractures. The model depicts both the geometry and connectivity of the fracture network, and provides a representation of the geometry of the associated intact rock blocks. Monte Carlo simulations were used in a stochastic process to create multiple but equi-probable realisations of the structural features.

Input parameters used to develop the DFN model included the following:

- Fracture orientations;
- Fracture intensities; and
- Fracture persistence distributions.

Fracture termination information (i.e., one fracture set preferentially terminating against another fracture set) is also an important parameter which influences block forming potential. No conclusive data were collected on this at site and therefore it was not considered as part of the current analyses.

An underlying spatial model was used that incorporates different distribution laws to simulate fracture orientation and location. The Enhanced Baecher spatial model was used in the current analyses, according to which fracture centres are randomly located in space using a Poisson process.

6.2 DFN Model Input

6.2.1 Fracture Orientation

Fracture data used in the DFN model for the Iron Cap deposit were based on core logging data from boreholes IC-10-014, IC-10-015, and IC-10-016. A comparison of fracture orientations from core logging data and fracture orientations in the DFN model are shown in Figure 6.1.

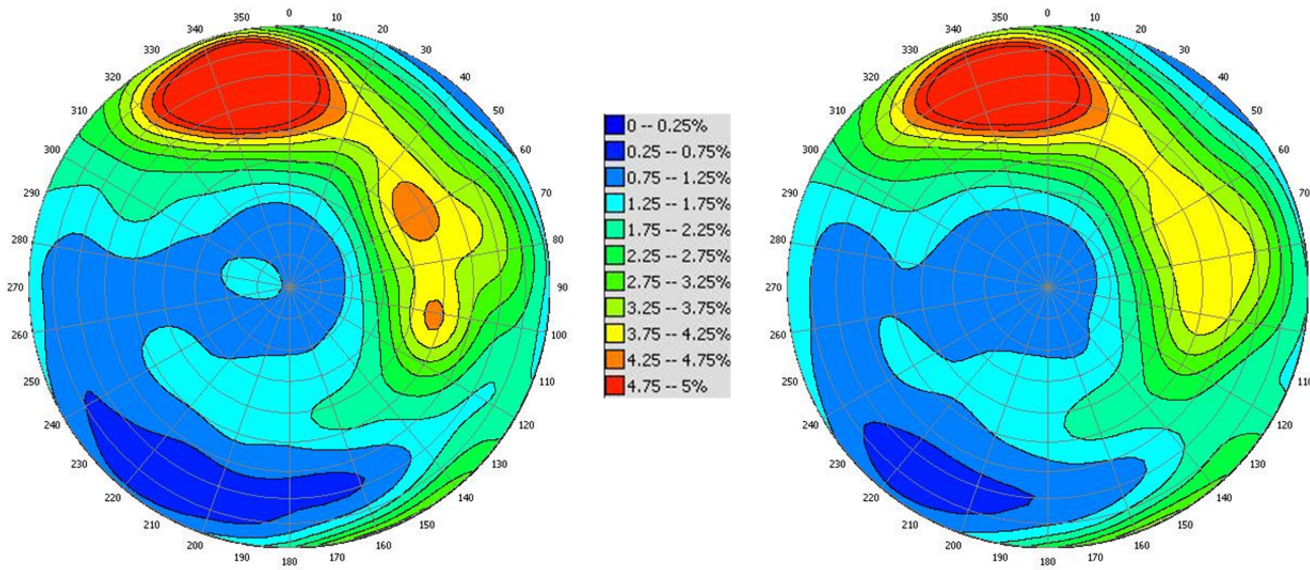


Figure 6.1: Stereographic projections of mapped (left) and simulated (right) fracture orientations

6.2.2 Fracture Intensity

The fracture intensity input to the model was obtained from the fracture frequency information in the geotechnical logs (expressed as number of fractures per metre). The methodology adopted to estimate the fracture intensity was as follows:

- Cumulative Fracture Intensity (CFI) plots were initially generated to establish variation of linear fracture frequency with depth (Appendix F).
- A correction was applied to the fracture frequency data as part of the conversion from linear intensity to volumetric intensity to account for the fracture frequency being defined relative to a borehole or scanline trajectory, which may introduce sampling biases.

6.2.3 Fracture Persistence

No mapped fracture persistence data was available for the Iron Cap deposit, therefore the same size distribution as the one estimated for the Mitchell deposit was assumed in the model. The fracture persistence for the Mitchell deposit corresponds to an exponential distribution for fracture radius (mean of 2 m), which it was shown to yield a good agreement between the simulated and the mapped fracture persistence data.

6.3 DFN Model Results

The DFN model was used to estimate the distribution of in-situ block sizes in the rock mass using an algorithm that defines all fracture intersections. This was then used to identify fully formed blocks. The in-situ block size analyses were carried out for a volume with dimensions 5 x 5 x 5 m.

The estimated distribution of volumetric block sizes is shown in Figure 6.2. This curve represents the "weighted" average taking into account the varying fracture intensity indicated for the various Iron Cap boreholes. The block volume size equivalent to 50% passing was estimated at 2.5 m^3.

Note that the in-situ block sizes determined from the DFN analyses refer to the three-dimensional blocks that are fully formed by existing fractures in the simulated rock mass (i.e., the assessment does not consider blocks that may almost completely form, say 99% formed by non-persistent fractures, and it does not consider the impact of any stress induced fractures that may form during the caving process).

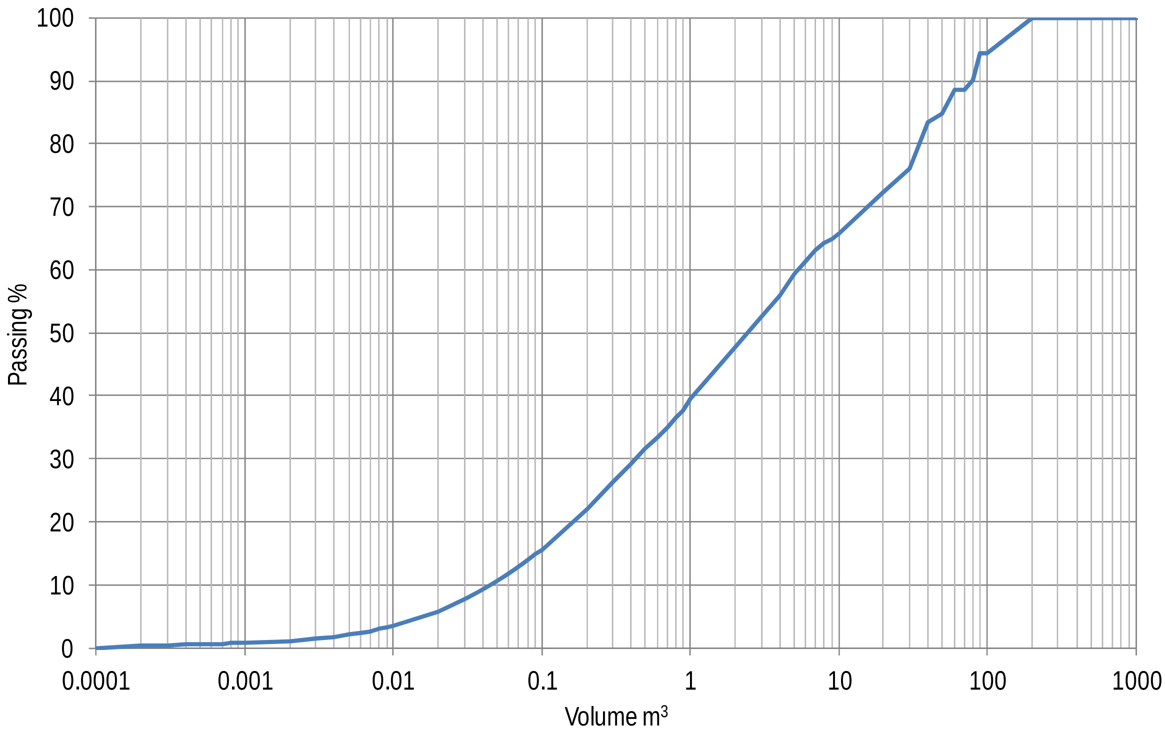


Figure 6.2: Block size percent passing averaged curve estimated for the Iron Cap deposit

7.0 HYDROGEOLOGICAL CHARACTERIZATION

Hydrogeological testing was conducted at Iron Cap as part of the Open Pit Slope Design PFS (BGC 2011). Based on the test results, the hydraulic conductivity of the bedrock was found to decrease with depth from a maximum of 3 x 10^{-6} m/s to a minimum of 8 x 10^{-9} m/s, although values varied by up to two orders of magnitude at any given depth. Detailed hydrogeological test results are available in BGC's report (BGC 2011).

8.0 DISCUSSION

The Iron Cap deposit appears to be comprised of strong, moderately fractured rock. Rock quality variations are most commonly attributed to variations in fracture frequency as the strength of the rock mass does not vary significantly within the deposit.

The fracture frequency is higher for Iron Cap than the nearby Mitchell deposit resulting in a corresponding lower predicted median in-situ block size of 2.5 m^3, compared to approximately 6 m^3 for the Mitchell deposit.

There are several gaps in data that have been identified in the geotechnical and hydrogeological studies. These gaps will need to be addressed as part of future studies when the project is advanced to the next level of study. These gaps include the following:

- There are only three geotechnical holes in the Iron Cap deposit and one of these three holes suggests significantly more fractured rock than the other two. With only three holes, there are insufficient data to confidently determine which of the existing holes most accurately represent the characteristics of the rock mass. For the current level of study, average properties from the three holes have been used in the assessment. Future studies will need to include additional geotechnical drilling data to obtain a better spatial understanding of the fracture intensity in the deposit.
- Geotechnical logging at Iron Cap to date has focused on collecting information relevant to open pit design. Future logging should include collecting data tailored to assessing the caving geomechanics of the deposit (i.e., rock fabric, microdefects, etc.).
- To date no geotechnical mapping has been undertaken that is directly relevant to the Iron Cap deposit. Assumptions regarding fracture persistence have been based on limited mapping data in the area of the Mitchell deposit. Where possible, geotechnical mapping of relevant rock exposures in the area of the Iron Cap deposit should be carried out as part of future studies.
- There have been no fracture propagation assessments applicable to preconditioning designs or in-situ stress interpretations developed at the Iron Cap deposit. Measurements carried out in the Mitchell deposit may not accurately reflect the fracture propagation and stress environment at Iron Cap because of the influence of surface topography. Future drilling programs should include hydraulic fracturing tests.

After this data collection is complete, more sophisticated numerical analysis studies should be undertaken to evaluate design aspects of the block cave (e.g., likelihood of stress-related fracturing, magnitude of abutment stresses, etc.).

9.0 CLOSURE

We trust this report meets your current needs. If you have any questions, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Karen Moffitt, P.Eng.
Associate, Senior Geotechnical Engineer

ORIGINAL SIGNED

Ross Hammett, P.Eng.
Principal, Senior Civil/Mining Engineer

KMM/RDH/md

o:\final\2011\1439\11-1439-0002\1114390002-006-r-rev0\1114390002-006-r-rev0-iron cap geotechnical characterization 13dec_12.docx

REFERENCES

Barton, N., R. Lien and J. Lunde. 1974. *Engineering Classification of Rock Masses for Design of Tunnel Support.* Rock Mechanics, 6, p. 189-236.

BGC (Bruce Geotechnical Consultants). 2011. *KSM Project Pre-Feasibility Study Update: Iron Cap Zone Open Pit Slope Design - FINAL.* Prepared for Seabridge Gold Inc. Submitted June 15, 2011.

Bieniawski, Z.T. 1976. *Rock Mass Classification in Rock Engineering*. In: Exploration for Rock Engineering, Proceeding of the Symposium (Edited by Bieniawski, Z.T.) 1, 97-10. Cape Town, Balkema.

Deere, D.U., A.J. Hendron, F.D. Patton and E.J. Cording. 1967. *Design of surface and near surface construction in rock*. In Failure and breakage of rock, proc. 8th U.S. symp. rock mech., (ed. C. Fairhurst), 237-302. New York: Soc. Min. Engrs, Am. Inst. Min. Metall. Petrolm Engrs.

Golder Associates Ltd. 2012. *2011 Geotechnical and Hydrogeological Field Investigations, Mitchell Project.* Prepared for Seabridge Gold Inc. Submitted February 15, 2012.

ISRM (International Society of Rock Mechanics). 1981. *Rock Characterization, Testing and Monitoring.* In: Brown, E.T., ISRM Suggested Methods. Pergamon Press. Oxford, p. 211.

Seabridge. 2011. Kerr-Sulphurets-Mitchell (KSM) *Prefeasibility Study Update,* NI43-101 Report.

Wardrop. 2010. *Kerr-Sulphurets-Mitchell (KSM) Prefeasibility Study*. Prepared for Seabridge Gold Inc. Submitted March 31, 2010.

APPENDIX A

RMR_{76} Classification Criteria and Example Core Photographs

Table A-1: Rock Mass Rating (RMR_{76}) System

	Parameter		Ranges of Values						
1	Strength of intact rock material	Point load strength index	> 8 MPa	4-8 MPa	2-4 MPa	1-2 MPa	For this low range uniaxial		
		Uniaxial compressive strength	> 200 MPa	100-200 MPa	50-100 MPa	25-50 MPa	10-25 MPa	3-10 MPa	1-3 MPa
	Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% - 100%	75% - 90%	50% - 75%	25% - 50%	<25%		
	Rating		20	17	13	8	3		
3	Spacing of joints		>3 m	1-3 m	0.3 – 1 m	50 – 300 mm	<50 mm		
	Rating		30	25	20	10	5		
4	Condition of joints		Very rough surfaces Not continuous No Separation Hard joint wall rock	Slightly rough surfaces Separation <1 mm Hard joint wall rock	Slightly rough surfaces Separation <1 mm Soft joint wall rock	Slickensided surfaces OR Gouge <5 mm thick OR joint	Soft gouge >5 mm thick OR Joints open >5 mm continuous joints		
	Rating		25	20	12	6	0		
5	Groundwater	Inflow per 10 m per tunnel length	None		<25 litres / min	25-125 litres / min	>125 litres / min		
		Raito joint water pressure / major principal stress	0		0.0 – 0.2	0.2 – 0.5	>0.5		
		General conditions	Completely dry		Moist only (interstitial water)	Water under moderate pressure	Server water problems		
	Rating		10		7	4	0		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

VERY POOR ROCK (RMR = 0-20)

M-11-125*: 705.07 – 705.58 m

* Note: there are no examples of very poor rock in Iron Cap geotechnical boreholes

POOR ROCK (RMR = 20-40)

IC-10-014: 65.05 – 68.15 m

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
EXAMPLE CORE PHOTOGRAPHS OF VERY POOR AND POOR ROCK

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	MV	10FEB12	SCALE NTS	REV. --
CADD	MV	10FEB12	**FIGURE A-1**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

FAIR ROCK (RMR = 40-60)

IC-10-014: 224.15 – 225.65 m

GOOD ROCK (RMR = 60-80)

IC-10-016: 120.40 – 122.70 m

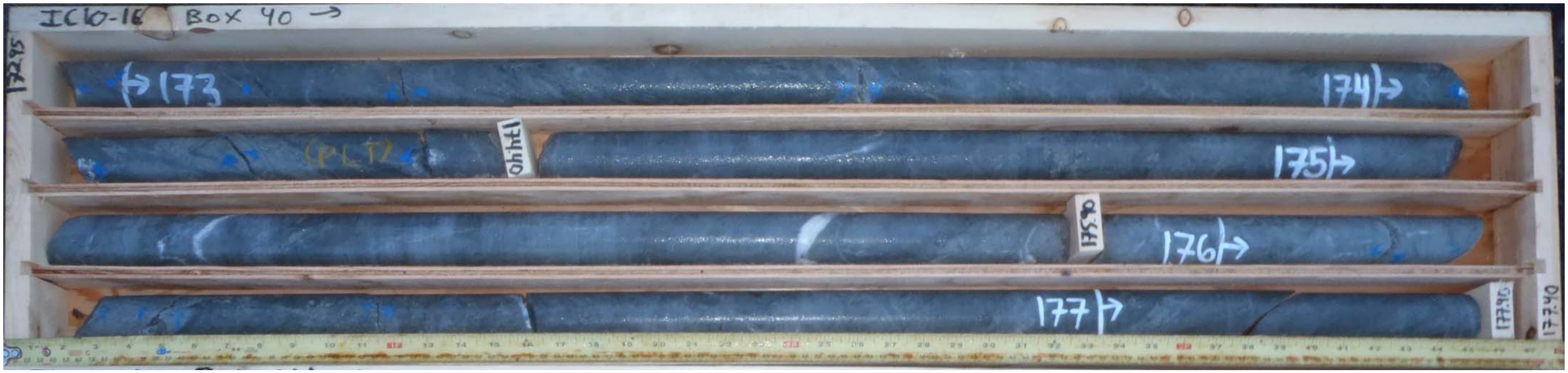
PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	EXAMPLE CORE PHOTOGRAPHS OF FAIR AND GOOD ROCK

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	MV	10FEB12	SCALE NTS	REV.--
CADD	MV	10FEB12	FIGURE A-2	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

VERY GOOD ROCK (RMR = 80-100)

IC-10-016: 172.95 – 177.40 m



PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	EXAMPLE CORE PHOTOGRAPH OF VERY GOOD ROCK

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	MV	10FEB12	SCALE NTS REV.--
CADD	MV	10FEB12	FIGURE A-3
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

APPENDIX B

Cross Sections Showing Logged and Correlated RMR

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

PROJECT	
	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA

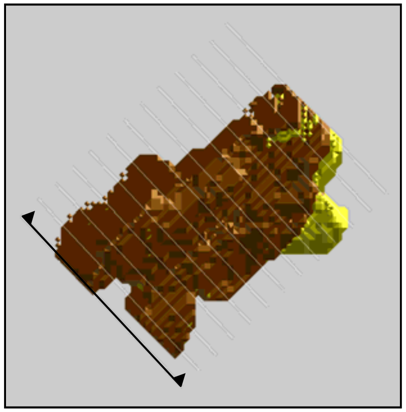
TITLE

IRON CAP – CROSS SECTION LOCATIONS

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	CY	14NOV11	SCALE NTS	REV. --
CADD	CY	14NOV11	FIGURE B-1	
CHECK	KMM			
REVIEW	RDH			

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

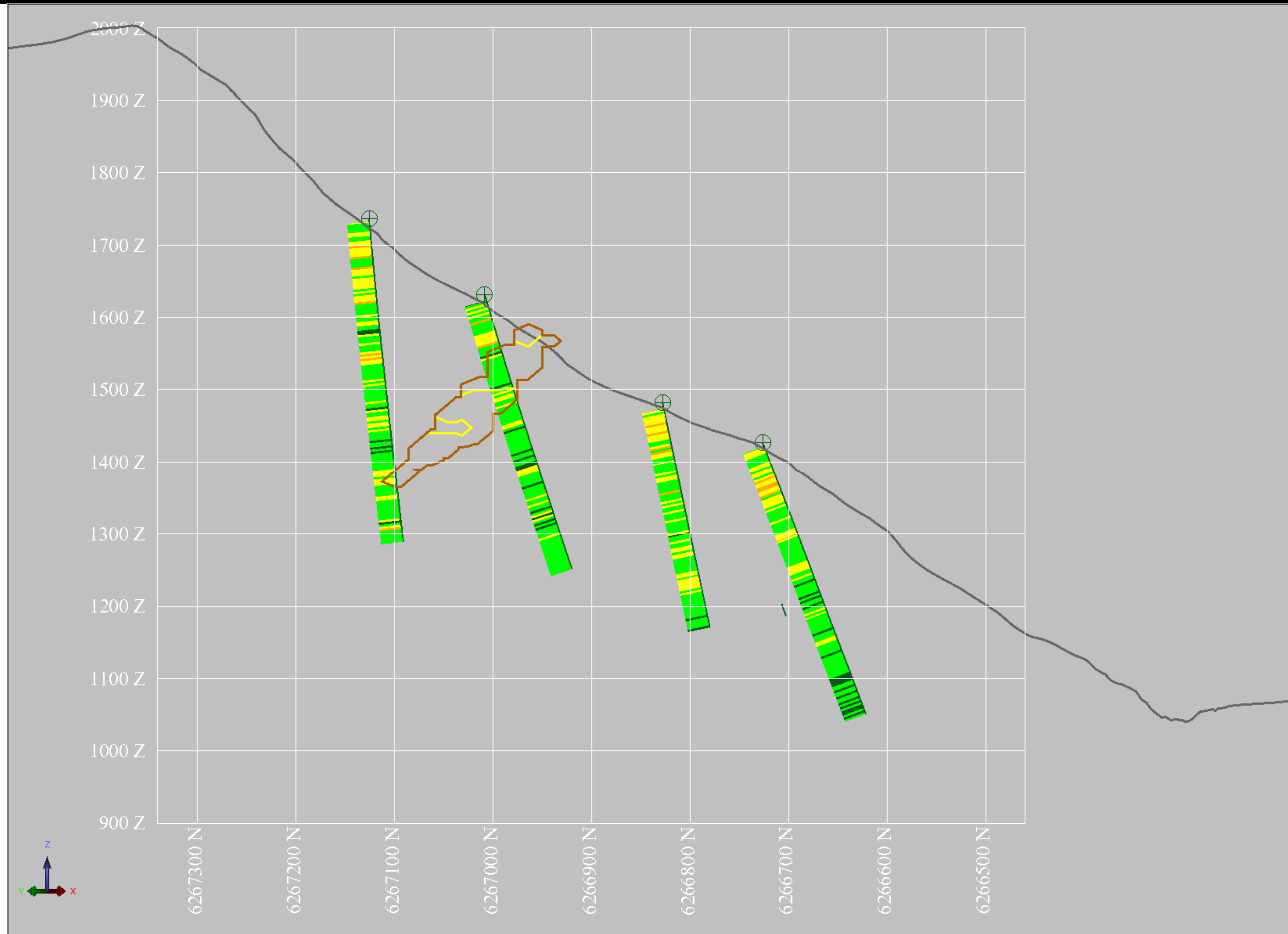


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

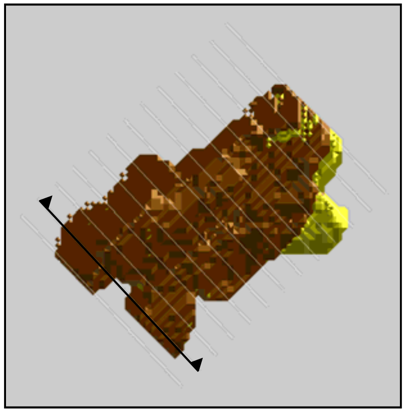
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 01
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	17NOV11	SCALE --	REV. --
CADD	CY	17NOV11	FIGURE B-2	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

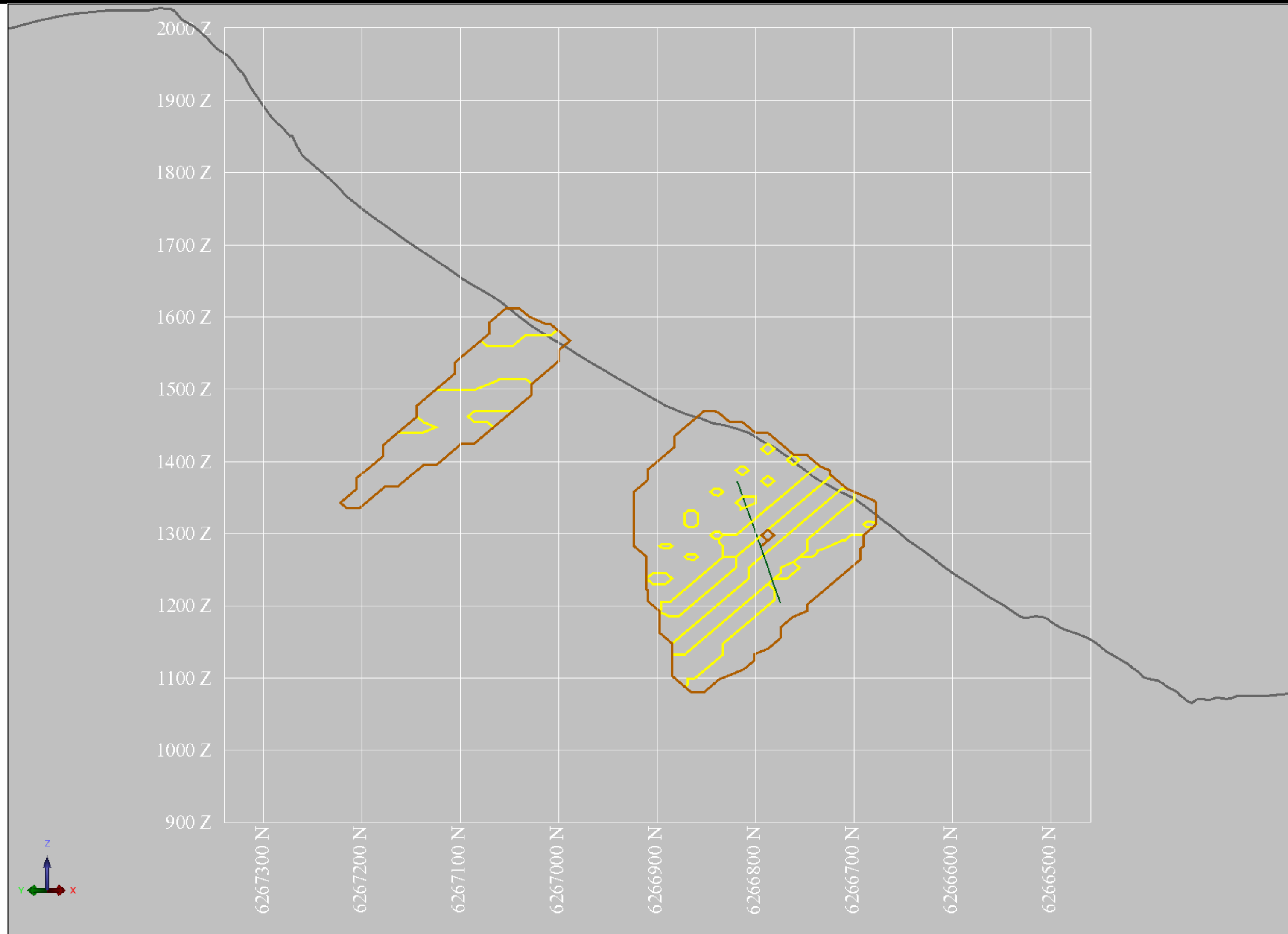


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 02
CORRELATED RMR AND LOGGED RMR

Golder Associates

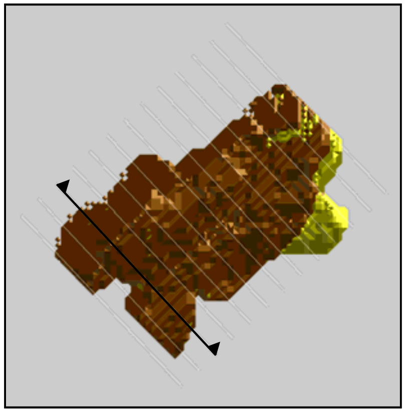
PROJECT No.11-1439-0002		
DESIGN	CY	17NOV11
CADD	CY	17NOV11
CHECK	KMM	15FEB12
REVIEW	RDH	15FEB12

PHASE No. 10000

SCALE -- REV.--

FIGURE B-3

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

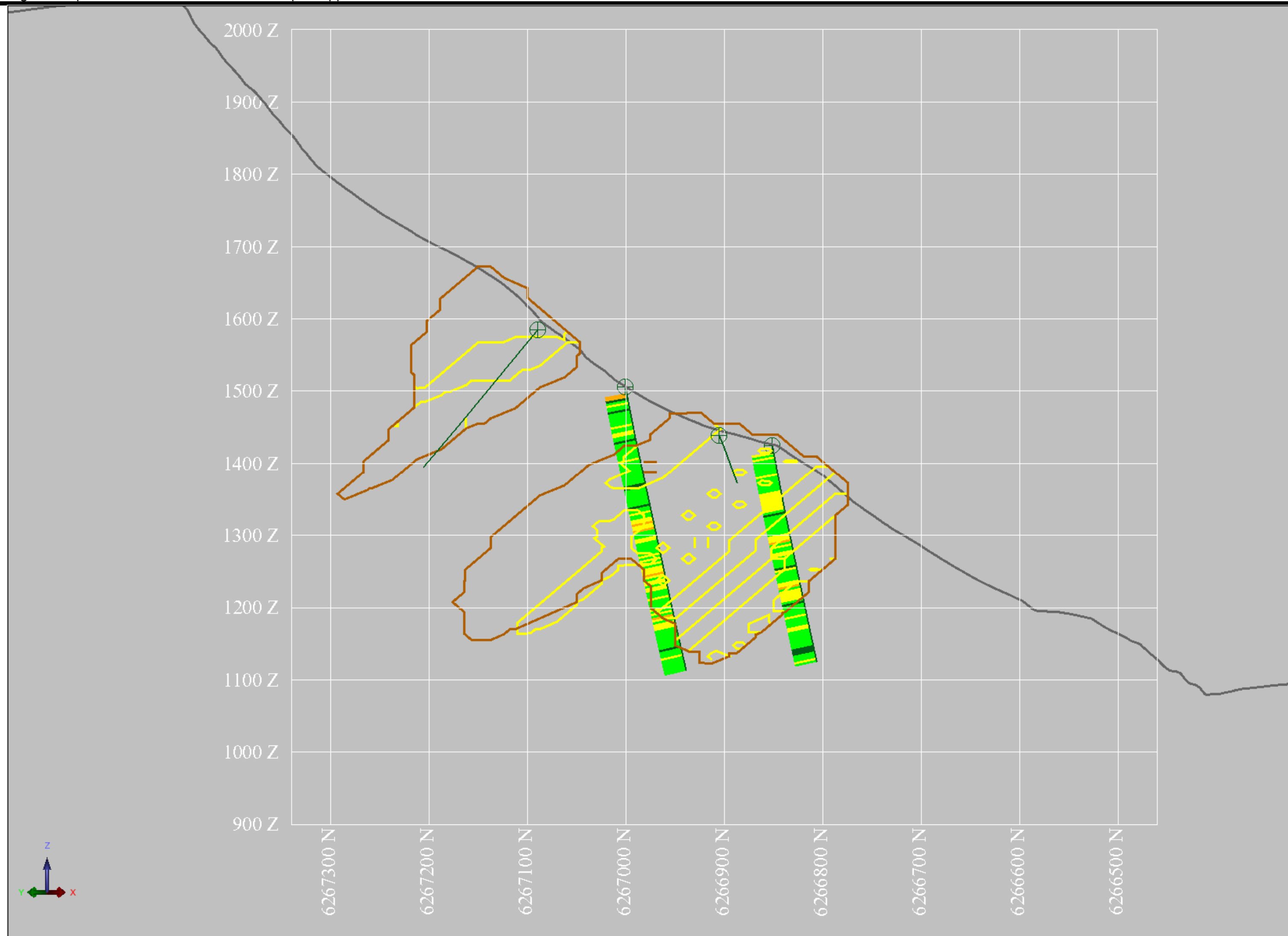


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT

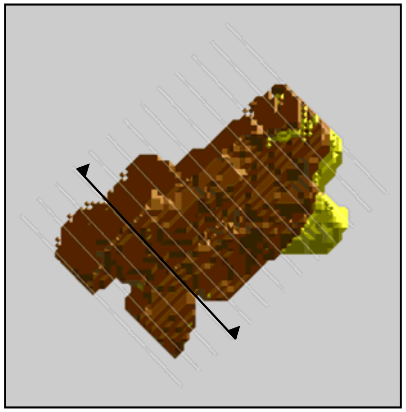
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

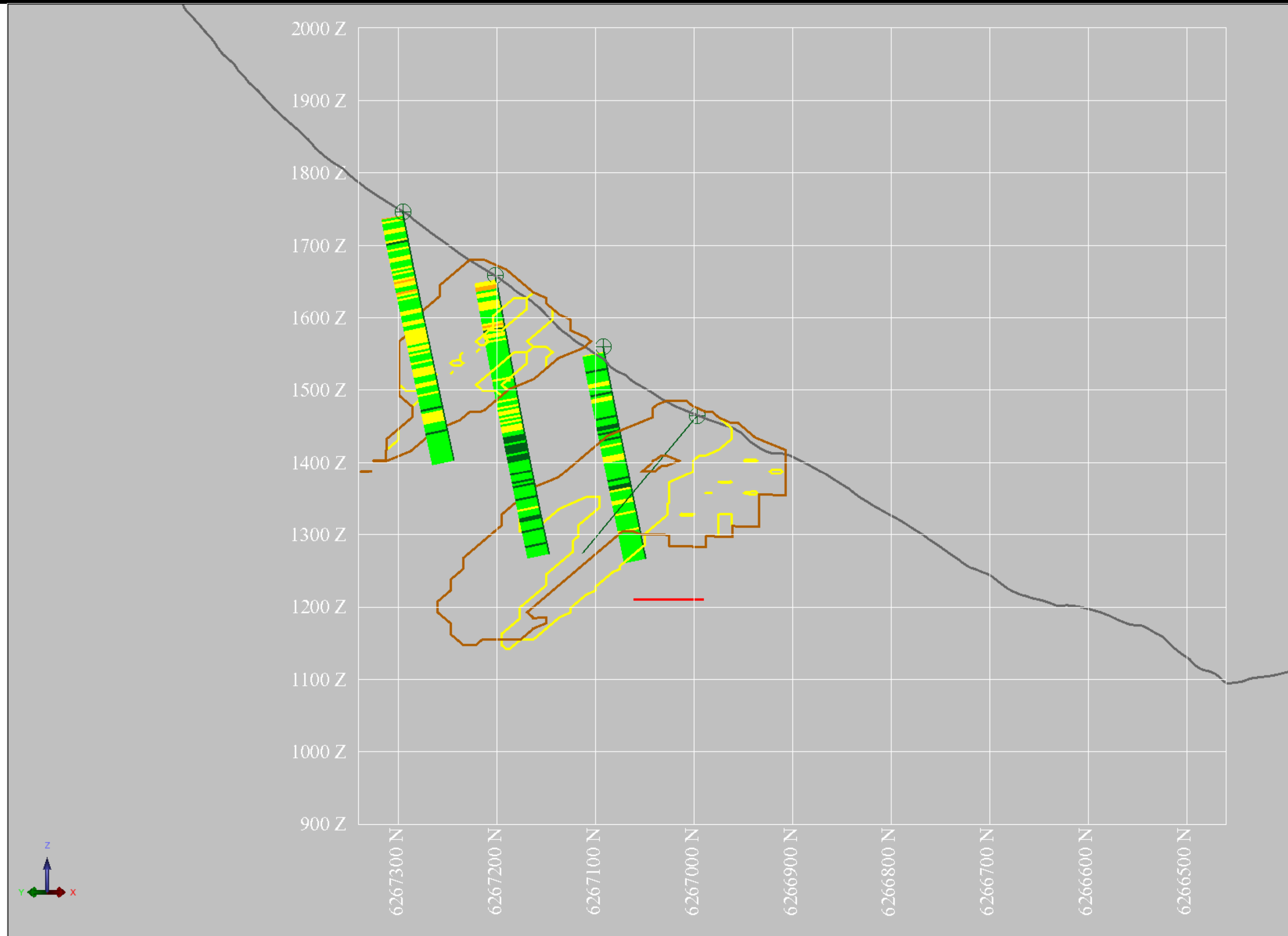
TITLE

IRON CAP – SECTION 03
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	17NOV11	SCALE --	REV.--
CADD	CY	17NOV11	FIGURE B-4	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

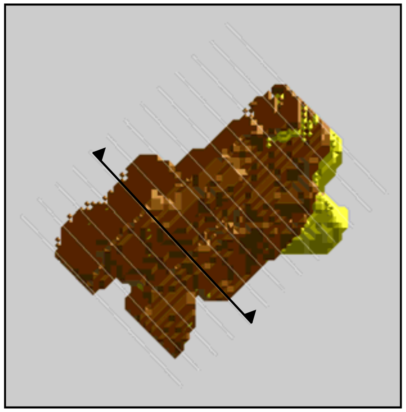
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 04
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	**FIGURE B-5**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

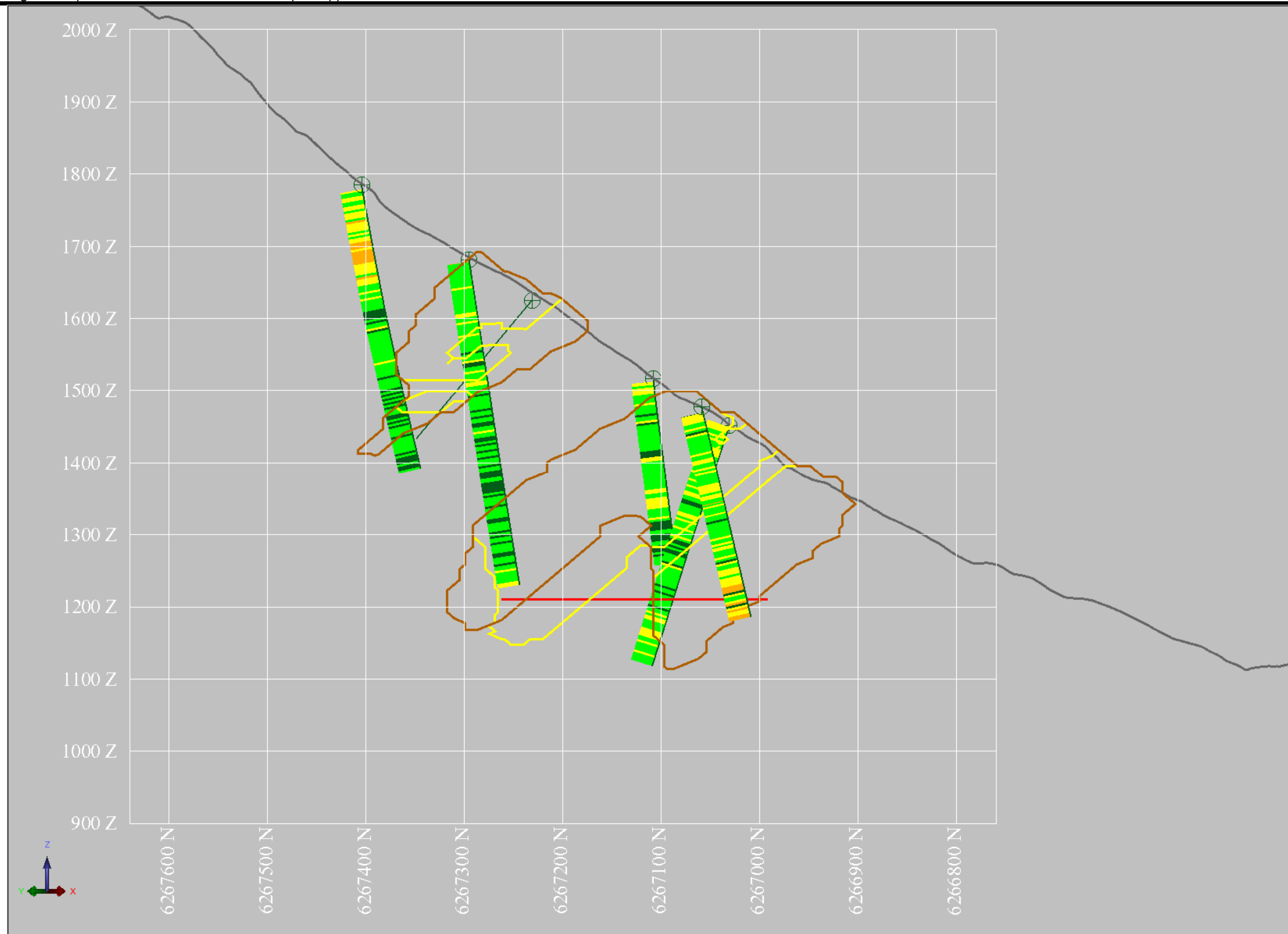


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT

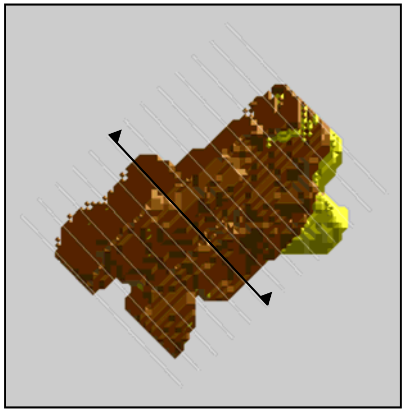
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 05
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	17NOV11	SCALE --	REV.--
CADD	CY	17NOV11	**FIGURE B-6**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

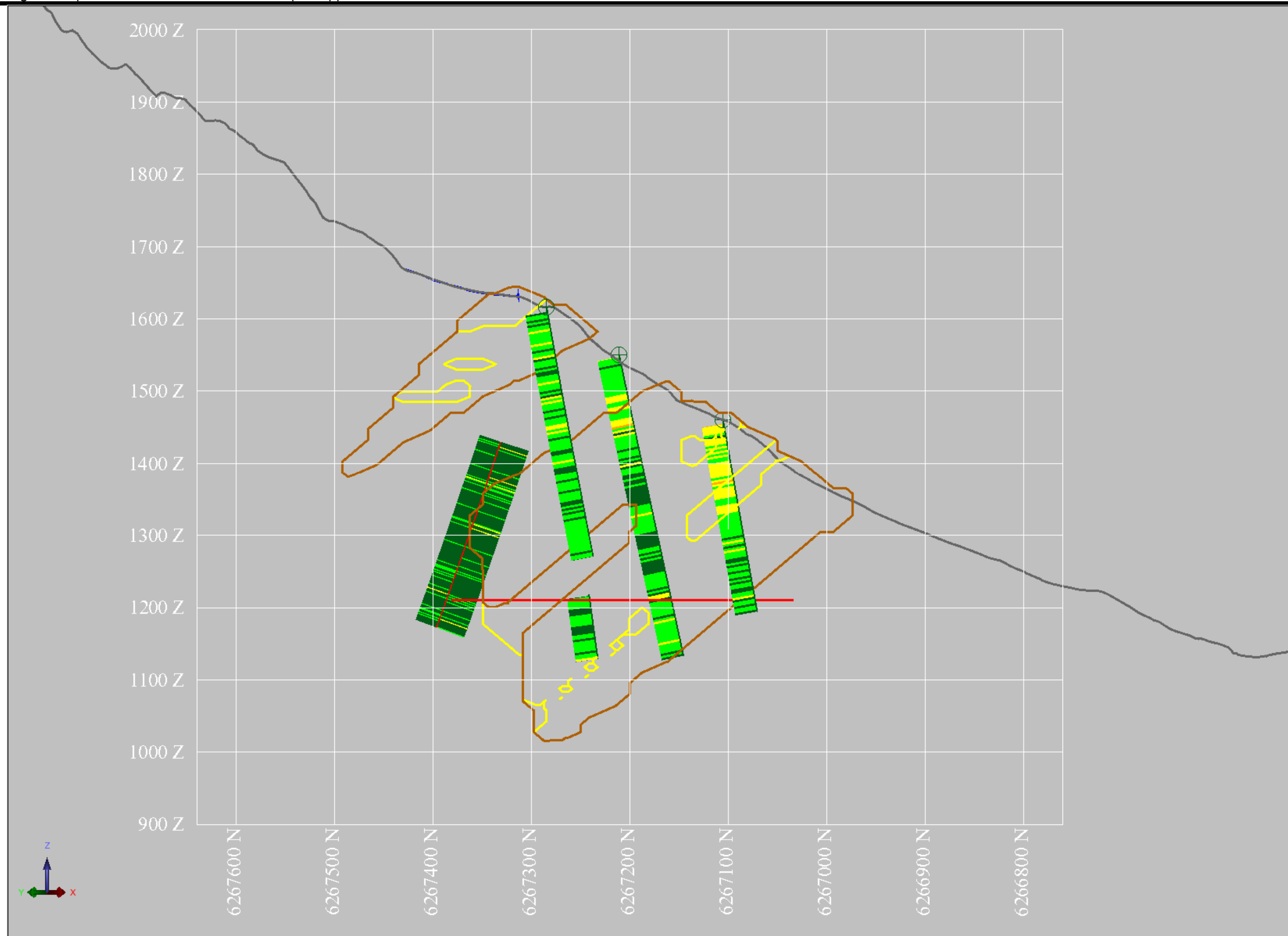


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

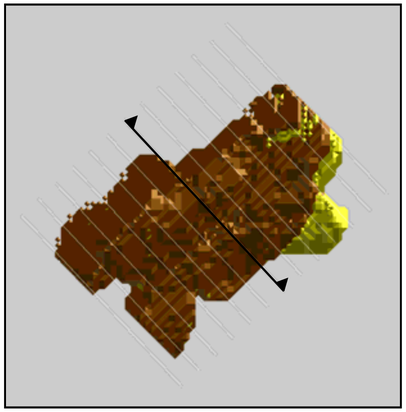
TITLE

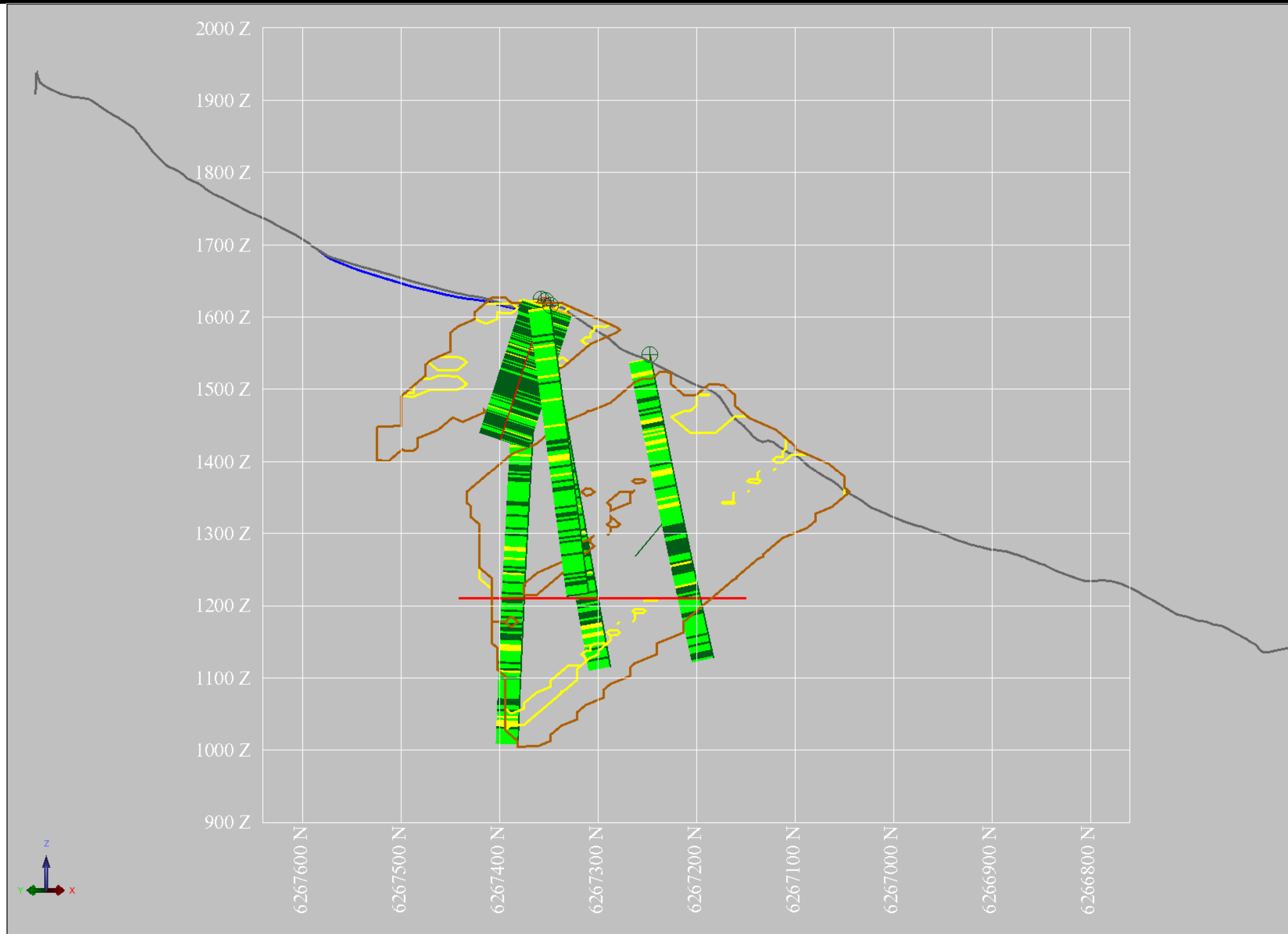
IRON CAP – SECTION 06
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	17NOV11	SCALE --	REV.--
CADD	CY	17NOV11	**FIGURE B-7**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

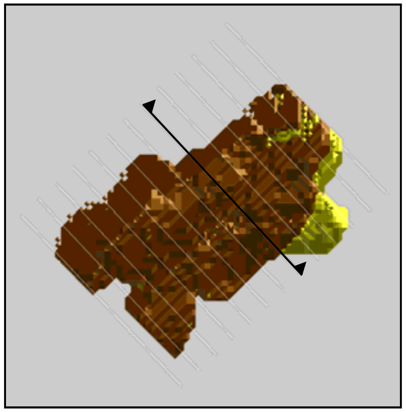
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

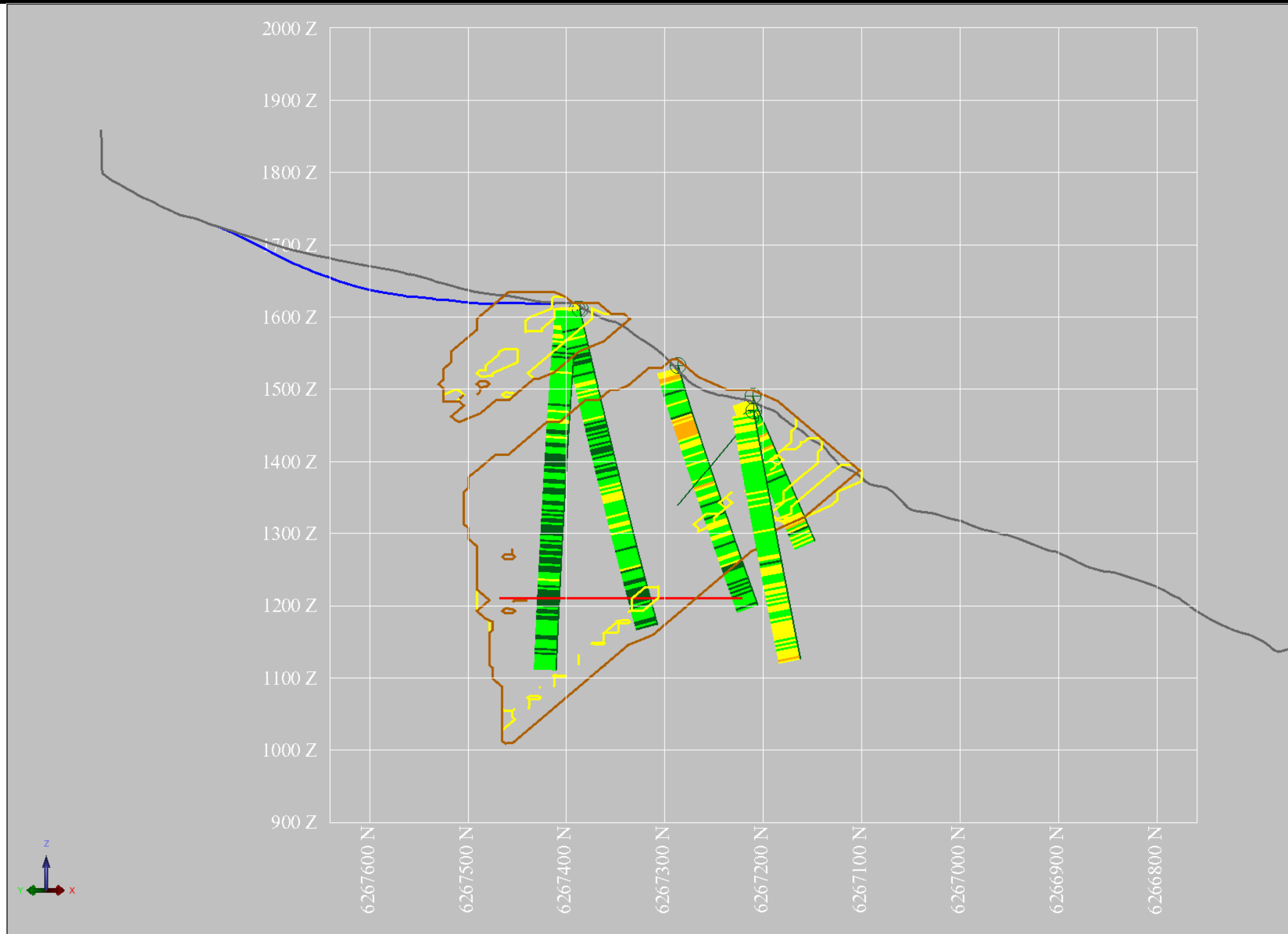
TITLE
IRON CAP – SECTION 07
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	**FIGURE B-8**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

RMR Correlated from RQD	
80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR	
80-100	20-40
60-80	0-20
40-60	

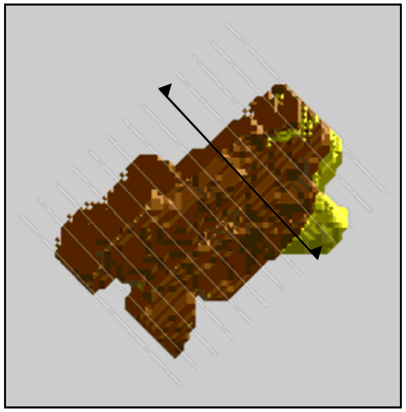
*Right of borehole, wide

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 08
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	**FIGURE B-9**
REVIEW	RDH	15FEB12	

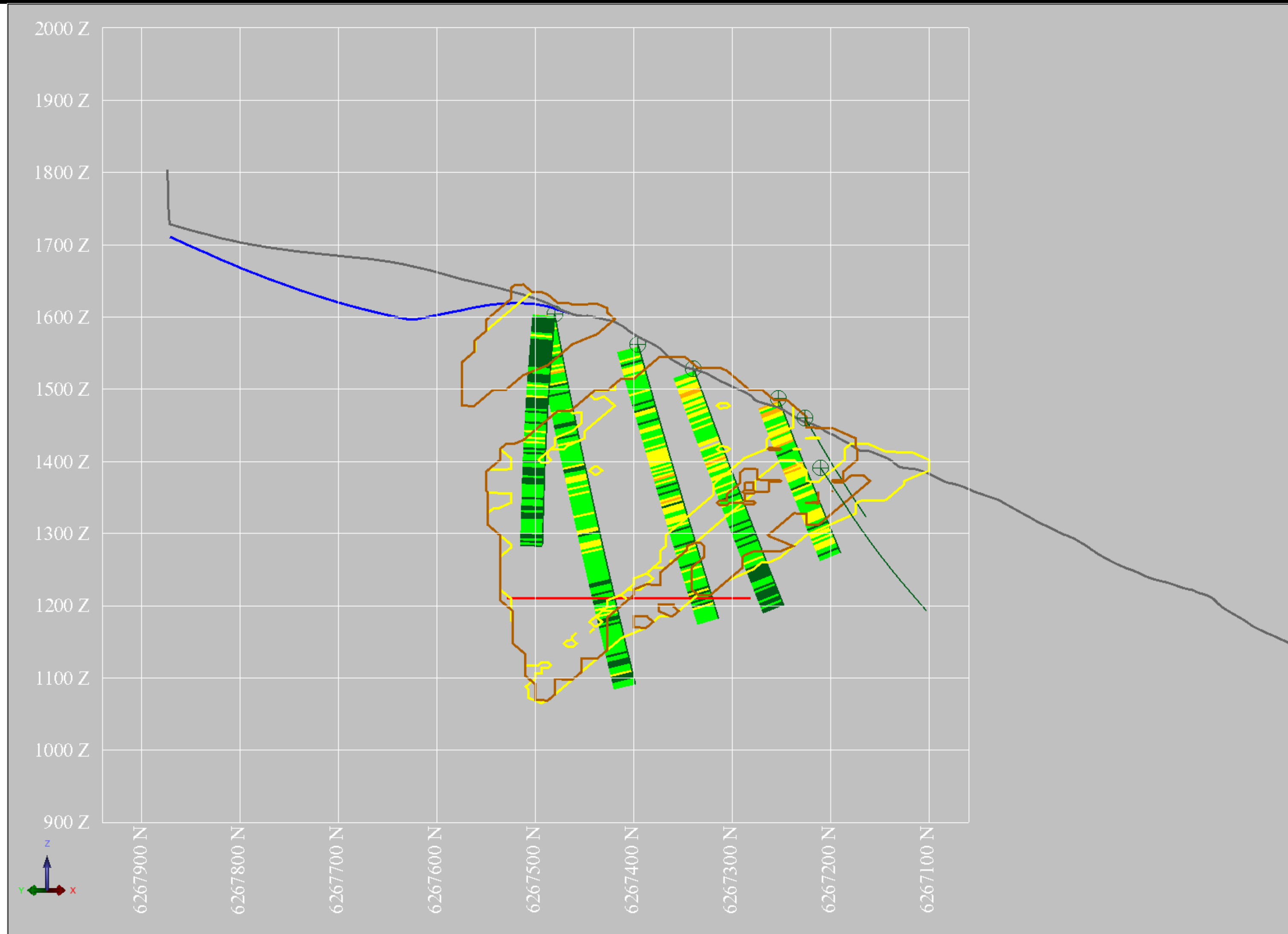


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

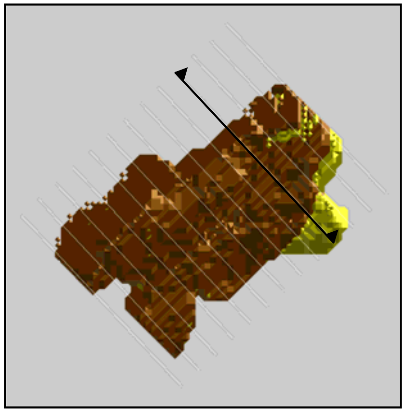
TITLE

IRON CAP – SECTION 09
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	FIGURE B-10
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

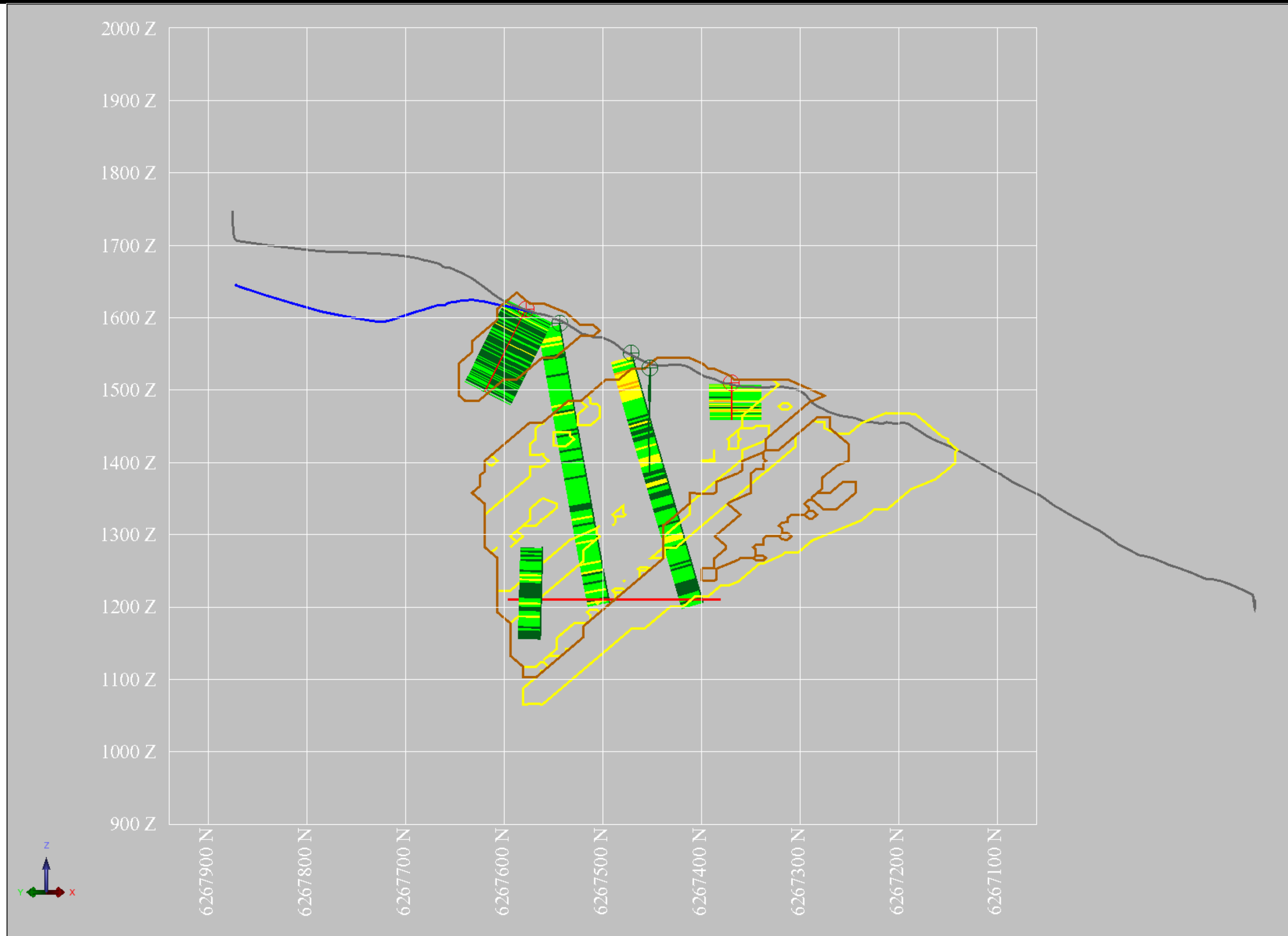


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

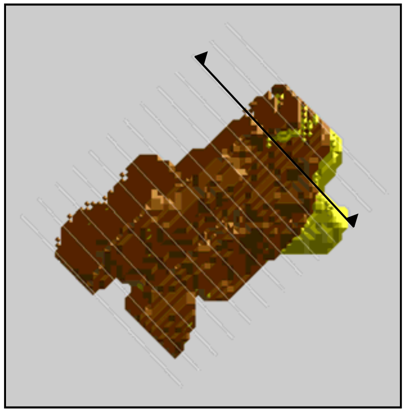
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 10
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	FIGURE B-11
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

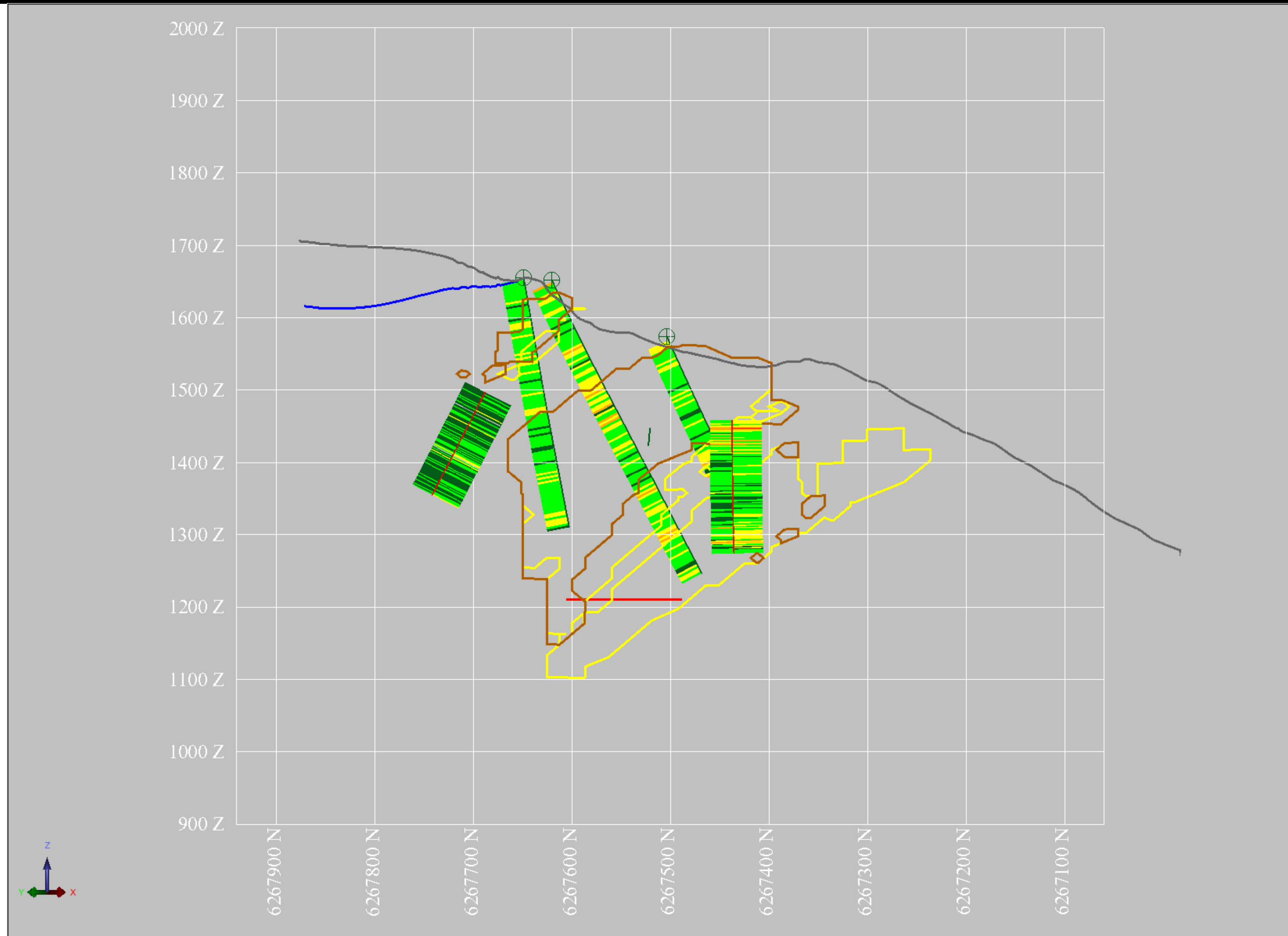


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

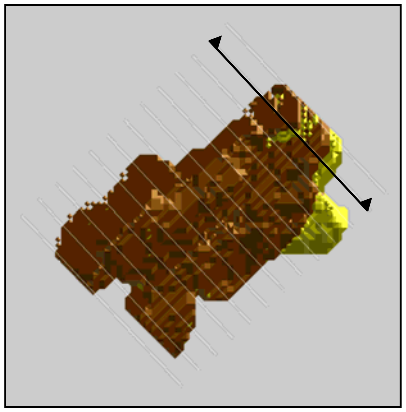
*Right of borehole, wide

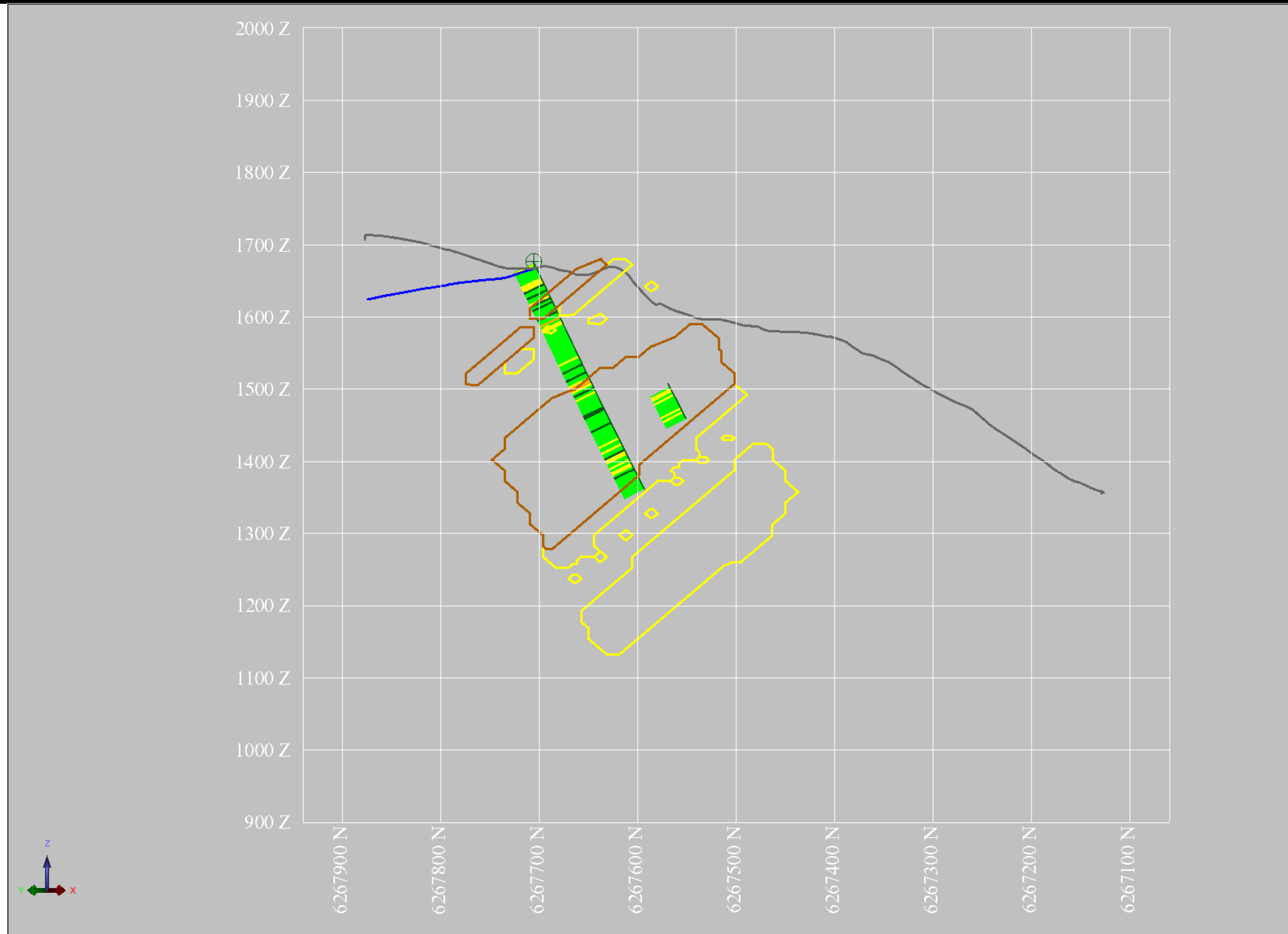
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 11
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	FIGURE B-12
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

RMR Correlated from RQD

- 80-100
- 60-80
- 40-60
- 20-40
- 0-20

*Left of borehole, narrow

Logged RMR

- 80-100
- 60-80
- 40-60
- 20-40
- 0-20

*Right of borehole, wide

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

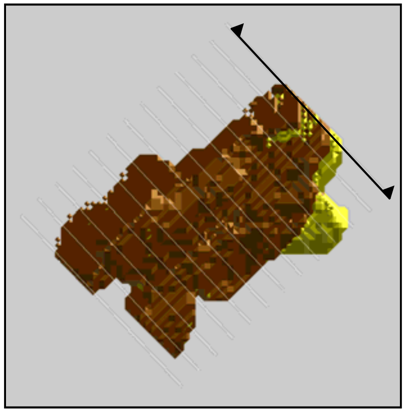
TITLE

IRON CAP – SECTION 12
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	**FIGURE B-13**
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

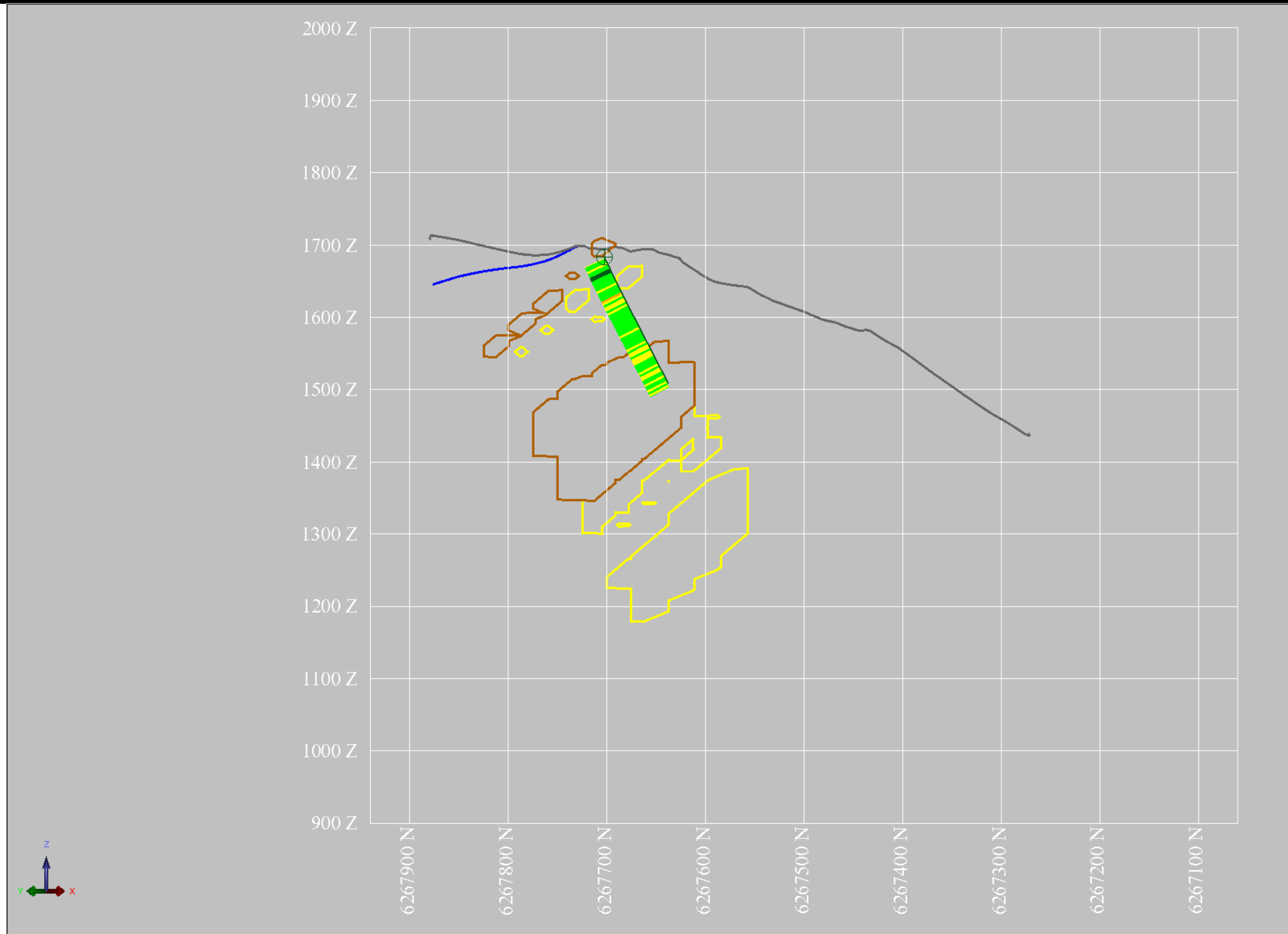


LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES



RMR Correlated from RQD

80-100	20-40
60-80	0-20
40-60	

*Left of borehole, narrow

Logged RMR

80-100	20-40
60-80	0-20
40-60	

*Right of borehole, wide

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

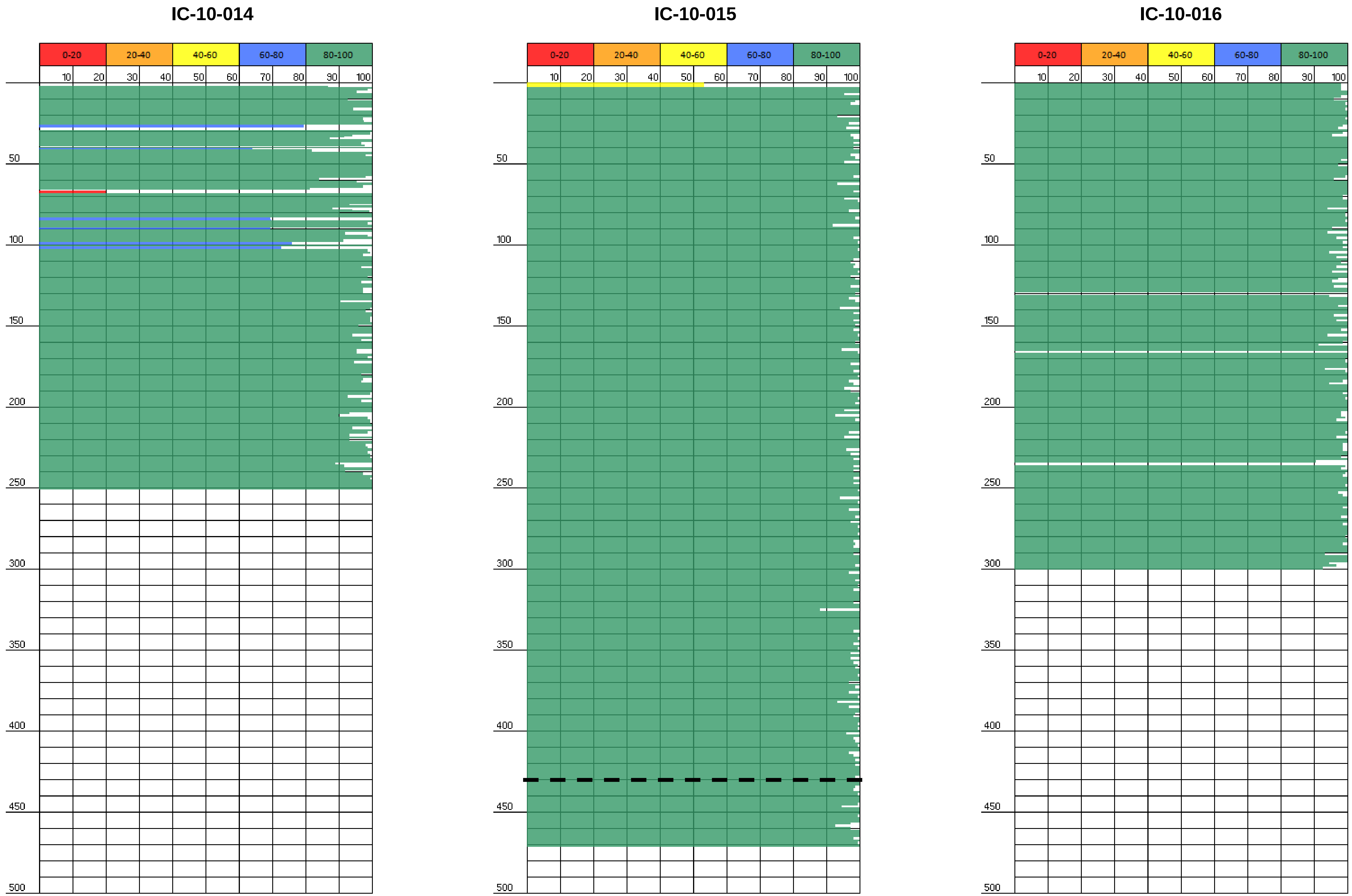
TITLE
IRON CAP – SECTION 13
CORRELATED RMR AND LOGGED RMR

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	17NOV11	SCALE -- REV.--
CADD	CY	17NOV11	**FIGURE B-14**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

APPENDIX C

Downhole Plots for Geotechnical Borehole Data



Proposed block cave extraction level footprint

Note: IC-10-014 and IC-10-016 do not intersect the extraction level footprint

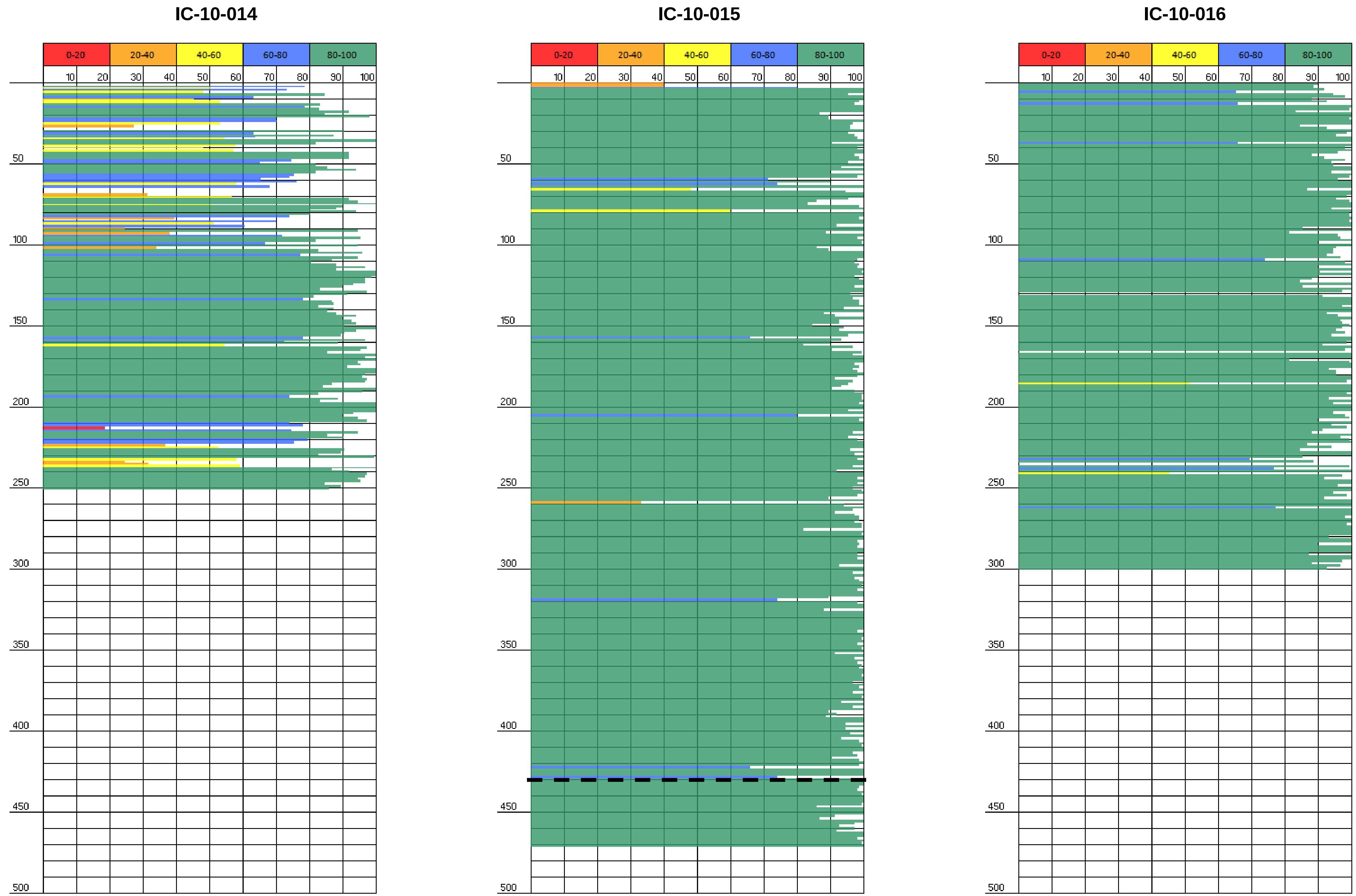
FILE: O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
DOWNHOLE PLOT
TOTAL CORE RECOVERY (%)

Golder Associates

PROJECT No.	11-1439-0002		PHASE / TASK No.	10000
DESIGN	MV	26SEP11	SCALE AS SHOWN	REV.
CADD	JC	26SEP11	FIGURE C-1	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		



- - - - Proposed block cave extraction level footprint

Note: IC-10-014 and IC-10-016 do not intersect the extraction level footprint

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

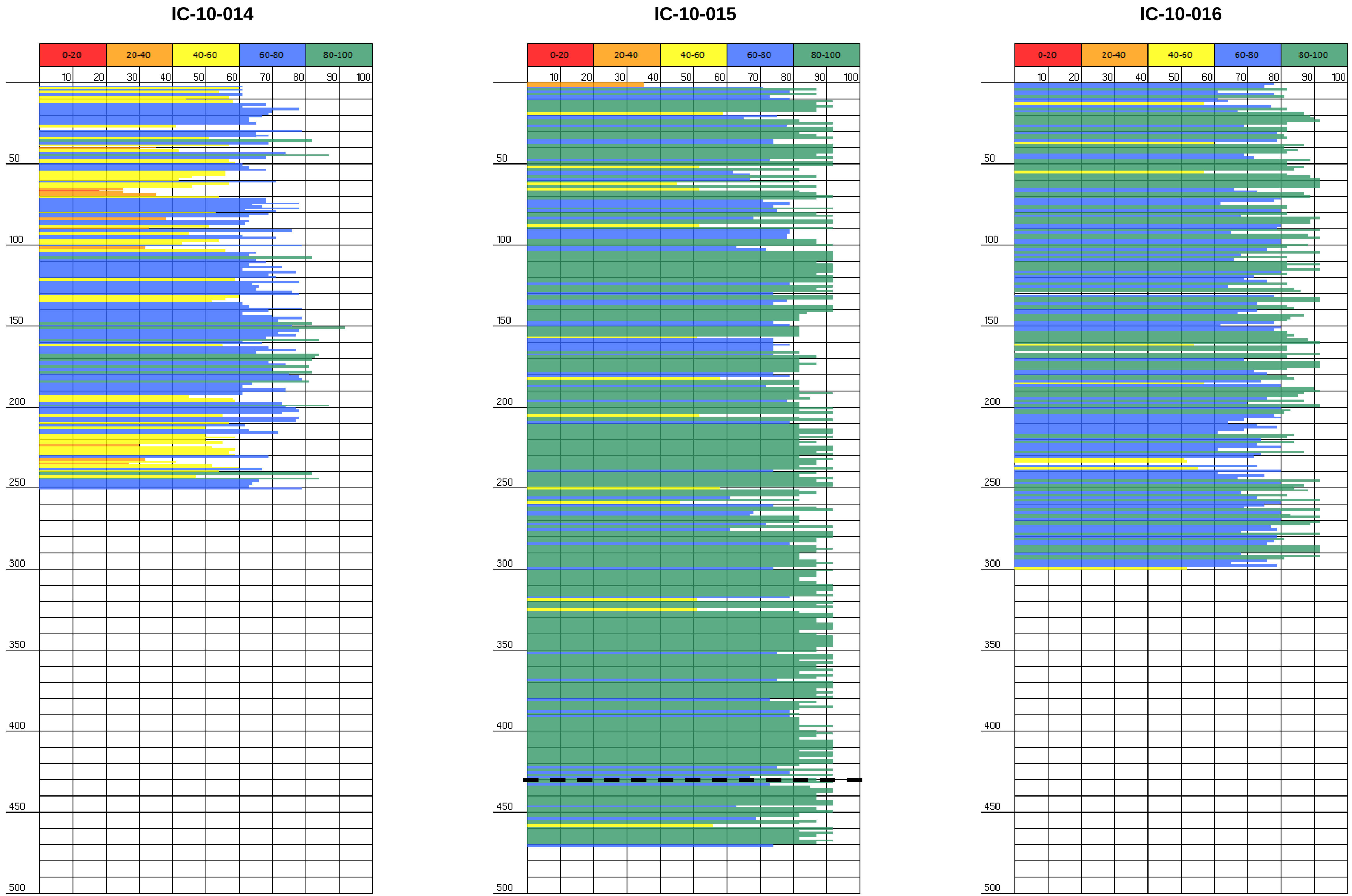
TITLE

DOWNHOLE PLOT
RQD (%)

Golder Associates

PROJECT No.		11-1439-0002	PHASE / TASK No. 10000
DESIGN	MV	26SEP11	SCALE AS SHOWN / REV.
CADD	JC	26SEP11	
CHECK	KMM	15FEB12	**FIGURE C-2**
REVIEW	RDH	15FEB12	

FILE: O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

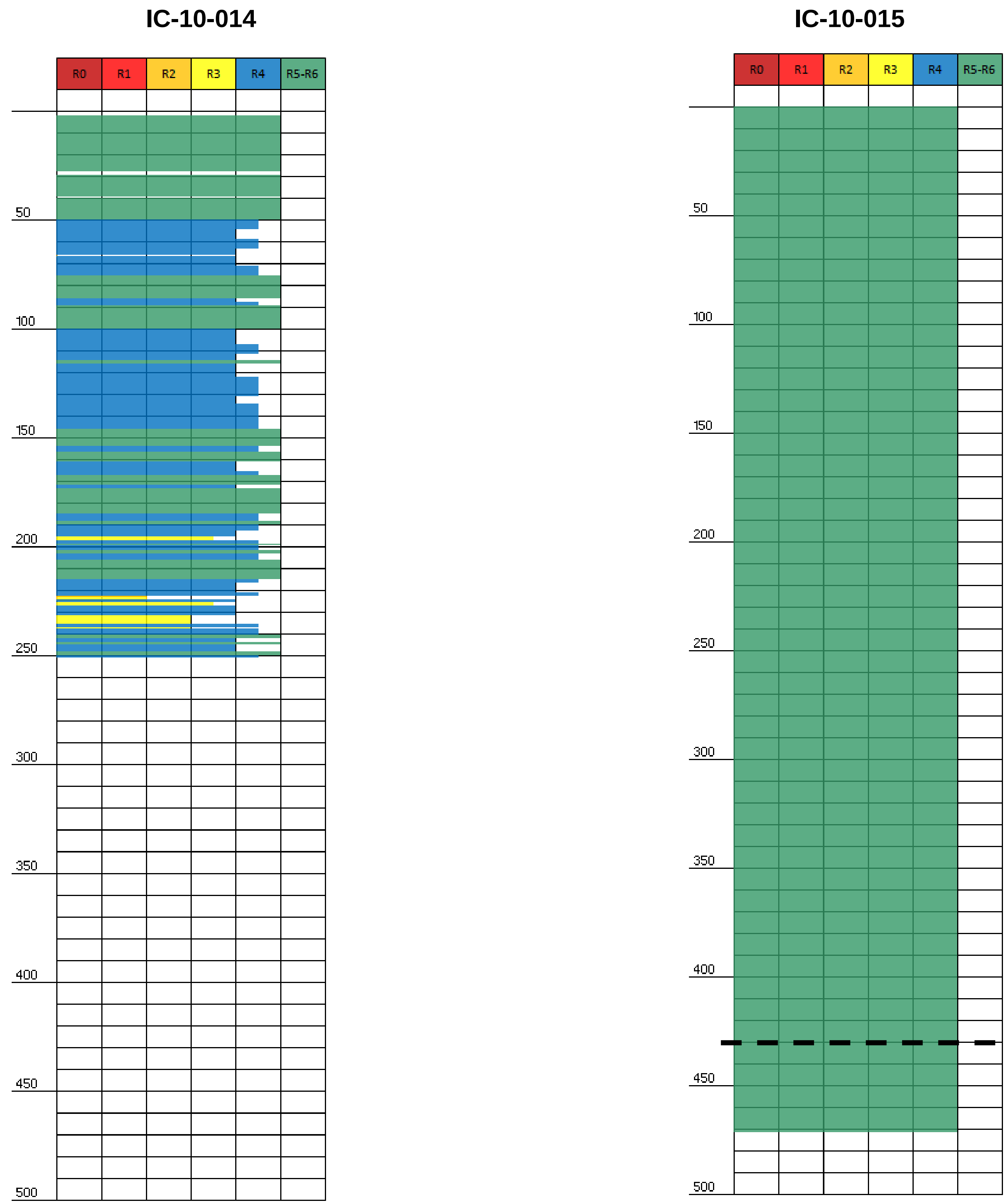


– – – – Proposed block cave extraction level footprint

Note: IC-10-014 and IC-10-016 do not intersect the extraction level footprint

PROJECT			
SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA			
TITLE			
DOWNHOLE PLOT RMR76			
Golder Associates	PROJECT No.	11-1439-0002	PHASE / TASK No. 10000
	DESIGN MV	26SEP11	SCALE AS SHOWN REV.
	CADD JC	26SEP11	
	CHECK KMM	15FEB12	FIGURE C-3
	REVIEW RDH	15FEB12	

FILE: O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



– – – – Proposed block cave extraction level footprint

Note: IC-10-014 and IC-10-016 do not intersect the extraction level footprint

PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA			
TITLE	DOWNHOLE PLOT ROCK STRENGTH			
Golder Associates	PROJECT No.		11-1439-0002	PHASE / TASK No. 10000
	DESIGN	MV	26SEP11	SCALE AS SHOWN REV.
	CADD	JC	26SEP11	FIGURE C-4
	CHECK	KMM	15FEB12	
	REVIEW	RDH	15FEB12	

FILE: O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

▬ ▬ ▬ ▬ Proposed block cave extraction level footprint

Note: IC-10-014 and IC-10-016 do not intersect the extraction level footprint

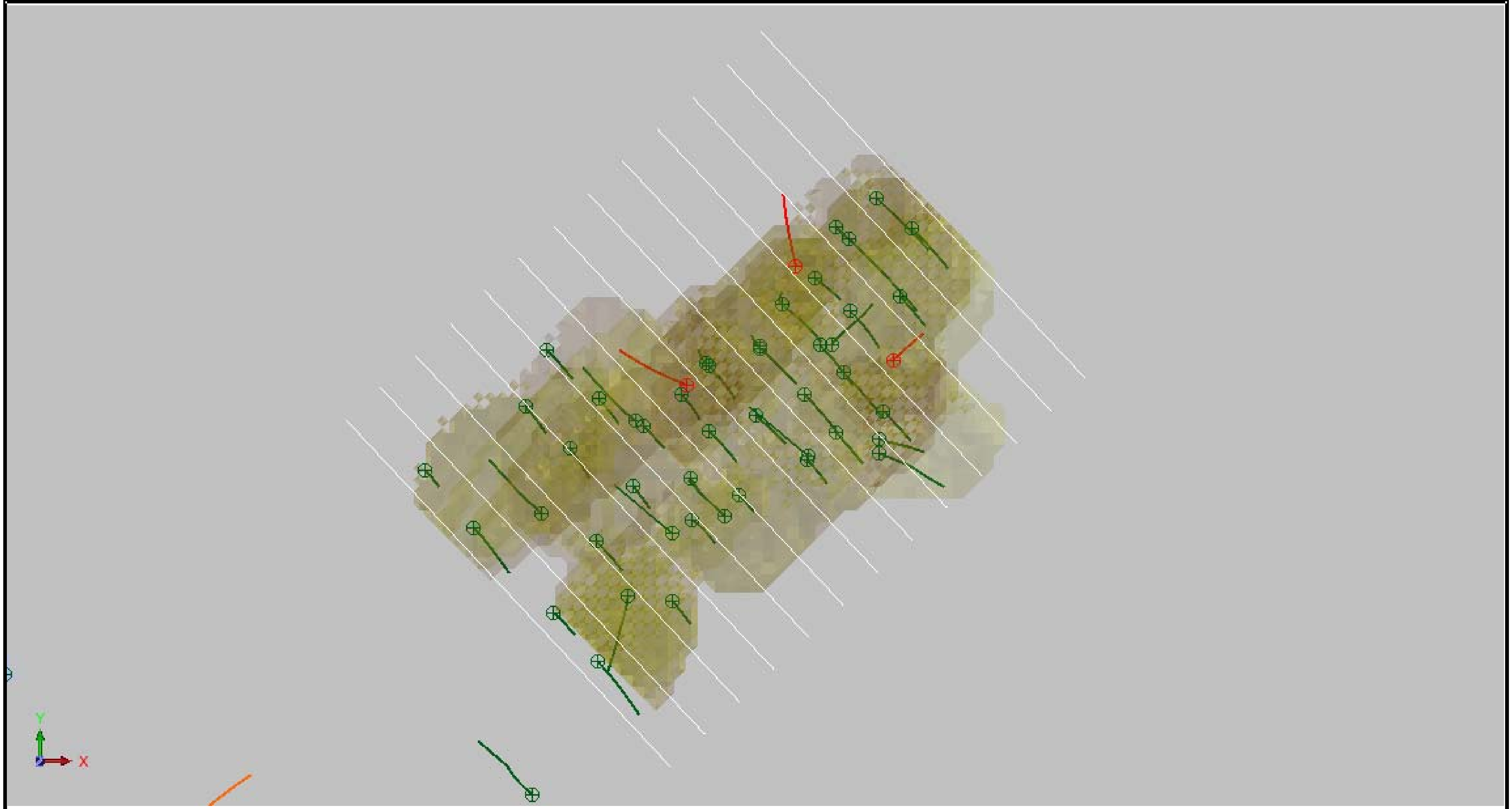
FILE: O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices

PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	DOWNHOLE PLOT FRACTURE FREQUENCY (Fractures/m)

Golder Associates				
PROJECT No.	11-1439-0002		PHASE / TASK No.	10000
DESIGN	MV	26SEP11	SCALE AS SHOWN	REV.
CADD	JC	26SEP11	FIGURE C-5	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

APPENDIX D

Cross Sections Showing Alteration Type and Fracture Frequency



BOREHOLE
EXPLORATION HOLES
GEOTECH HOLES

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

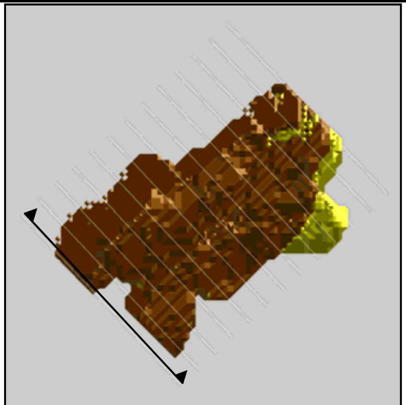
TITLE

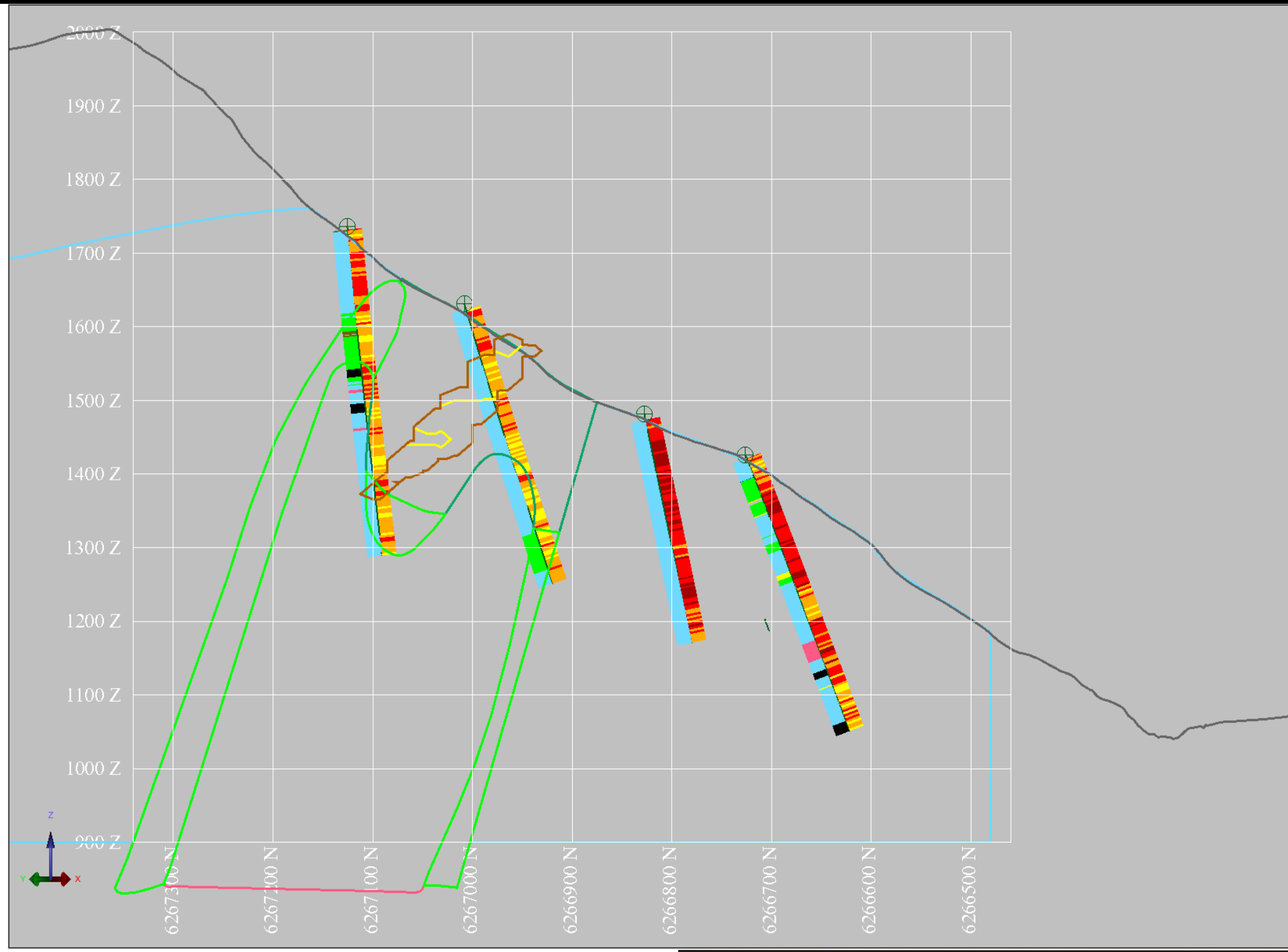
IRON CAP – CROSS SECTION LOCATIONS

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	07NOV11	FIGURE D-1	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 01
ALTERATION, LITHOLOGY and RQD

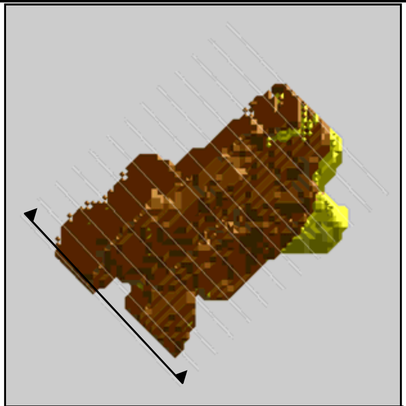
Golder Associates

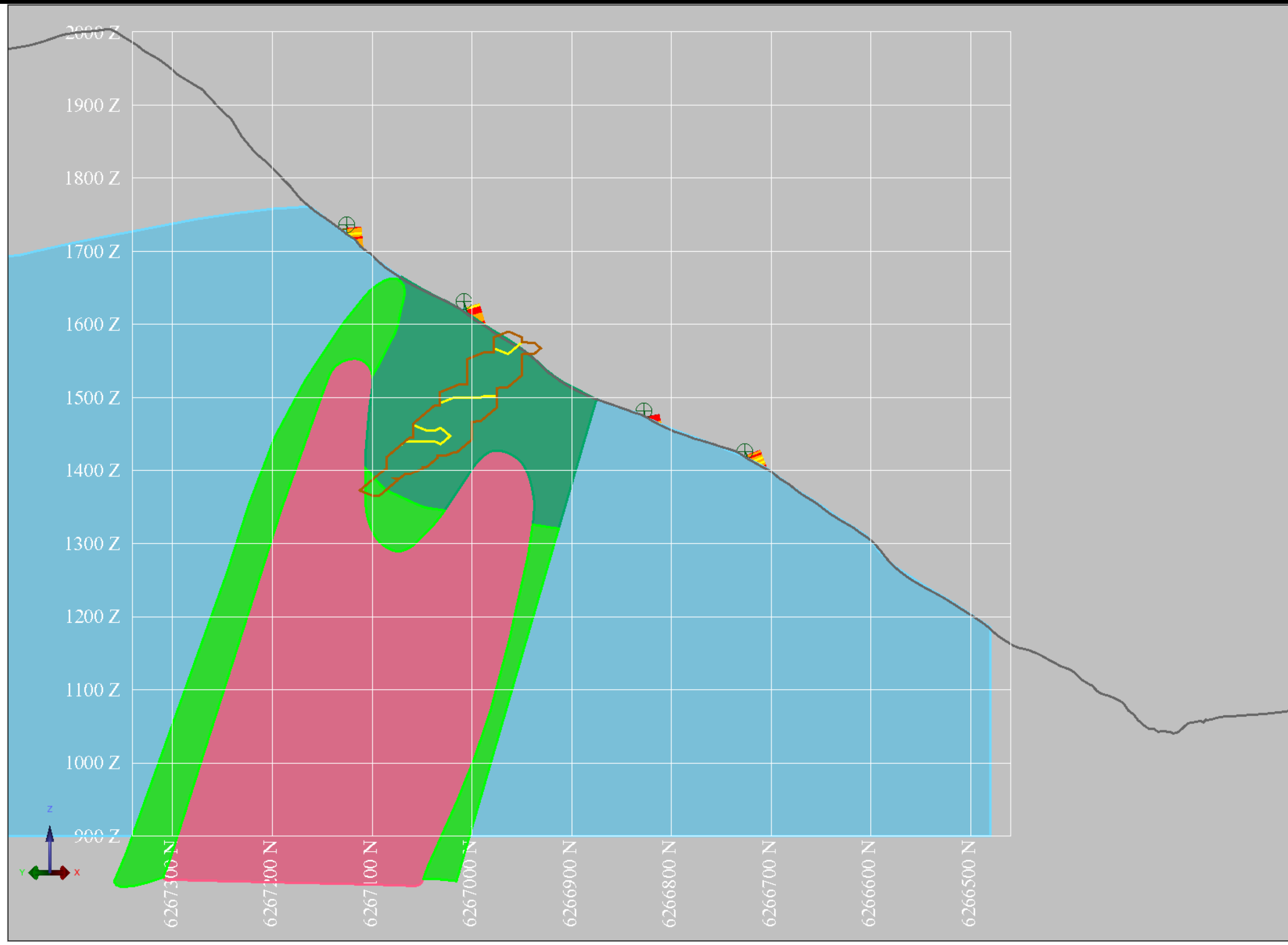
PROJECT No. 11-1439-0002		PHASE No. 10000
DESIGN	CY	07NOV11
CADD	CY	17NOV11
CHECK	KMM	15FEB12
REVIEW	RDH	15FEB12

SCALE NTS   REV. --

FIGURE D-2

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

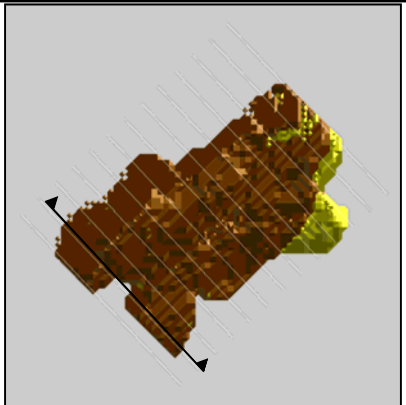
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

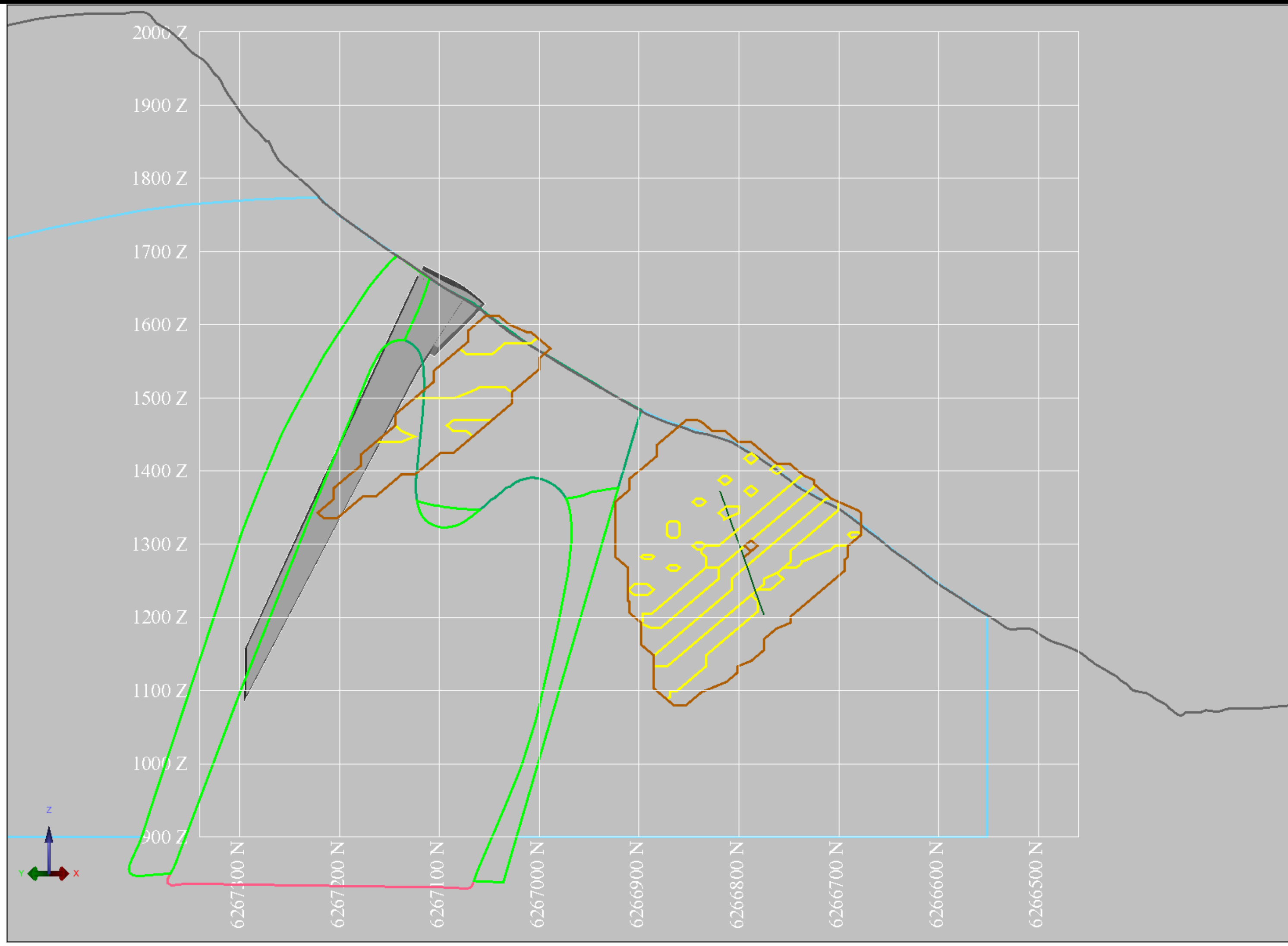
TITLE
IRON CAP – SECTION 01
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	**FIGURE D-3**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

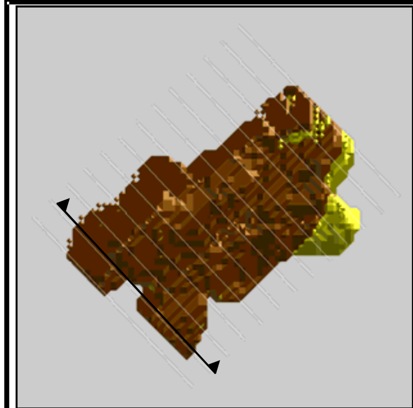
TITLE

IRON CAP – SECTION 02
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	**FIGURE D-4**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



LEGEND

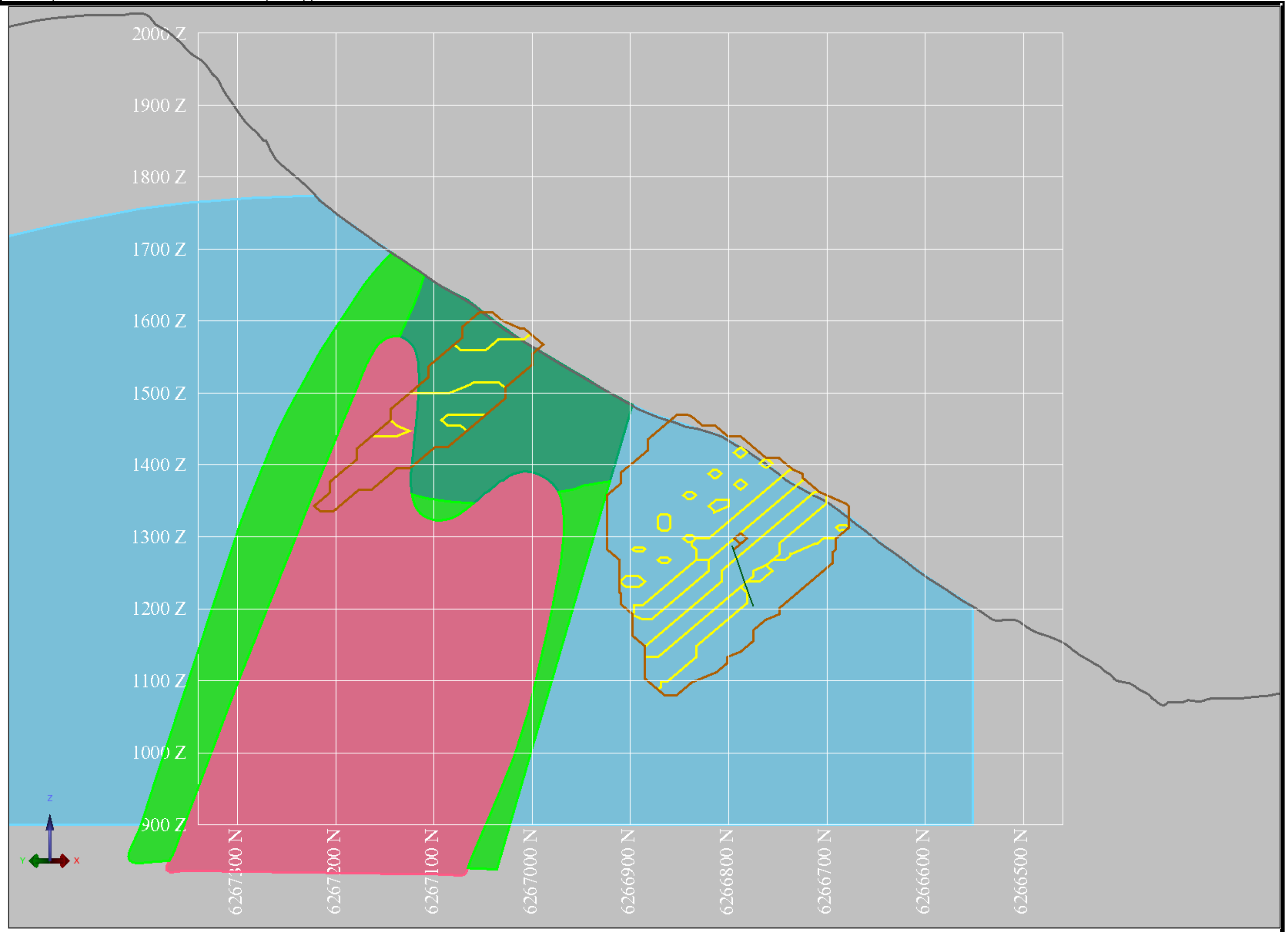
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	Fault Zone
Potassic	



Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

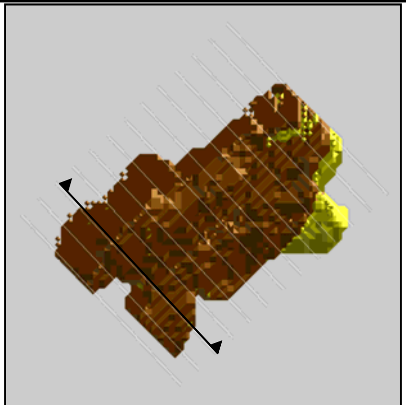
TITLE

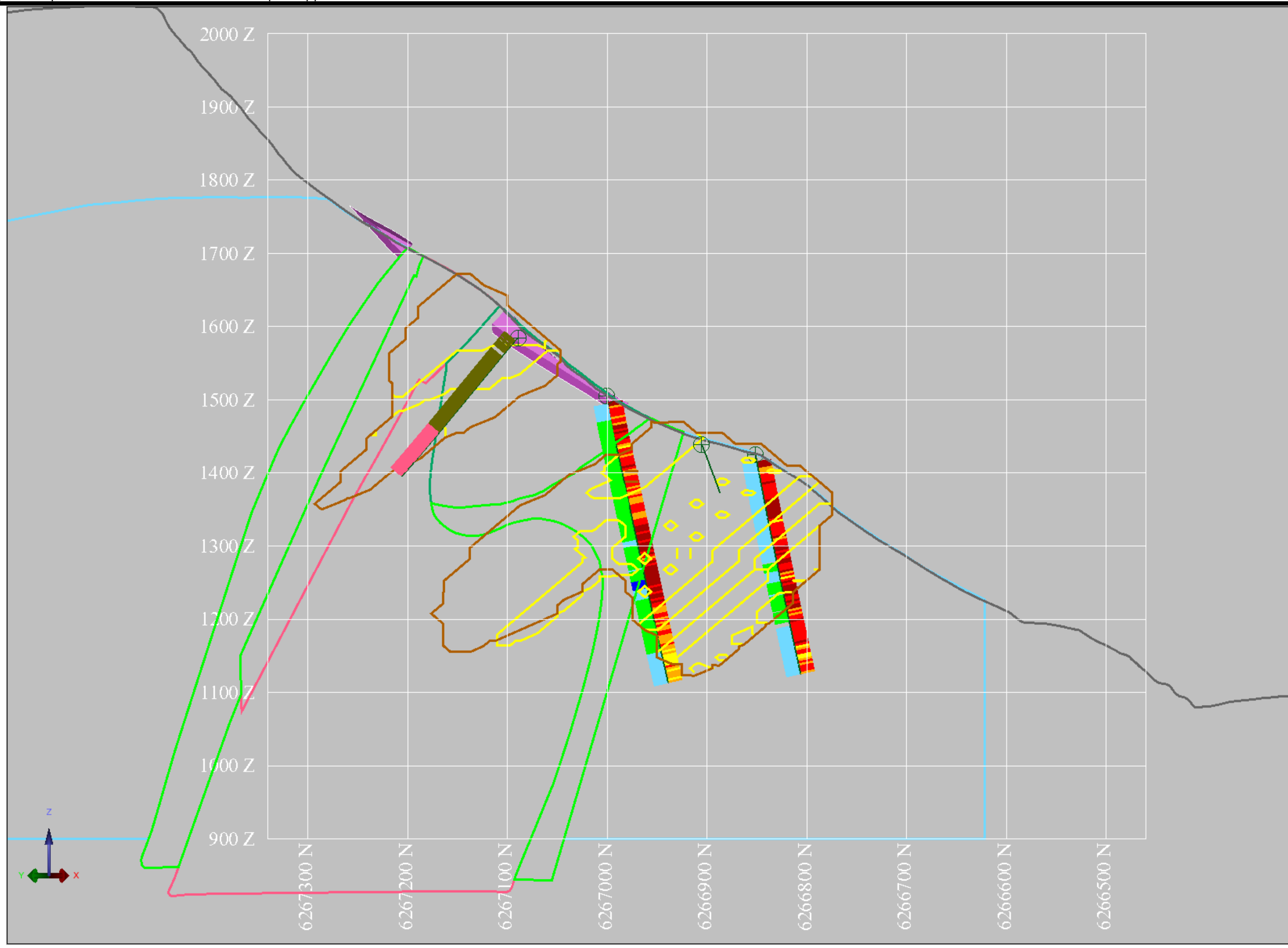
IRON CAP – SECTION 02
ALTERATION SHELLS

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV. --
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	**FIGURE D-5**
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

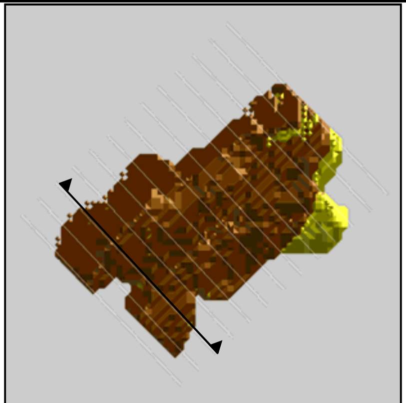
Fracture Frequency (/m)

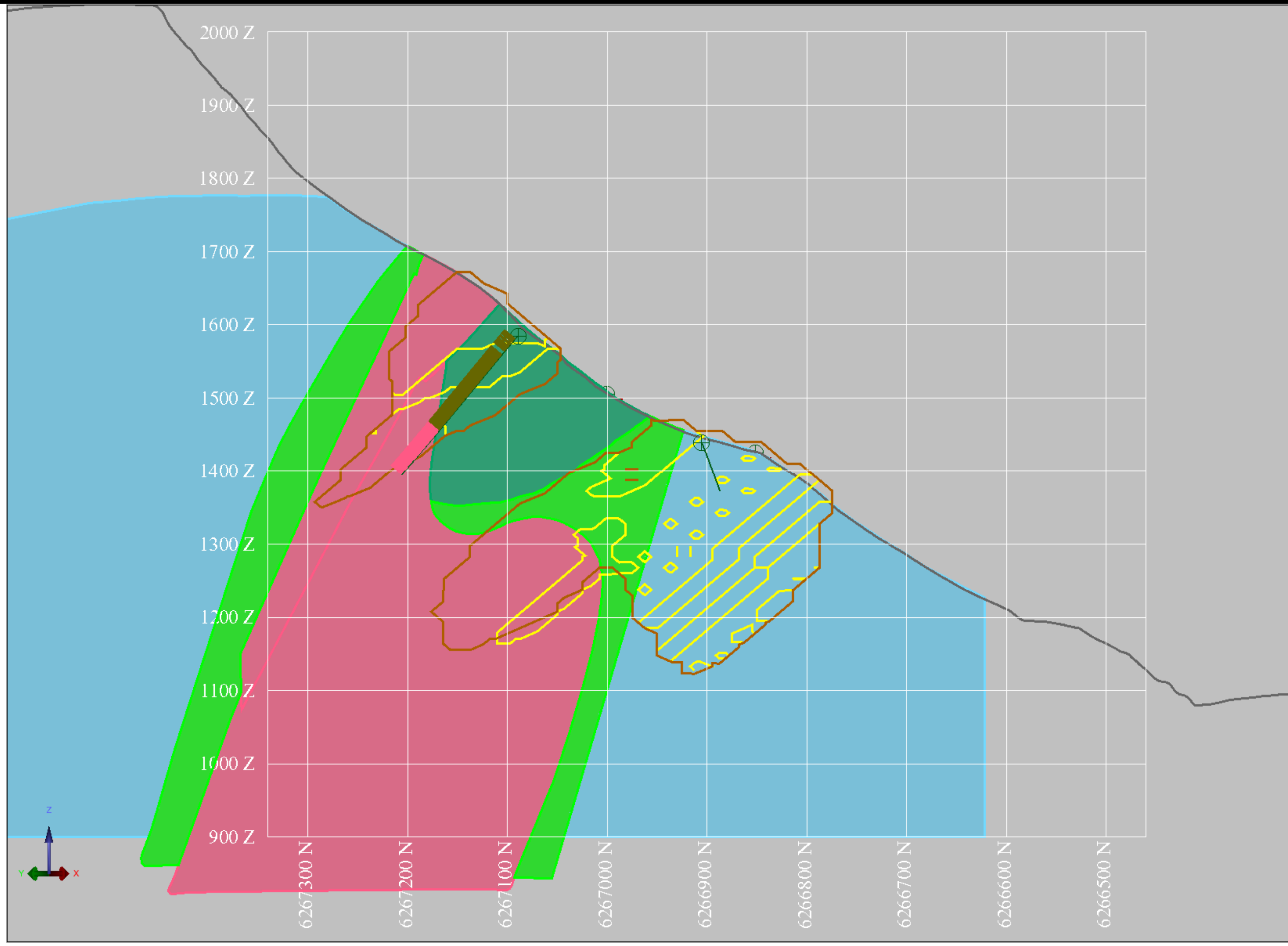
0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	IRON CAP – SECTION 03 ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	17NOV11	FIGURE D-6	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

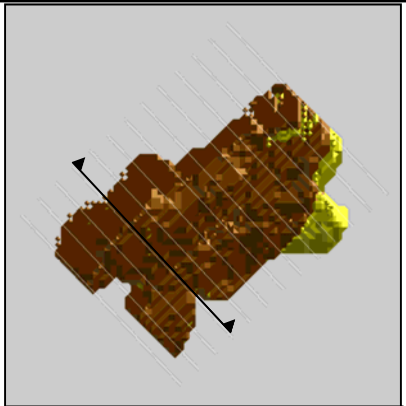
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

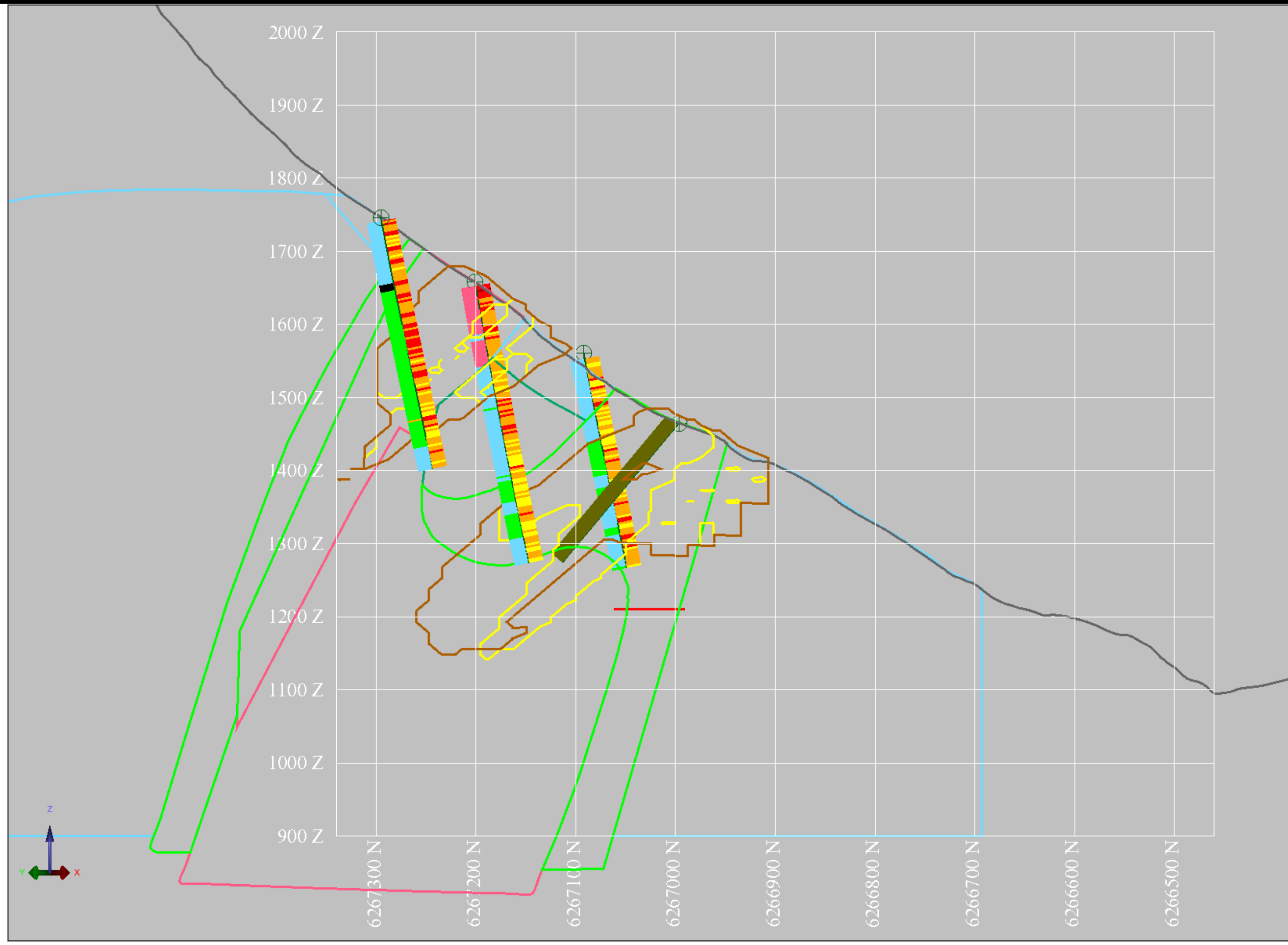
TITLE
IRON CAP – SECTION 03
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	**FIGURE D-7**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

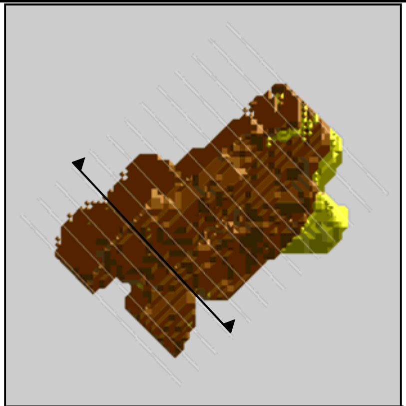
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

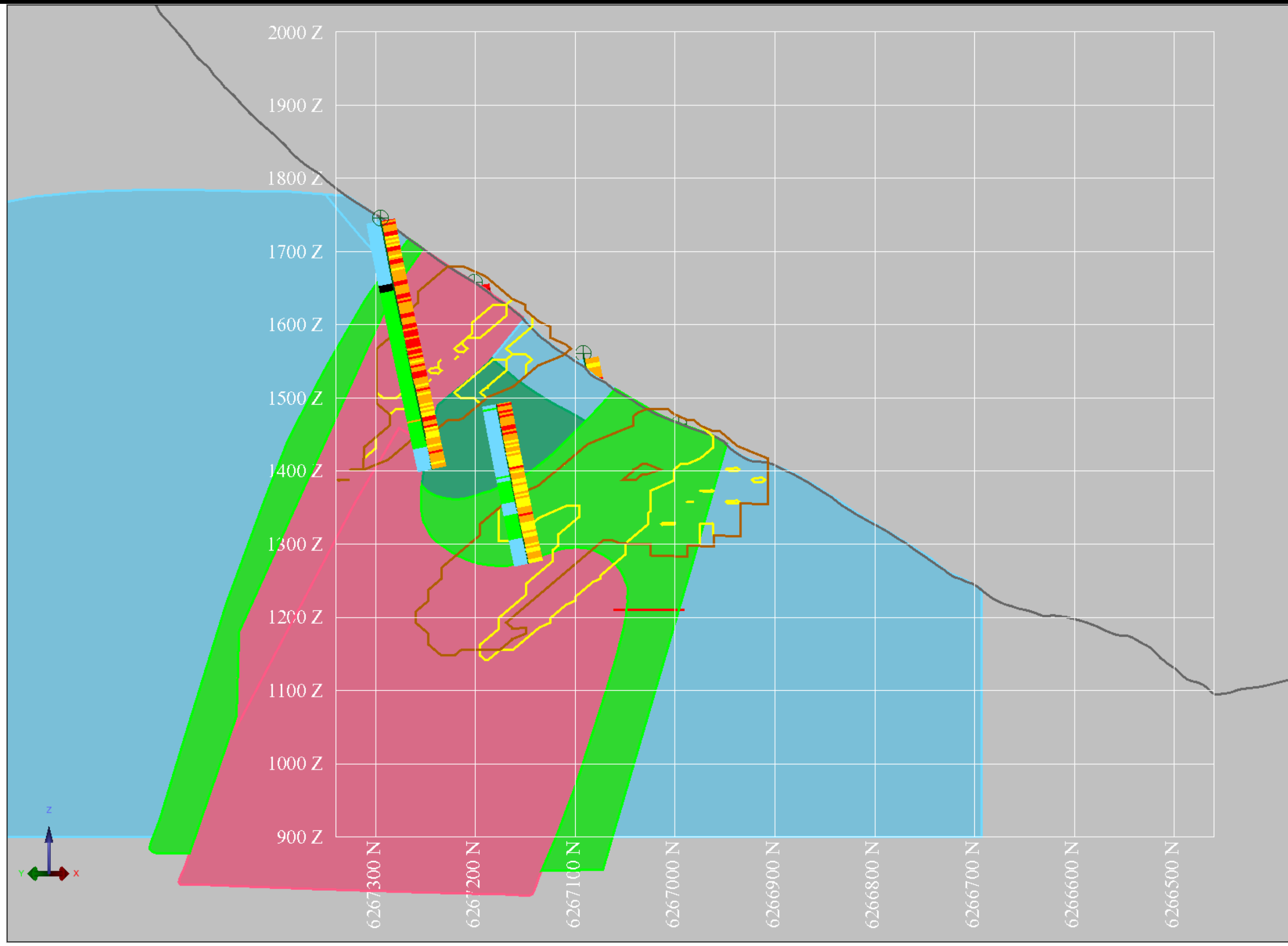
TITLE
IRON CAP – SECTION 04
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	**FIGURE D-8**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

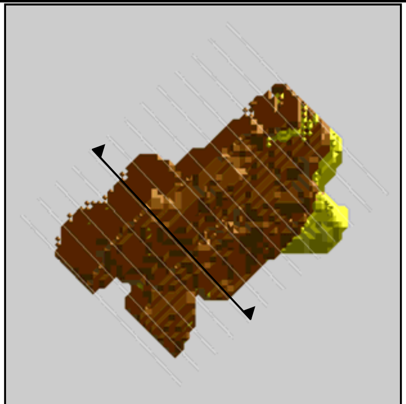
- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	IRON CAP – SECTION 04 ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	FIGURE D-9	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



LEGEND

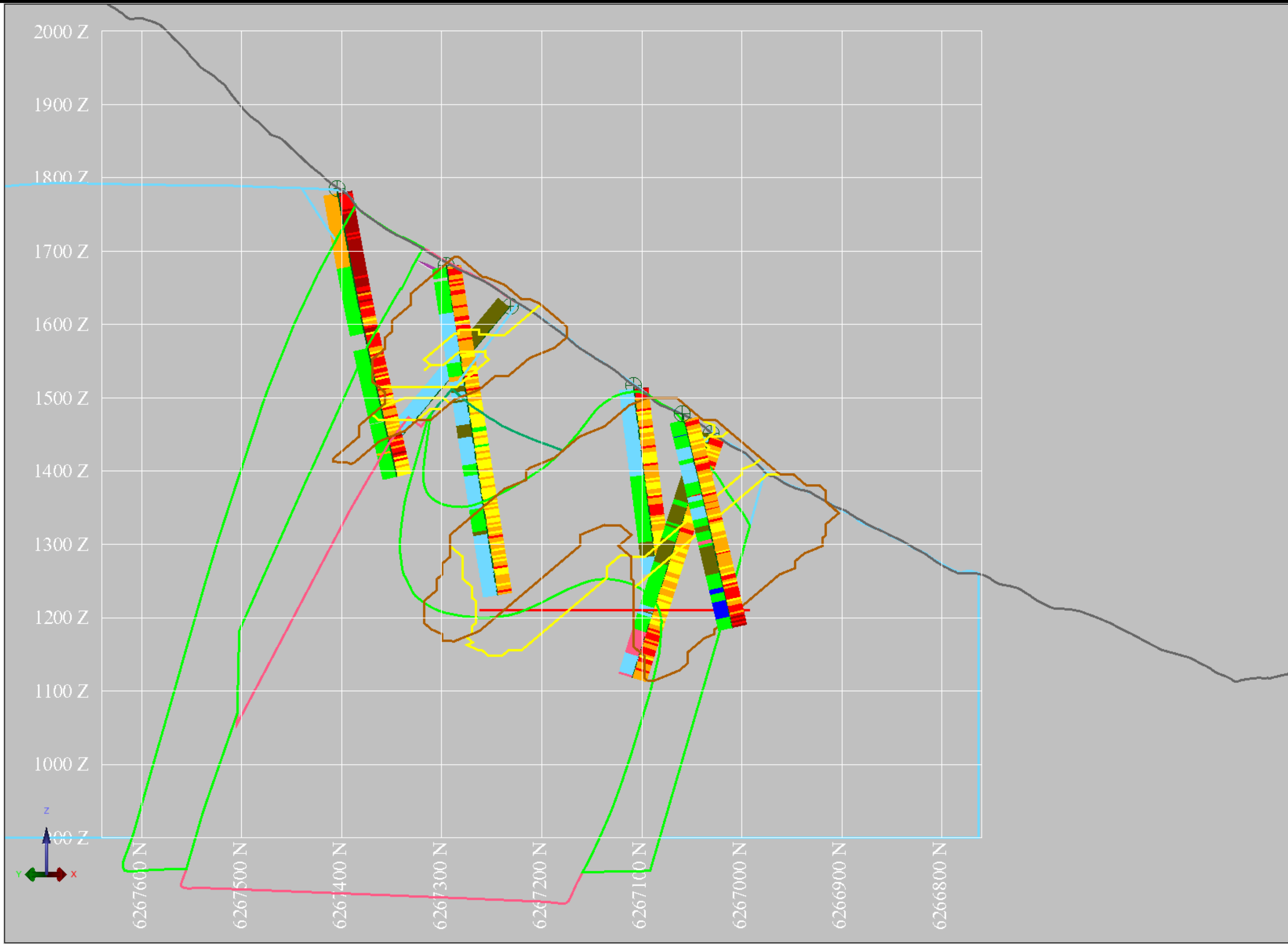
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone



Fracture Frequency (/m)

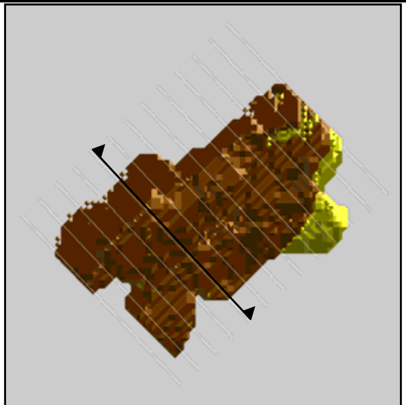
0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

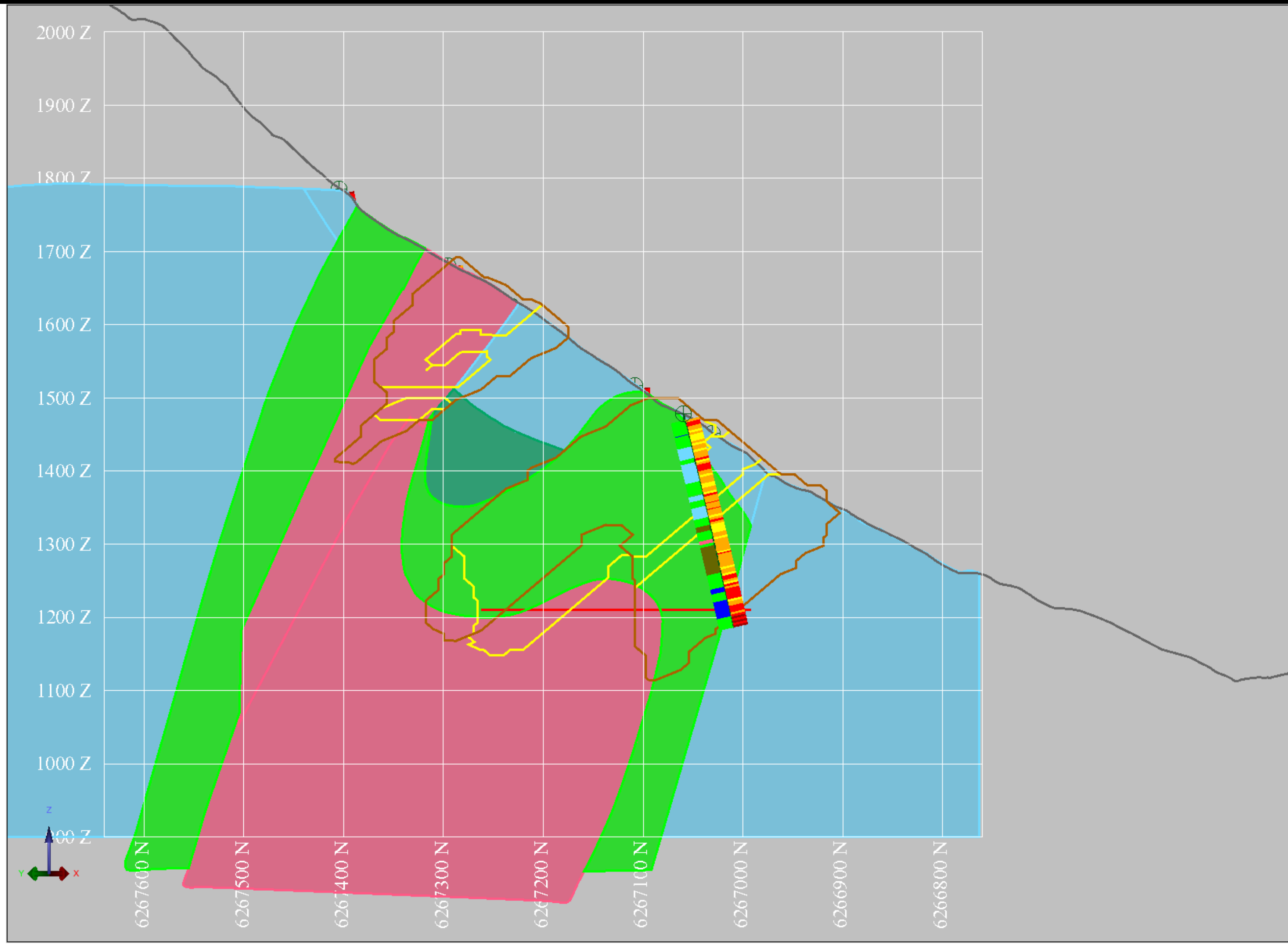
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 05
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	**FIGURE D-10**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 05
ALTERATION SHELLS

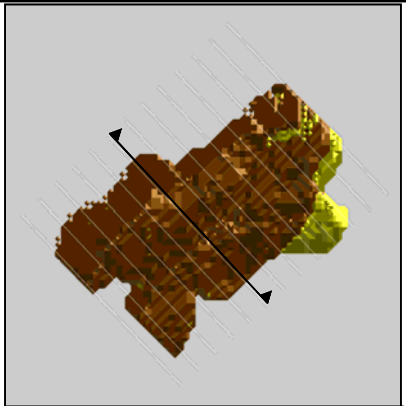
Golder Associates

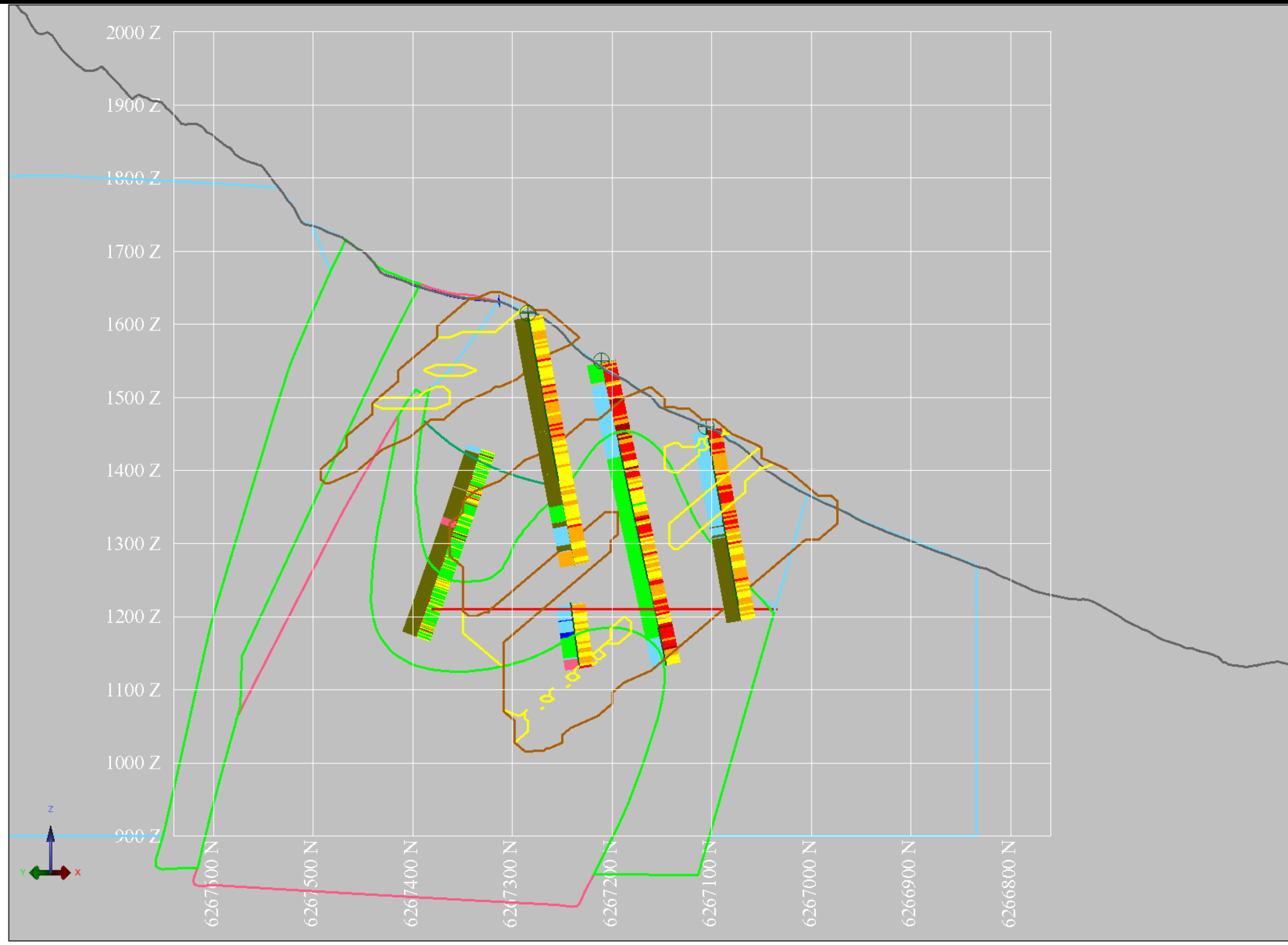
PROJECT No.11-1439-0002		
DESIGN	CY	07NOV11
CADD	CY	17NOV11
CHECK	KMM	15FEB12
REVIEW	RDH	15FEB12

PHASE No. 10000
SCALE NTS
REV.--

FIGURE D-11

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

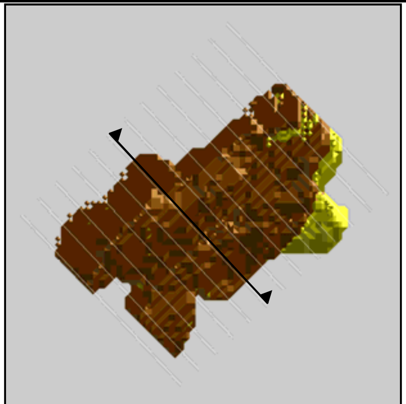
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

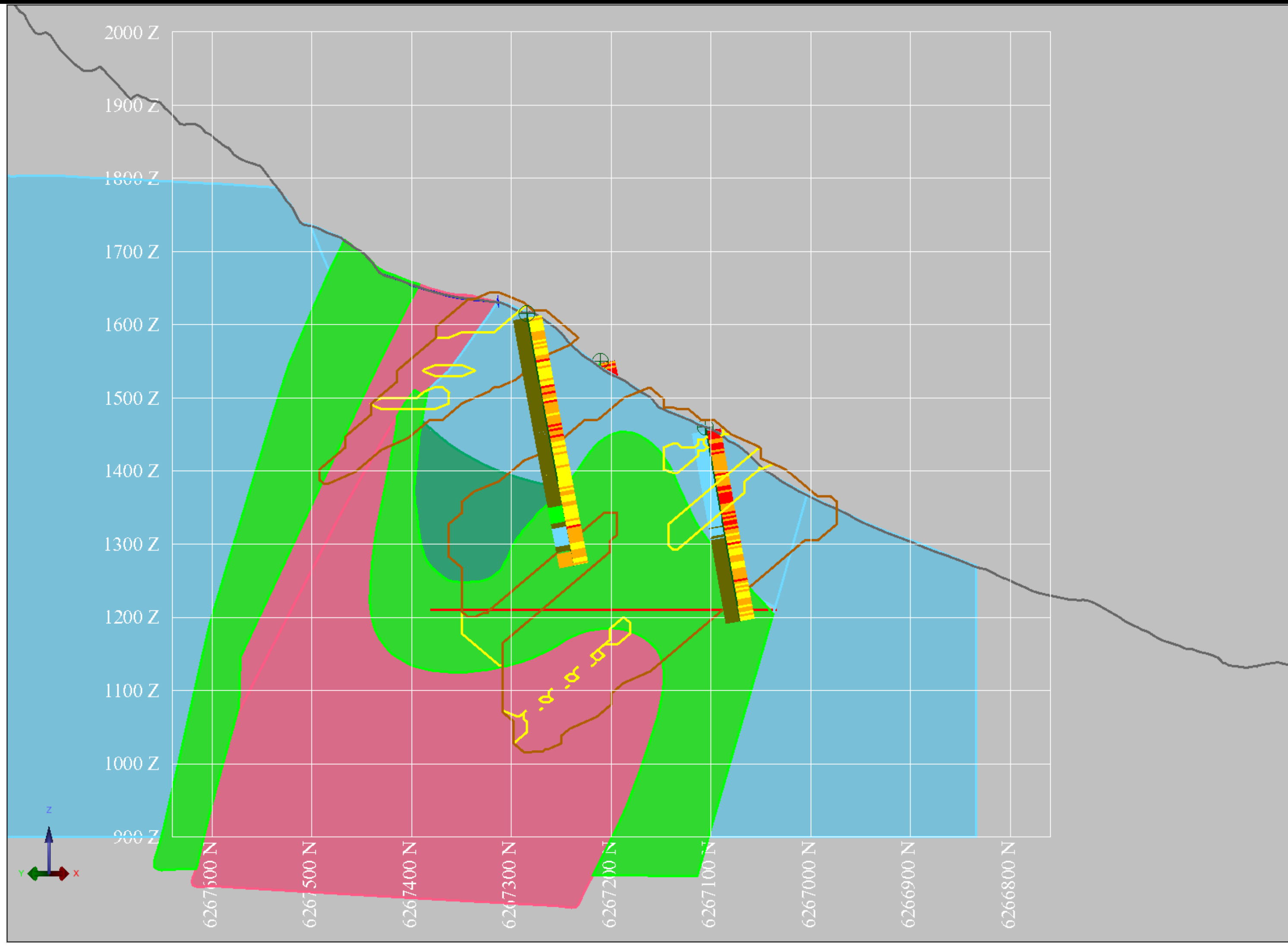
TITLE
IRON CAP – SECTION 06
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	**FIGURE D-12**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

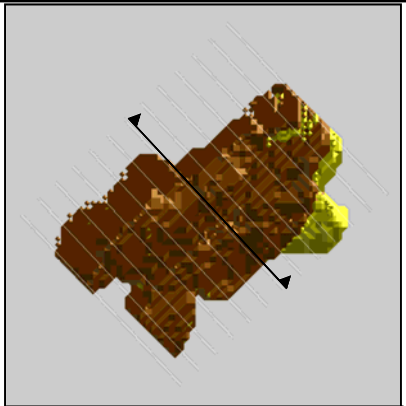
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

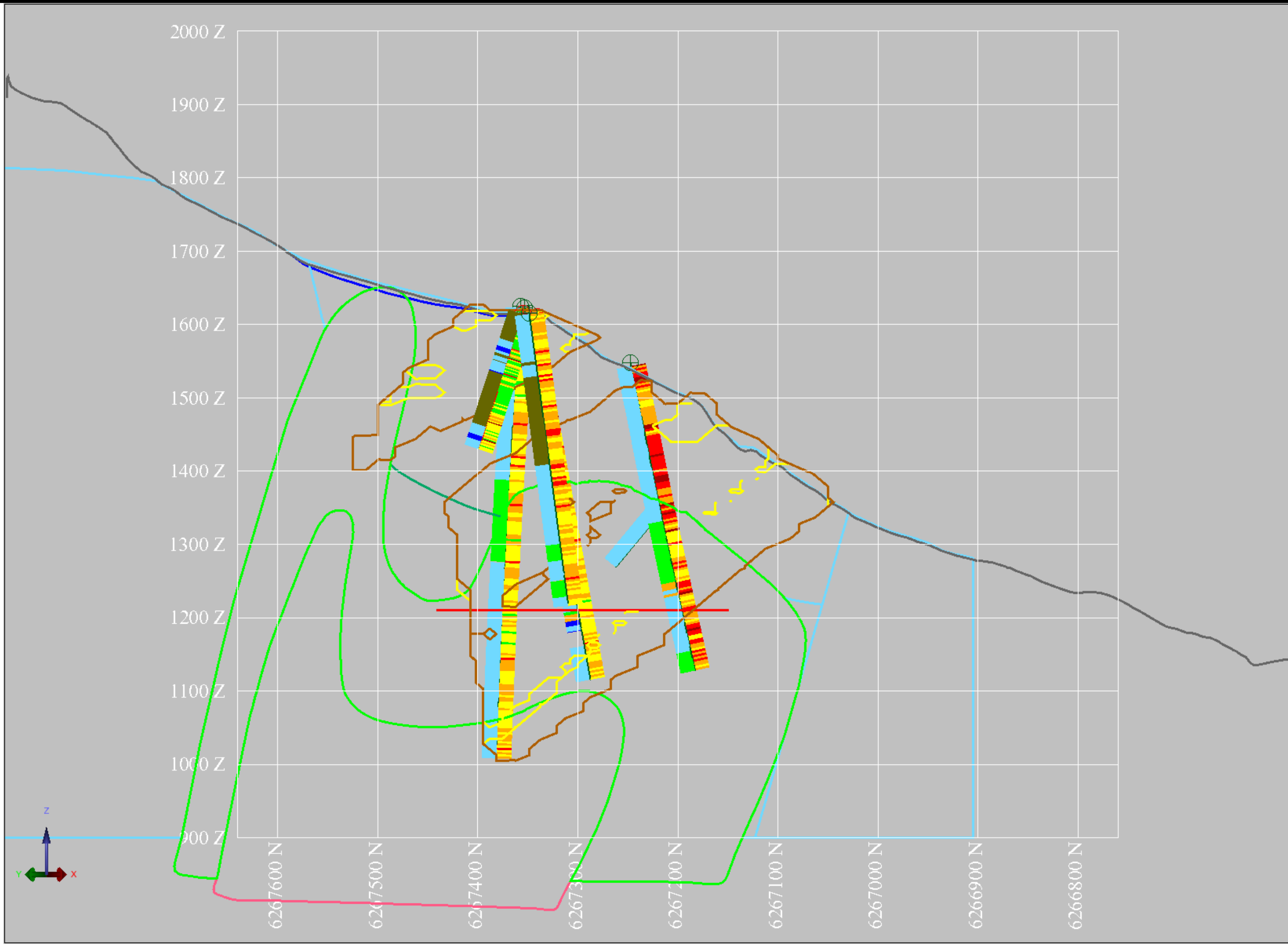
TITLE
IRON CAP – SECTION 06
ALTERATION SHELLS

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV. --
CADD	CY	17NOV11	**FIGURE D-13**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

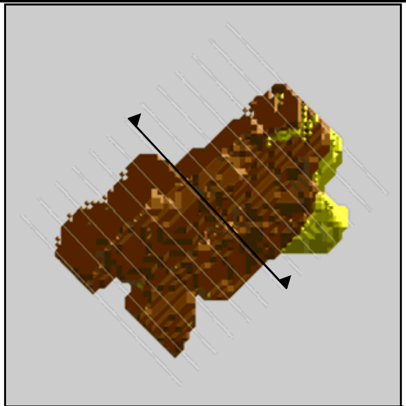
- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

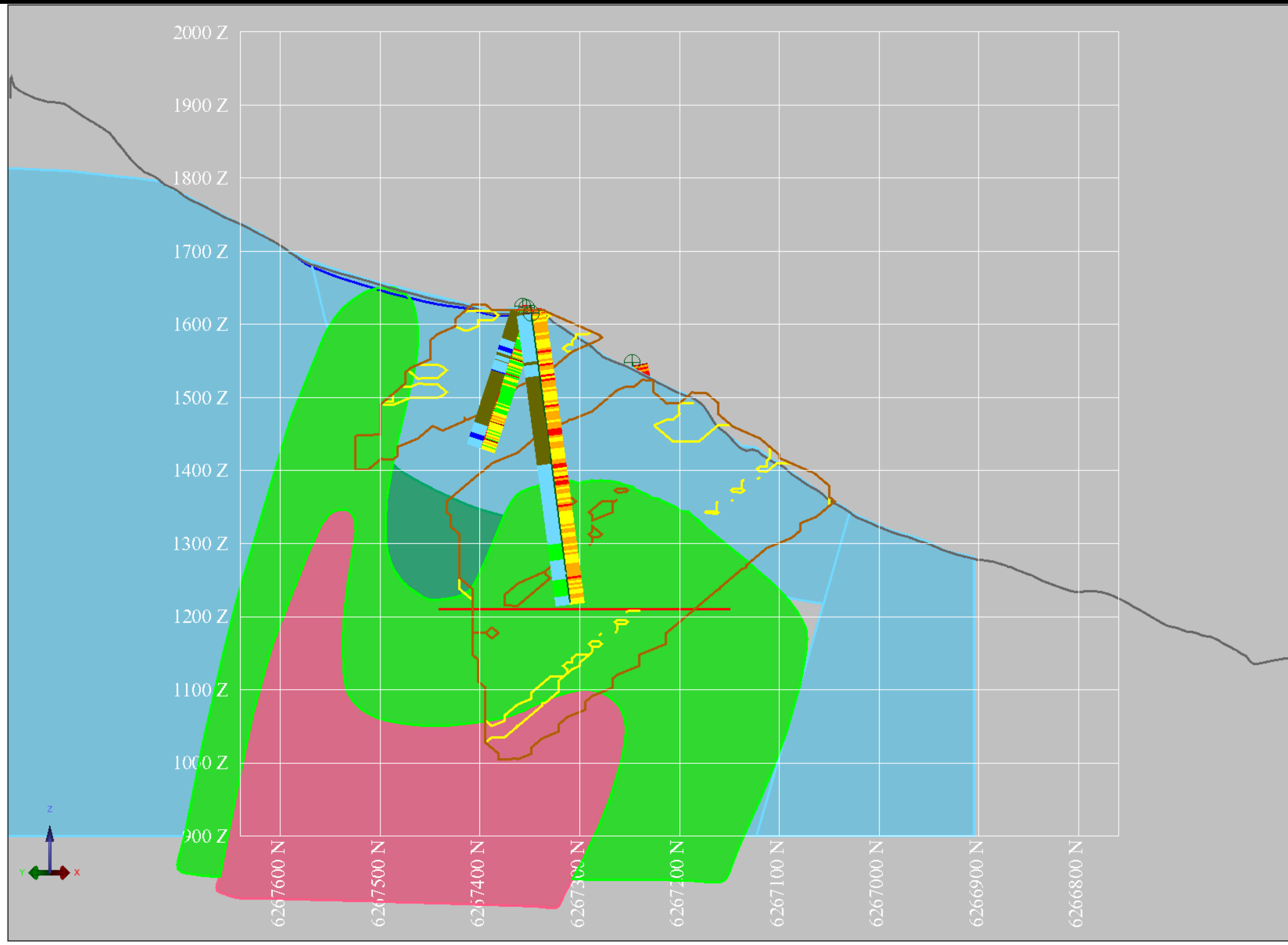
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 07
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	17NOV11	**FIGURE D-14**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

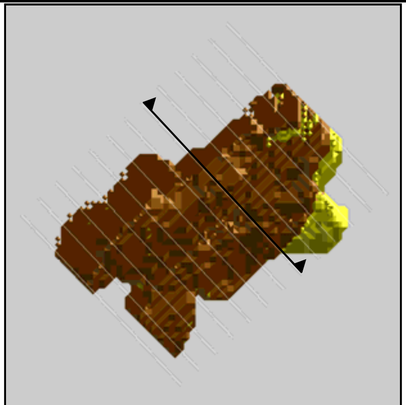
IRON CAP – SECTION 07
ALTERATION SHELLS

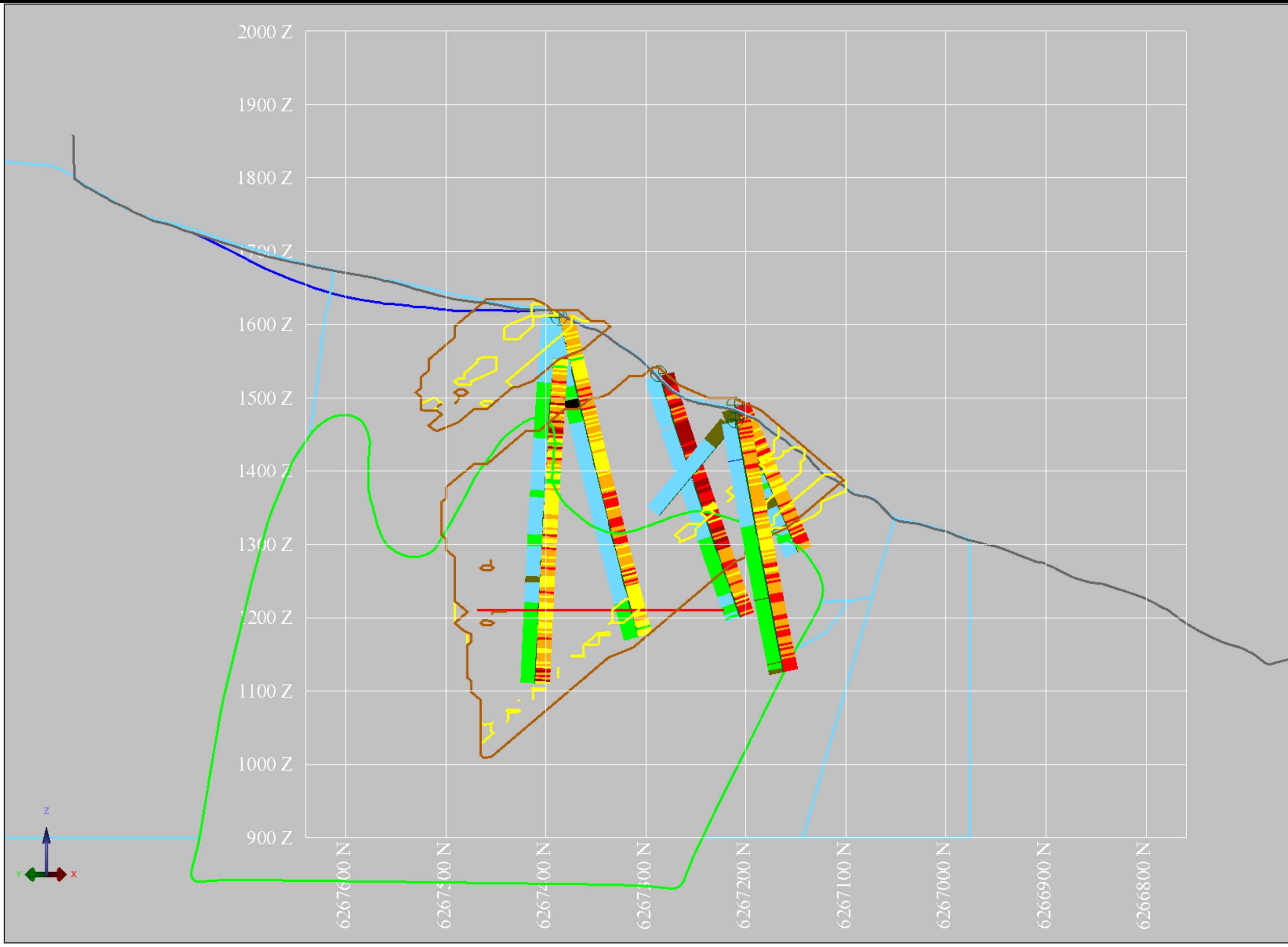
Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	17NOV11		
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

FIGURE D-15

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

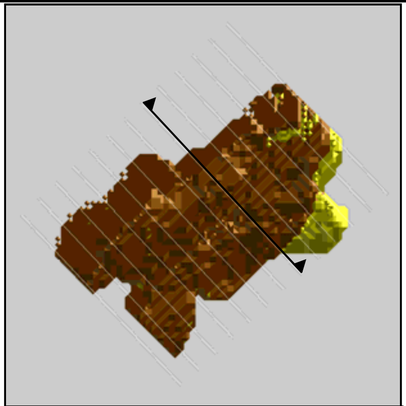
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 08
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	FIGURE D-16
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	



LEGEND

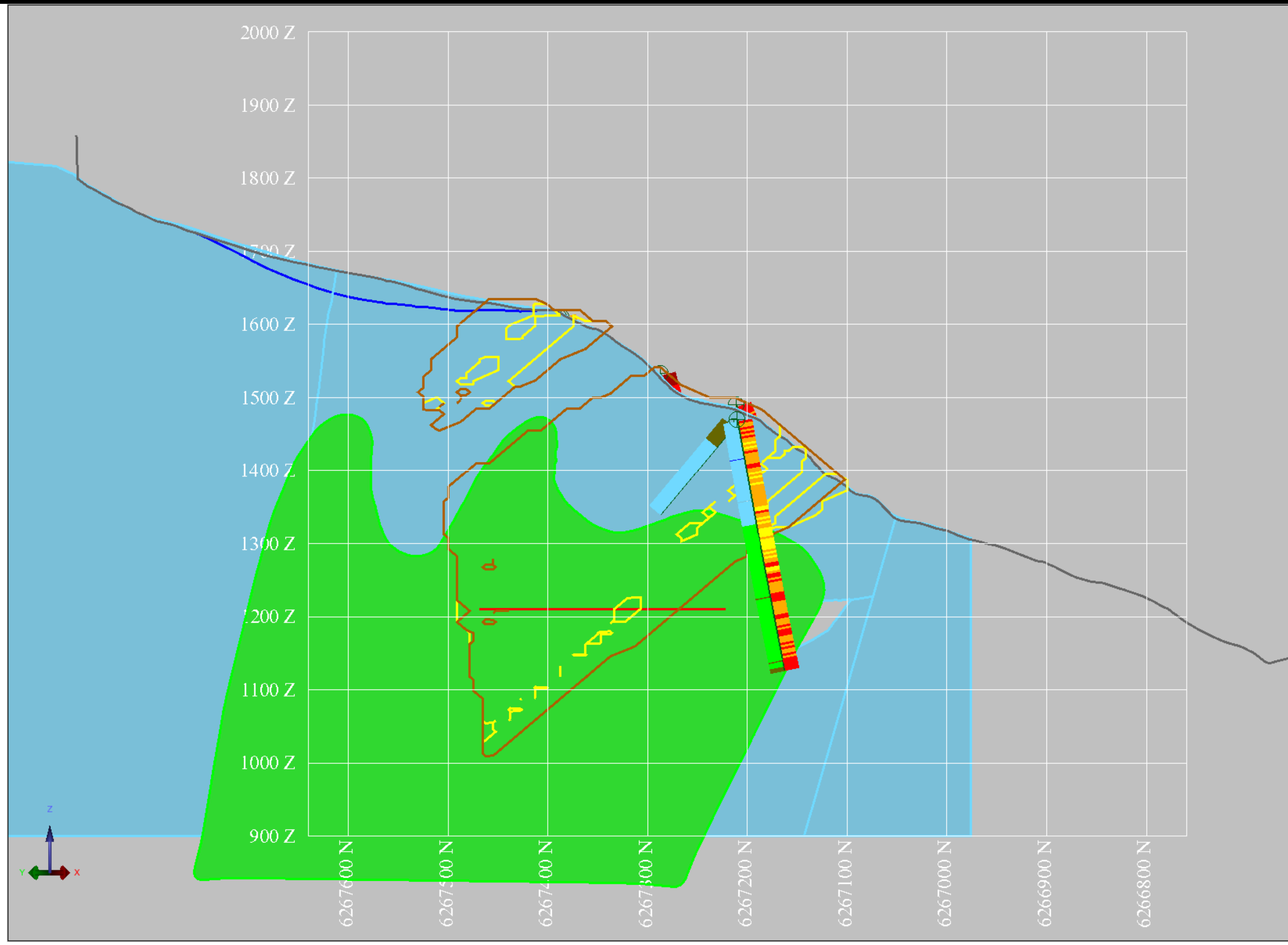
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone



Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

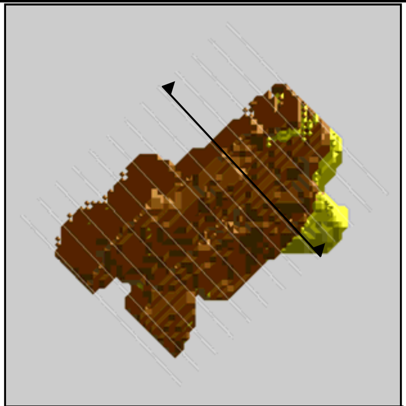
TITLE

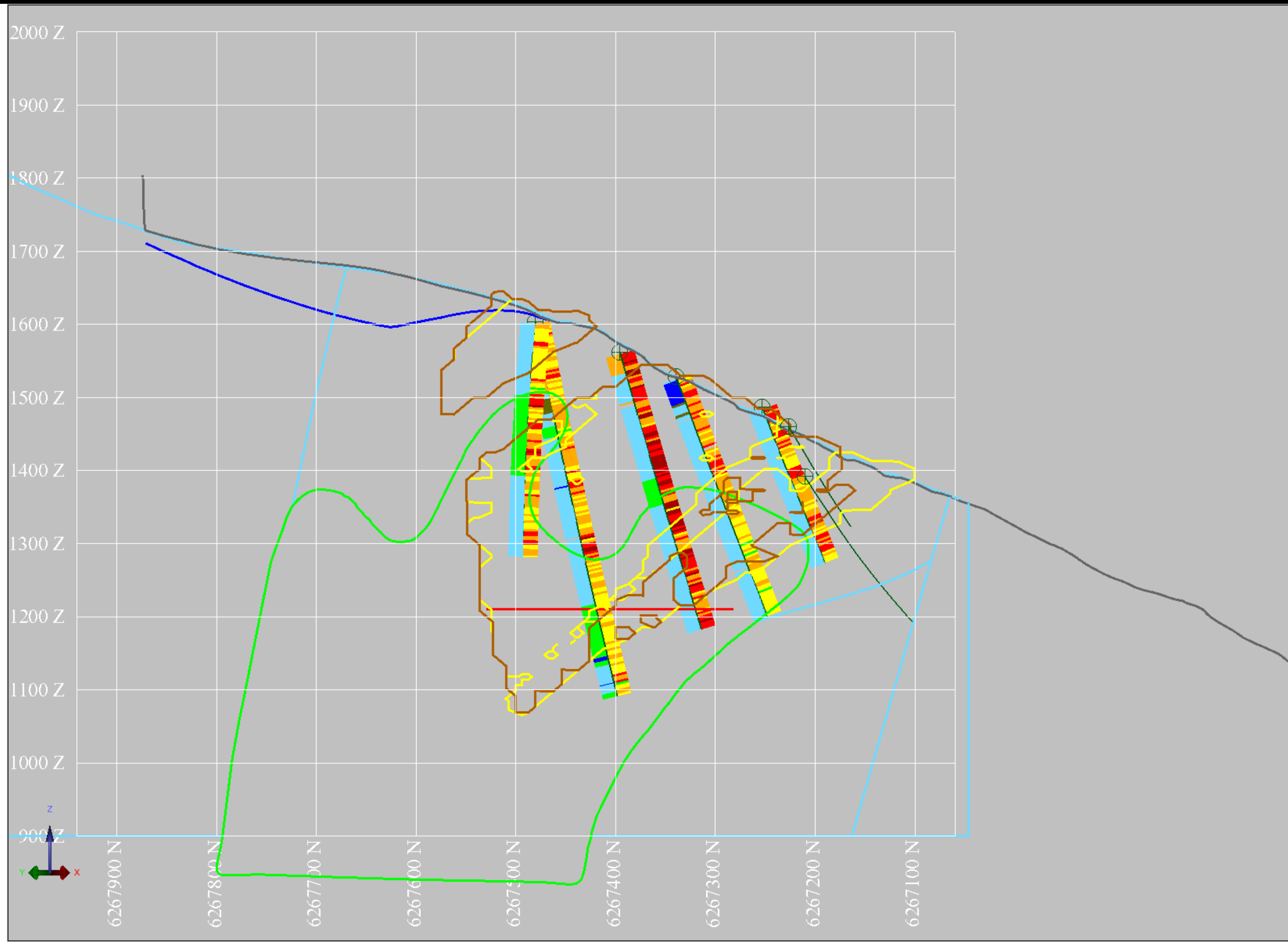
IRON CAP – SECTION 08
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS — REV. --
CADD	CY	17NOV11	**FIGURE D-17**
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

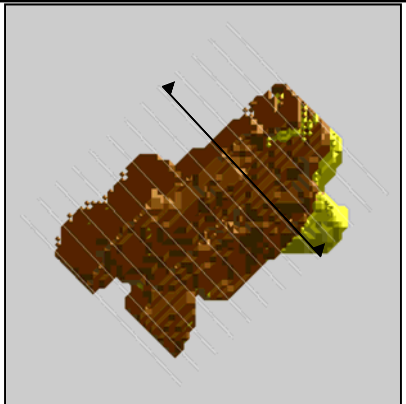
TITLE

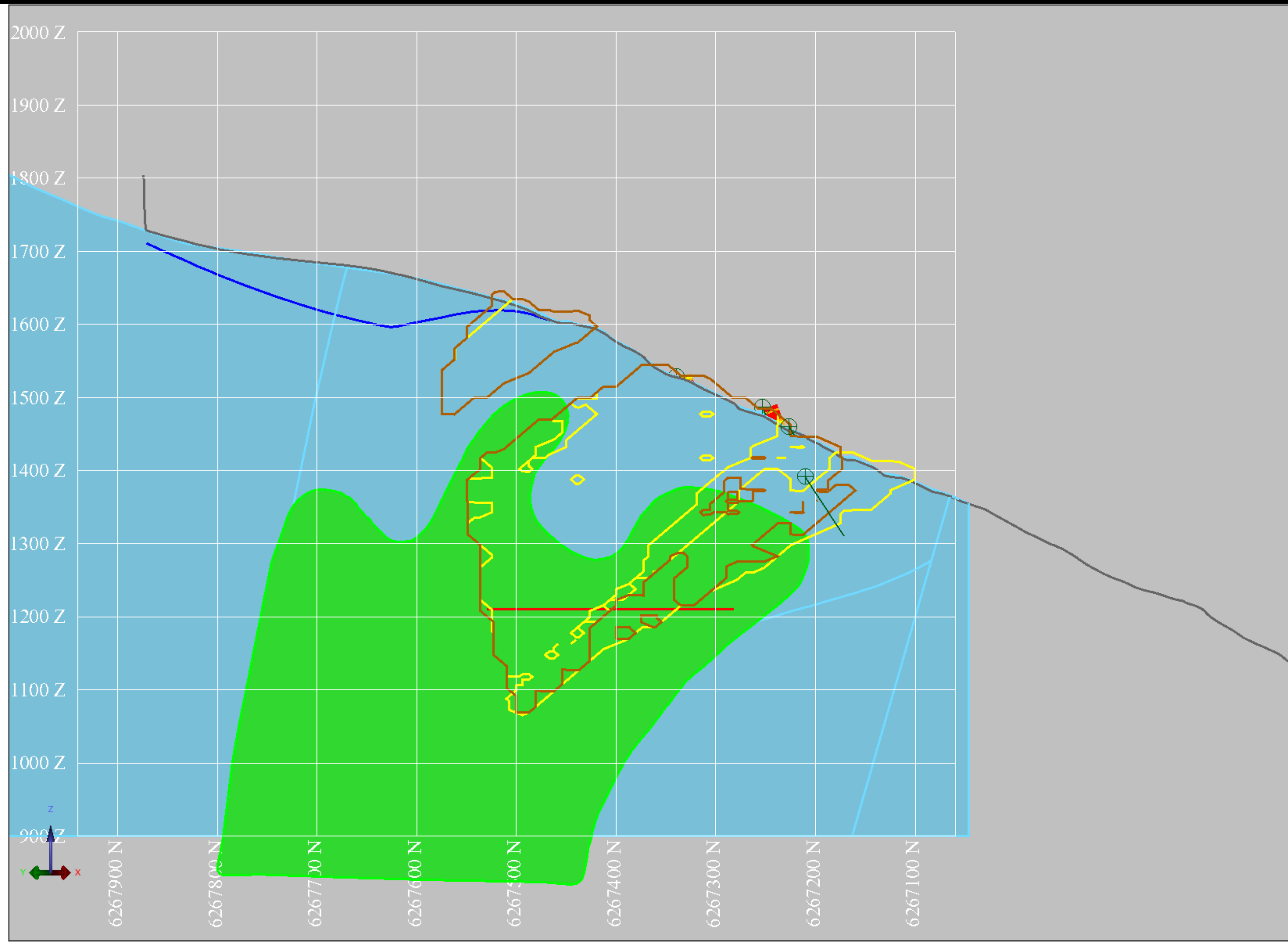
IRON CAP – SECTION 09
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	17NOV11	**FIGURE D-18**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

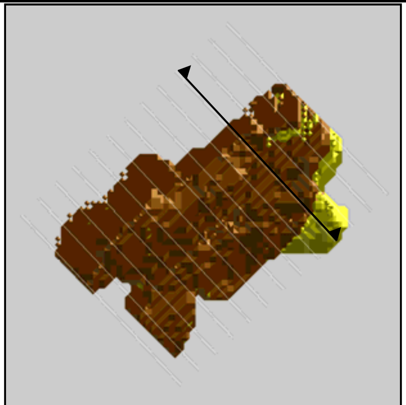
0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

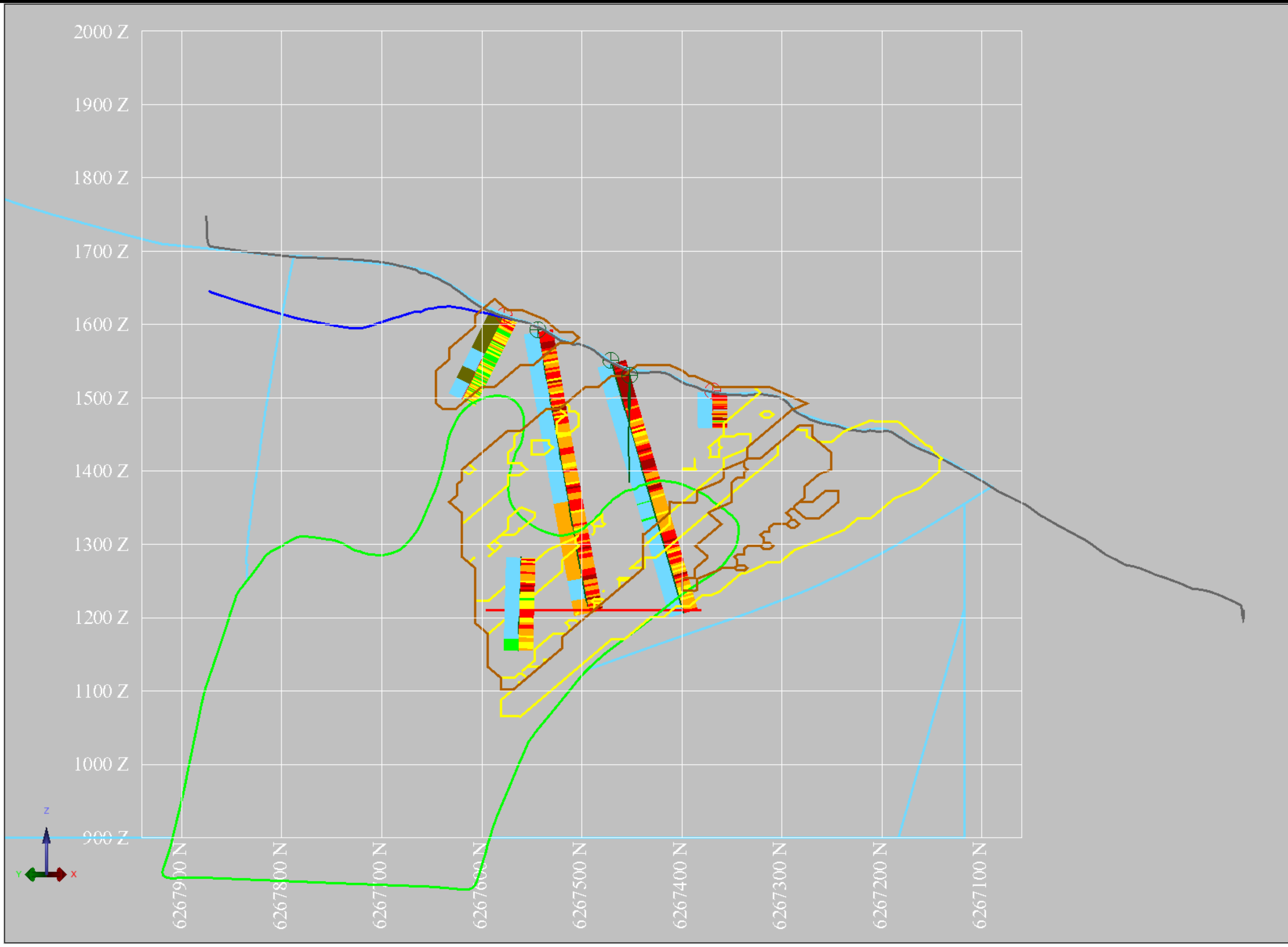
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
IRON CAP – SECTION 09
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV. --
CADD	CY	17NOV11	**FIGURE D-19**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

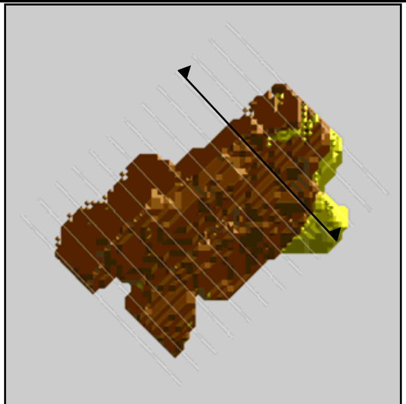
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

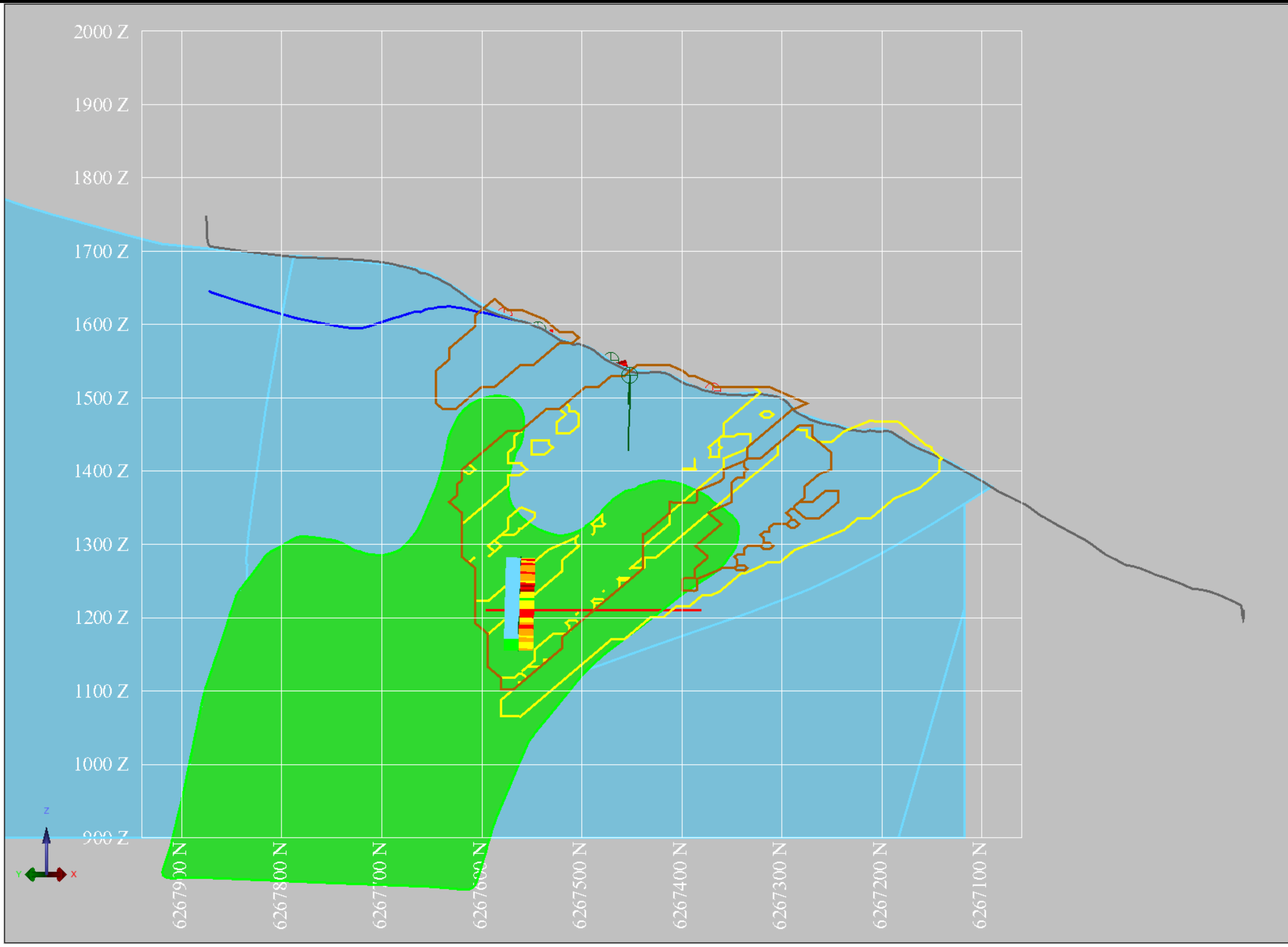
TITLE

IRON CAP – SECTION 10
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	**FIGURE D-20**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

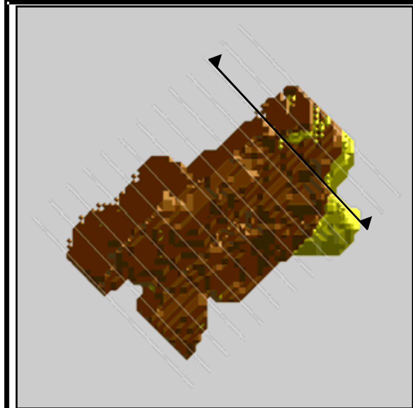
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

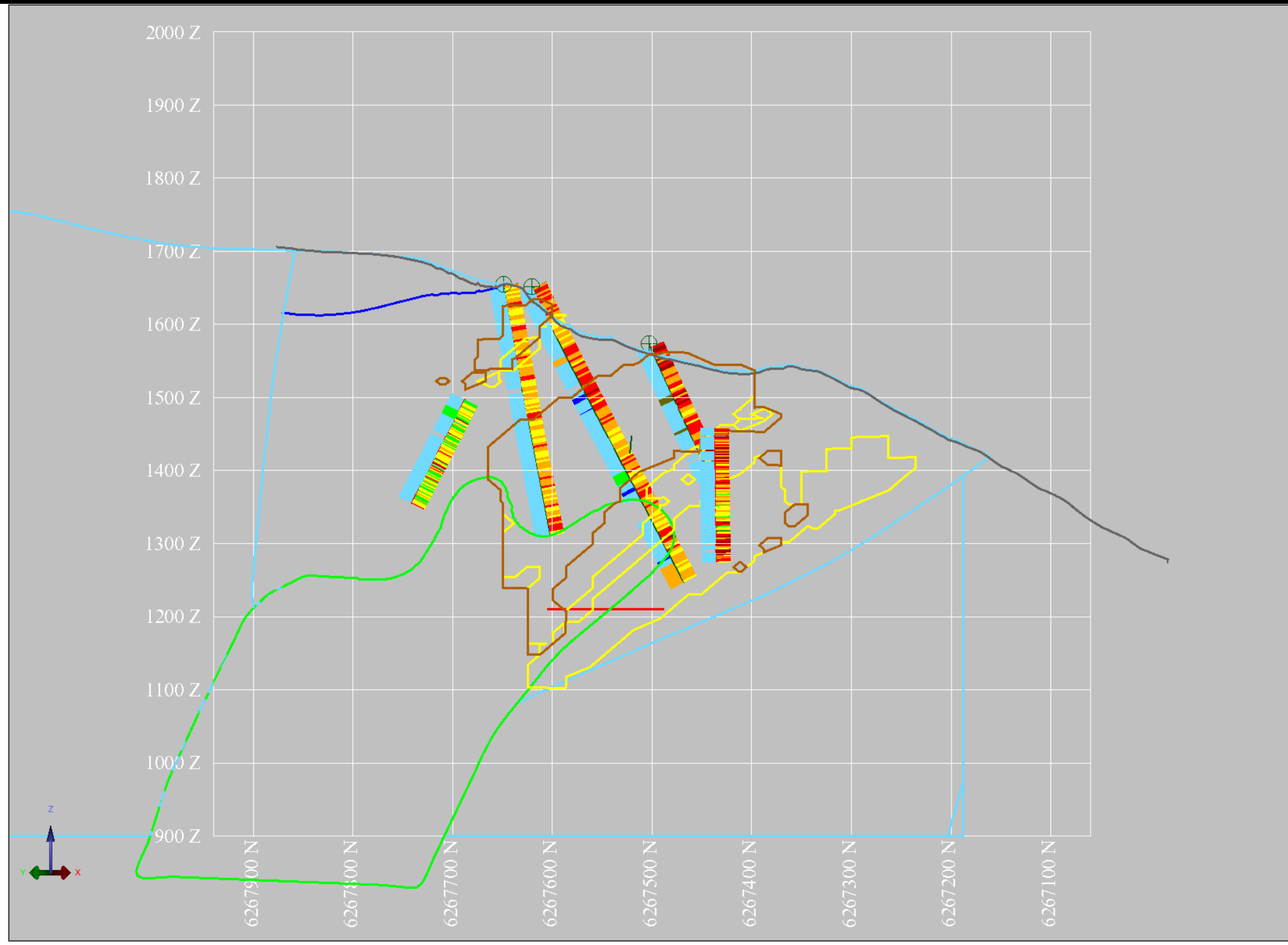
TITLE

IRON CAP – SECTION 10
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	FIGURE D-21
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone

Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

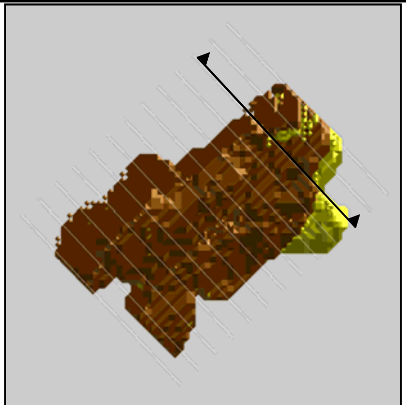
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 11
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	**FIGURE D-22**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		



LEGEND

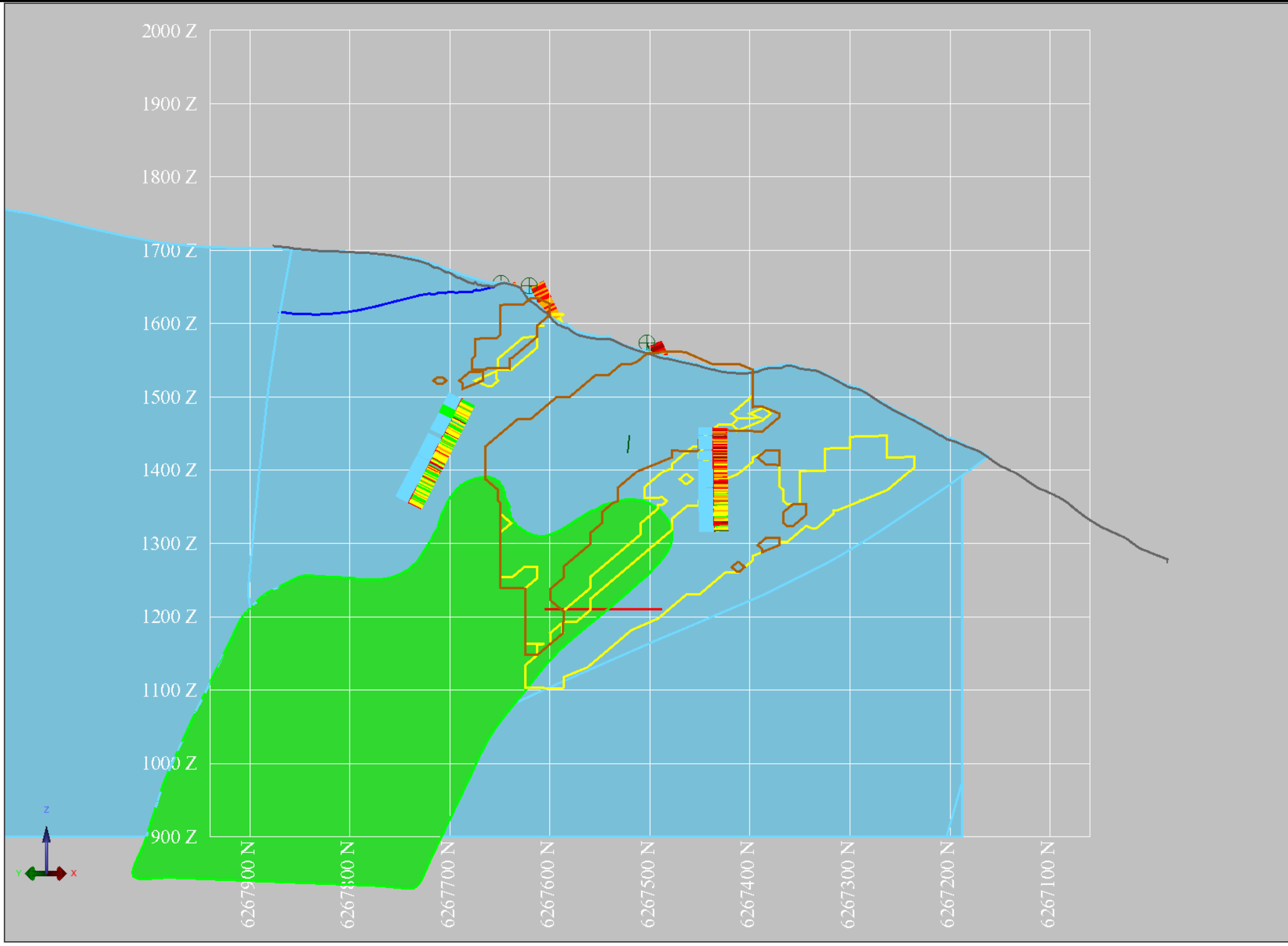
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone



Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

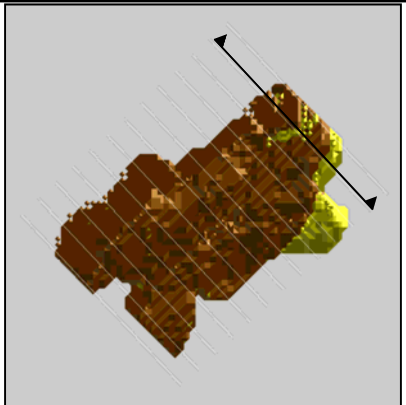
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 11
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	**FIGURE D-23**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		



LEGEND

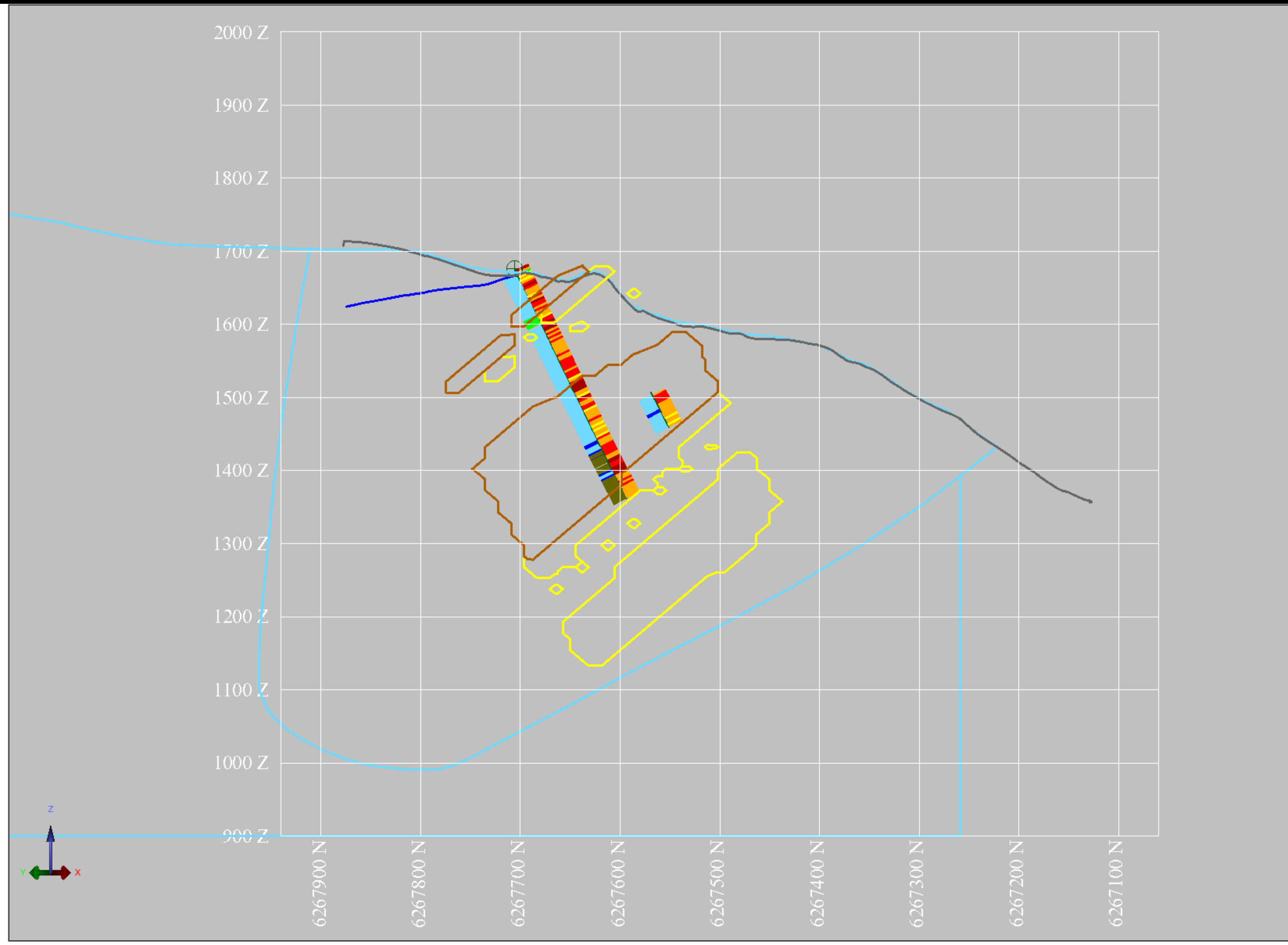
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

- CL-PR
- Carbonate
- Argillic
- QSP
- Potassic
- Silicic
- Skarn
- Quartz Vein
- Fault Zone



Fracture Frequency (/m)

- 0
- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

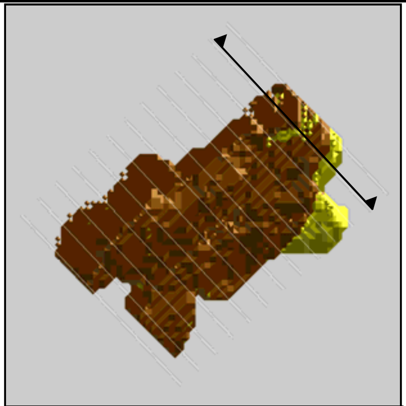
TITLE

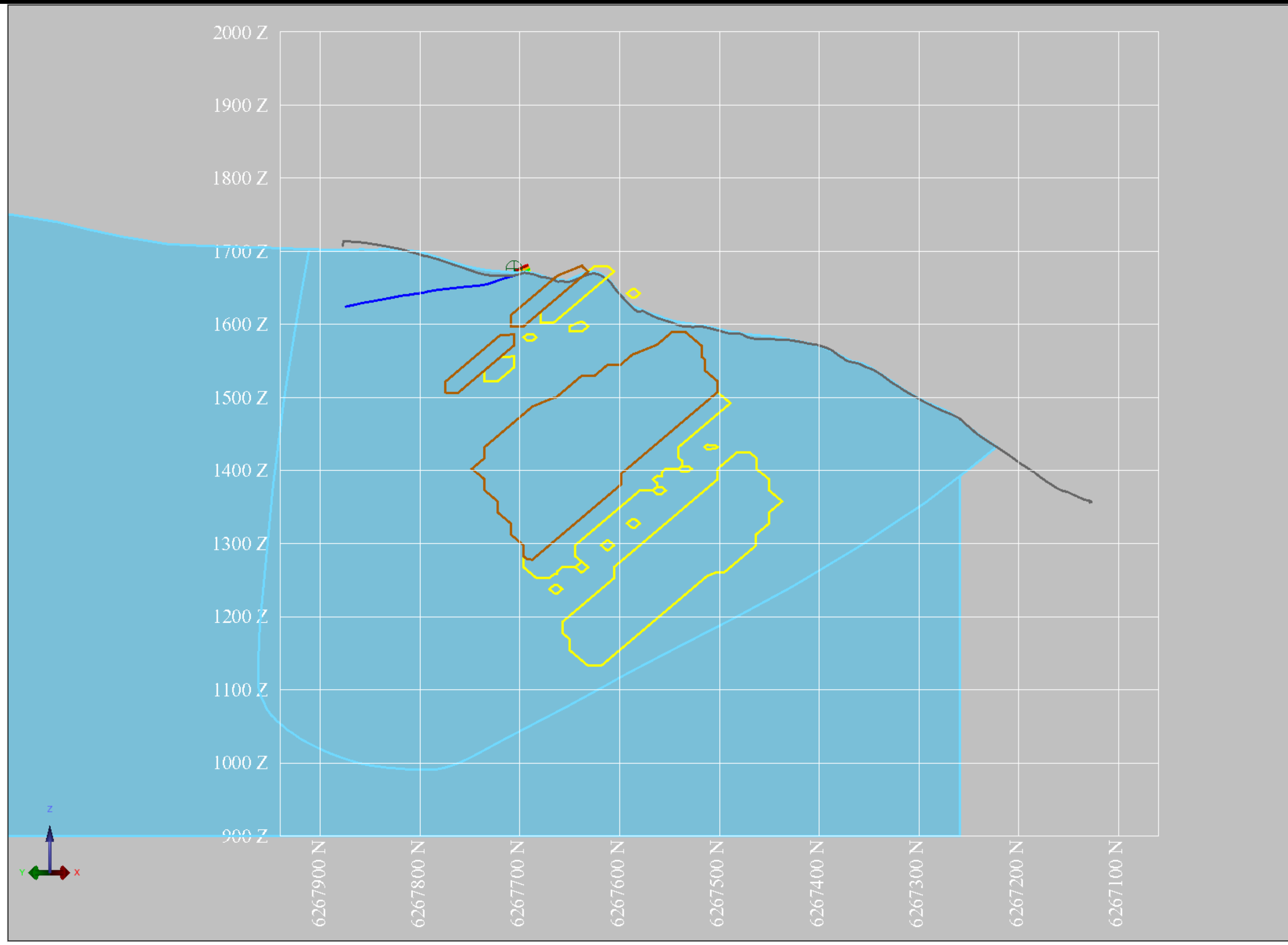
IRON CAP – SECTION 12
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11	**FIGURE D-24**	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

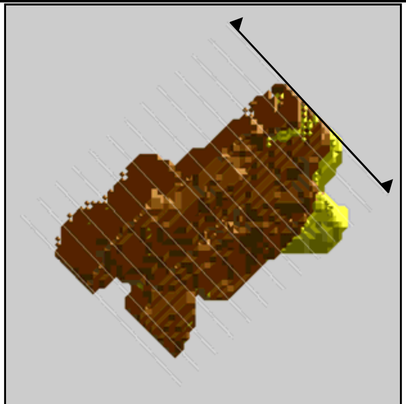
TITLE

IRON CAP – SECTION 12
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000	
DESIGN	CY	07NOV11	SCALE NTS	REV.--
CADD	CY	17NOV11		
CHECK	KMM	15FEB12	**FIGURE D-25**	
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



LEGEND

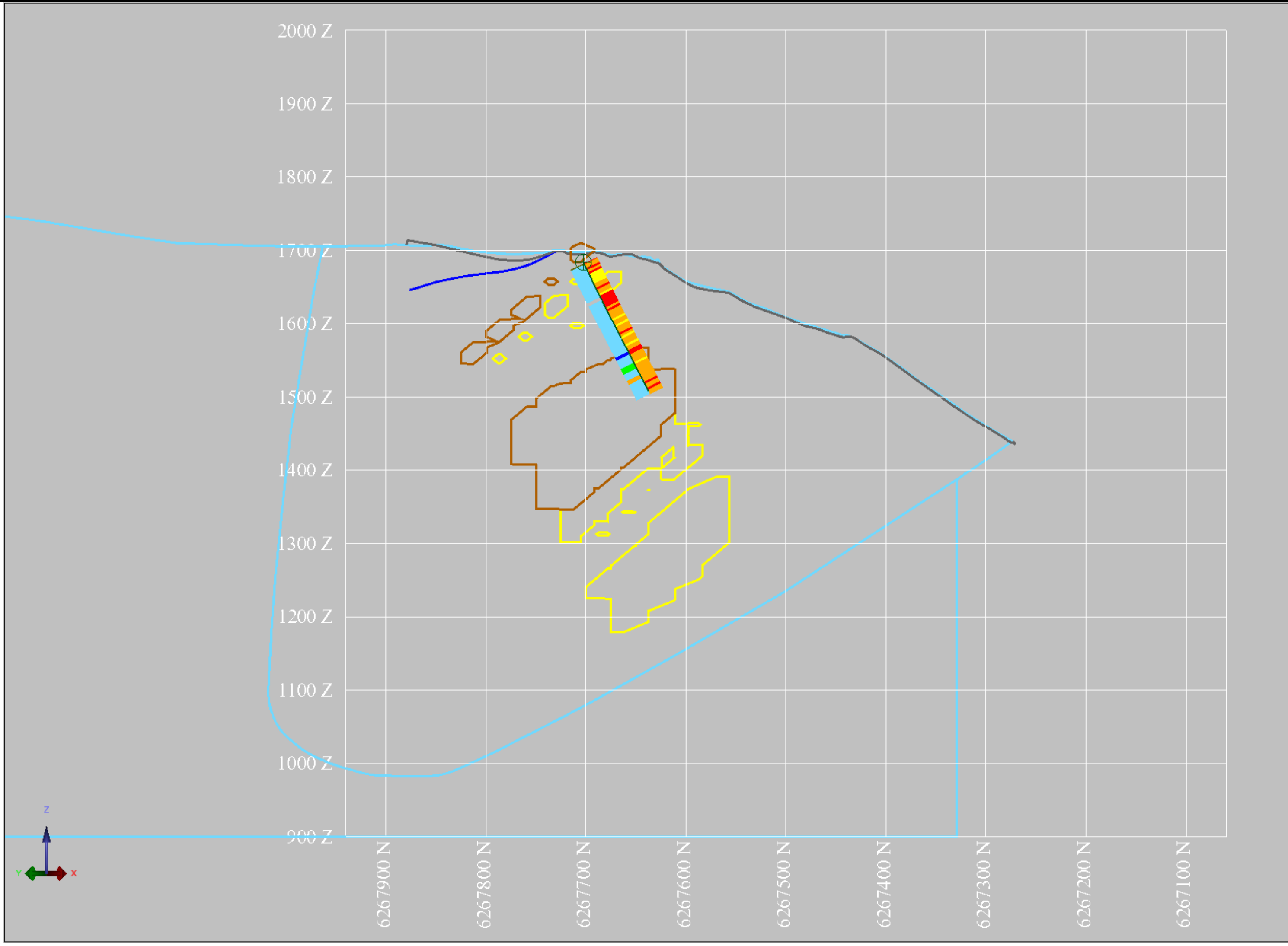
- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone



Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

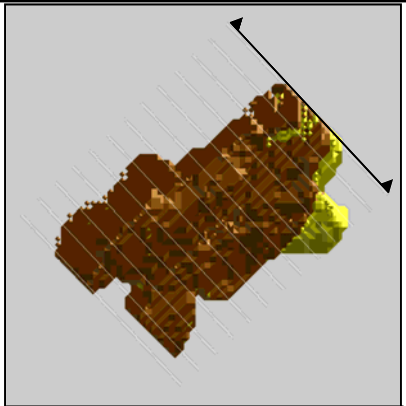
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

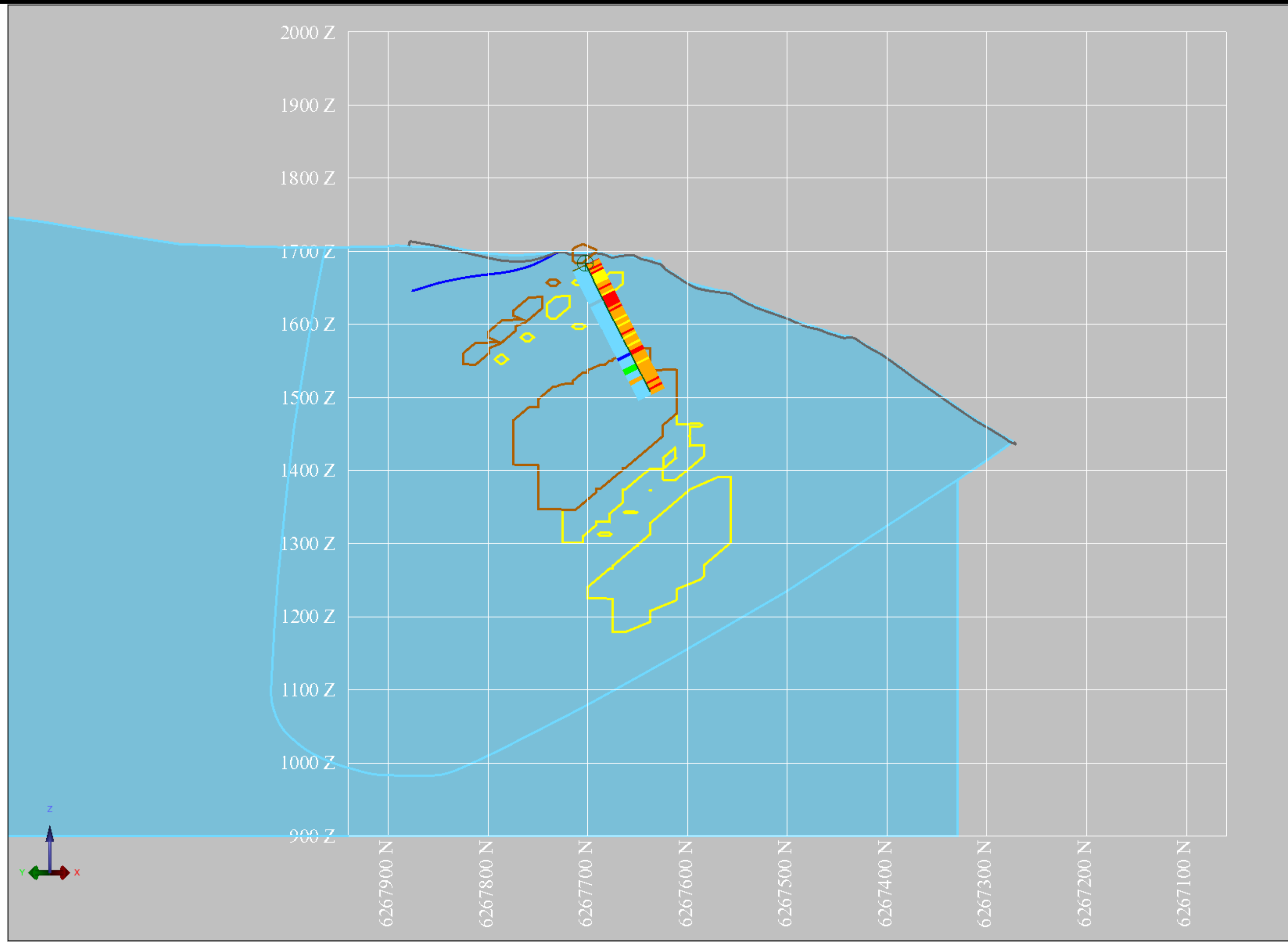
TITLE
IRON CAP – SECTION 13
ALTERATION, LITHOLOGY and RQD

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS REV.--
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	**FIGURE D-26**
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices





LEGEND

- CU 0.1% SHELL
- AU 0.25g/t SHELL
- TOPOGRAPHY
- ICE
- CL SHELL
- CL/SIL SHELL
- KP SHELL
- SIL SHELL
- CAVE FOOTPRINT

BOREHOLE

- EXPLORATION HOLES
- GEOTECH HOLES

Alteration

CL-PR	Silicic
Carbonate	Skarn
Argillic	Quartz Vein
QSP	
Potassic	Fault Zone

Fracture Frequency (/m)

0	3 - 5
0 - 1	5 - 10
1 - 3	> 10

PROJECT

SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE

IRON CAP – SECTION 13
ALTERATION SHELLS

Golder Associates

PROJECT No.11-1439-0002			PHASE No. 10000
DESIGN	CY	07NOV11	SCALE NTS — REV. --
CADD	CY	17NOV11	
CHECK	KMM	15FEB12	**FIGURE D-27**
REVIEW	RDH	15FEB12	

APPENDIX E

DFN Modelling and In-Situ Fragmentation Assessment

Seabridge Gold Inc. – Iron Cap

DFN Modelling and In-Situ Fragmentation Assessment

11-1439-0002 ph.10000

Golder Associates

Presentation Outline

- Introduction

- Methodology – Data Analysis
  - DFN Modelling and Workflow
  - Fracture Spatial Variation
  - Fracture Orientation Analysis
  - Fracture Size (Length) Analysis
  - Fracture Intensity Analysis
    - Cumulative Fracture Intensity
    - P32 Analysis

- Fragmentation Modelling Results

Discrete Fracture Network (DFN) Modelling

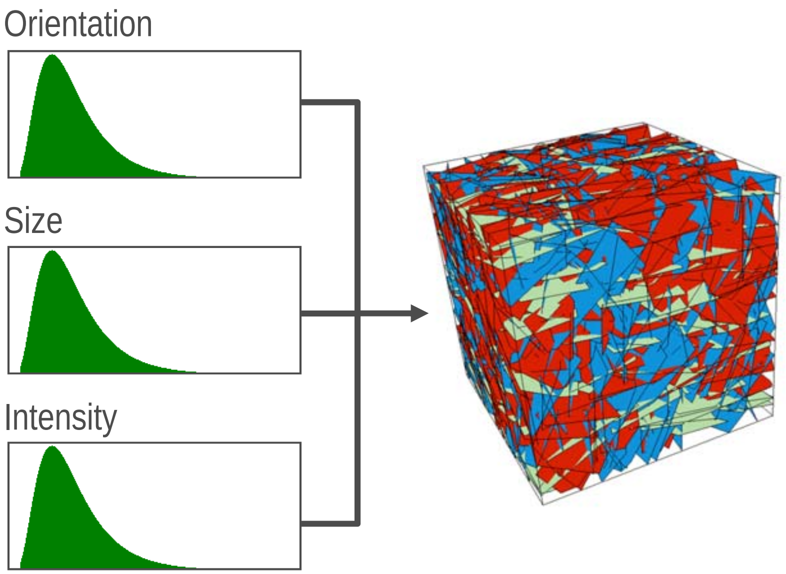
Introduction to DFN Modelling

- A key motivation for Golder's participation in the development of discrete fracture network modelling techniques was recognition of the generally poor way that conventional geotechnical characterization methods handle fracture data. In most applications, fracture properties are typically averaged or at best given unrepresentative geometric properties, often based upon unrealistic assumptions of fracture ubiquity, infinite length and parallel orientations. In contrast, DFN modelling attempts to model the rock mass fabric by describing the fracture system in a more realistic way, allowing a description of the fracture geometry that is driven by verifiable data.
- DFN models seek to describe the heterogeneous nature of fractured rock masses by explicitly representing key elements of the fracture system as discrete objects in space with appropriately defined geometries and properties. By building geologically realistic models that combine the larger observed deterministic structures with smaller stochastically inferred fractures, DFN models capture both the geometry and connectivity of the fracture network as well as the geometry of the associated intact rock blocks.

Discrete Fracture Network (DFN) Modelling

Parameters Required for a DFN Based Fragmentation Assessment

- The aim of the DFN modelling is to condition the fracture model as much as is possible to available data, and then use Monte Carlo simulations to quantify the uncertainty of extrapolation of the fracture pattern throughout the mine volume. It is a stochastic process allowing multiple but equi-probable realisations to be created.
- DFN models require certain fracture properties to be defined, namely:
  - Fracture Spatial Variation;
  - Fracture Orientation Distribution;
  - Fracture Size Distribution; and
  - Fracture Intensity.
  - Fracture termination (expressed as percentage) may also be defined for a given fracture set with respect to a primary one.



Fracture properties (orientation, size and intensity) can be defined by using various forms of distributions

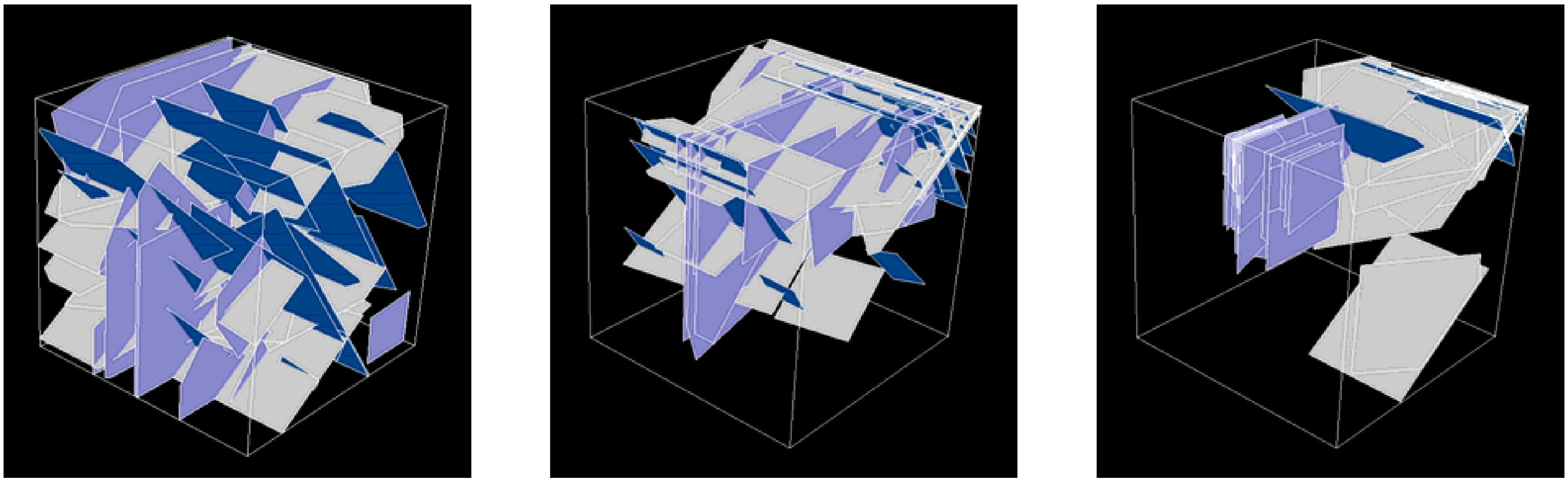
Discrete Fracture Network (DFN) Modelling

Fracture Spatial Variation

- A key parameter in the synthesis of a specific DFN model is the definition of a fracture spatial model. The main difference between DFN models is a function of the way fracture characteristics are considered (Dershowitz and Einstein, 1988; Staub et al., 2002; Rogers et al., 2007). Most of the models involve the same considerations for specific fracture characteristics, such as shape (generally polygons), size and termination at intersections. Fracture spatial models can be grouped according to the specific distribution laws utilised to simulate fracture orientation and fracture location. The choice of a specific fracture spatial model is typically based on assumptions made from field data and geological observations. The code FracMan used in the current study allows for the use of three different fracture spatial models:
- The Enhanced Baecher model, according to which fracture location may be defined by a regular (deterministic) pattern or a stochastic process. The stochastic approach assumes that the fracture centres are randomly located in space using a Poisson process.
- The Nearest-Neighbour model, which is a model particularly suited to model the tendency of fractures to be clustered around major points and faults by preferentially producing new fractures in proximity of earlier fractures (Dershowitz et al.,1998).
- The Fractal Levy-Lee model, which is a fractal model whose key features are that fracture centres are created sequentially and the size of a fracture is related to its distance from previous fractures (Staub et al., 2002).

Discrete Fracture Network (DFN) Modelling

Fracture Spatial Variation



Example of DFN models generated using different fracture spatial models for equivalent fracture orientation and radius distributions. Enhanced Baecher model (left), Nearest-Neighbour model (centered) and Fractal Levy-Lee model (right)

Discrete Fracture Network (DFN) Modelling

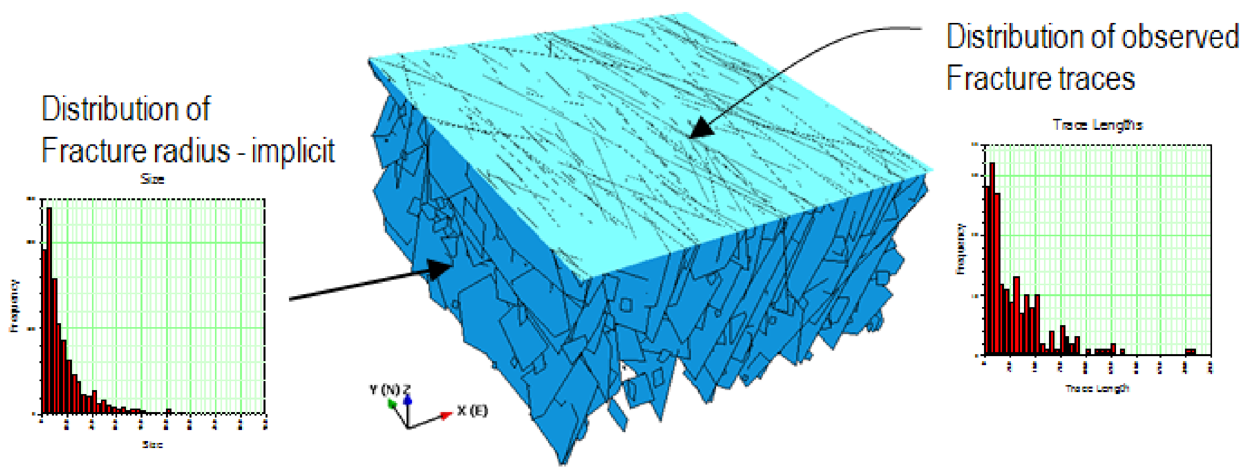
Fracture Orientation

- DFN models can be generated separately for each fracture set and then combined to obtain the overall representation of the fracture network. The application of separate statistical procedures to define fracture sets and, consequently the separate DFN models for each is known as a disaggregate approach. Distributions such as Fisher, Bingham, bivariate Fisher and bivariate Bingham can be used to represent fracture orientation. Alternatively, field data that do not conform to straight forward statistical methods (i.e. characterised by a highly dispersed scatter), can be analysed using a bootstrap approach, whereby a statistical method based upon multiple random sampling with replacement from an original sample is used to create a pseudo-replicate sample of fracture orientations.

Discrete Fracture Network (DFN) Modelling

Fracture Size Analysis

- The derivation of the fracture size distribution is critical to any DFN modelling campaign yet is generally among the most difficult parameter to constrain. The primary difficulty in determining fracture size is that it cannot be measured directly as any measurements relating to fracture size are actually measurements of the trace a fracture or fault make with a geological surface or mining exposure.



The problem in determining fracture size (radius) from observed fracture trace lengths

Methodology – Data Analysis

Fracture Intensity Analysis

- Defining fracture intensity within the mining industry is somewhat problematic as there are a wide range of possible measures, often with ambiguous definitions. In order get around this problem, the DFN community developed a series of fracture intensity measures

		Dimension of Measurement				
		0 (Count)	1 (Length)	2 (Area)	3 (Volume)	
Dimension of Sample	1D (e.g. borehole, scam line)	P10 *No of fractures per unit length of borehole*	P11 *Length of fractures per unit length*			*Linear Measures*
Dimension of Sample	2 (e.g. outcrop, bench mapping)	P20 *No of fractures per unit area*	P21 *Length of fractures per unit area*	*P22 Area of fractures per area*		*Areal Measures*
Dimension of Sample	3 (e.g. geophysical methods)	P30 *No of fractures per unit volume*		P32 *Area of fractures per unit volume*	P33 *Volume of fractures per unit volume*	*Volumetric Measures*
		Density		*Intensity*	*Porosity*	

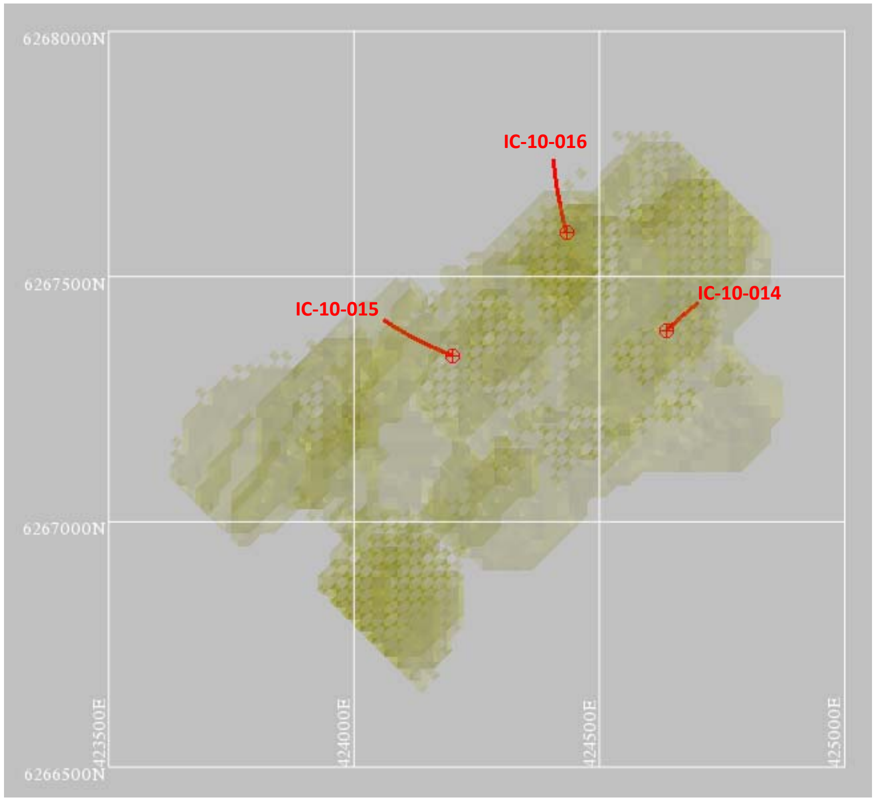
Fracture intensity measures based upon the dimension of the sample and the dimension of the fracture measure

Golder Associates

Primary Data Sources

Primary Data Sources

- The primary data used for this study are core logging data from boreholes IC-10-014, IC-10-015, IC-10-016
- A map showing the location of the drilled boreholes for Iron Cap is shown on the right



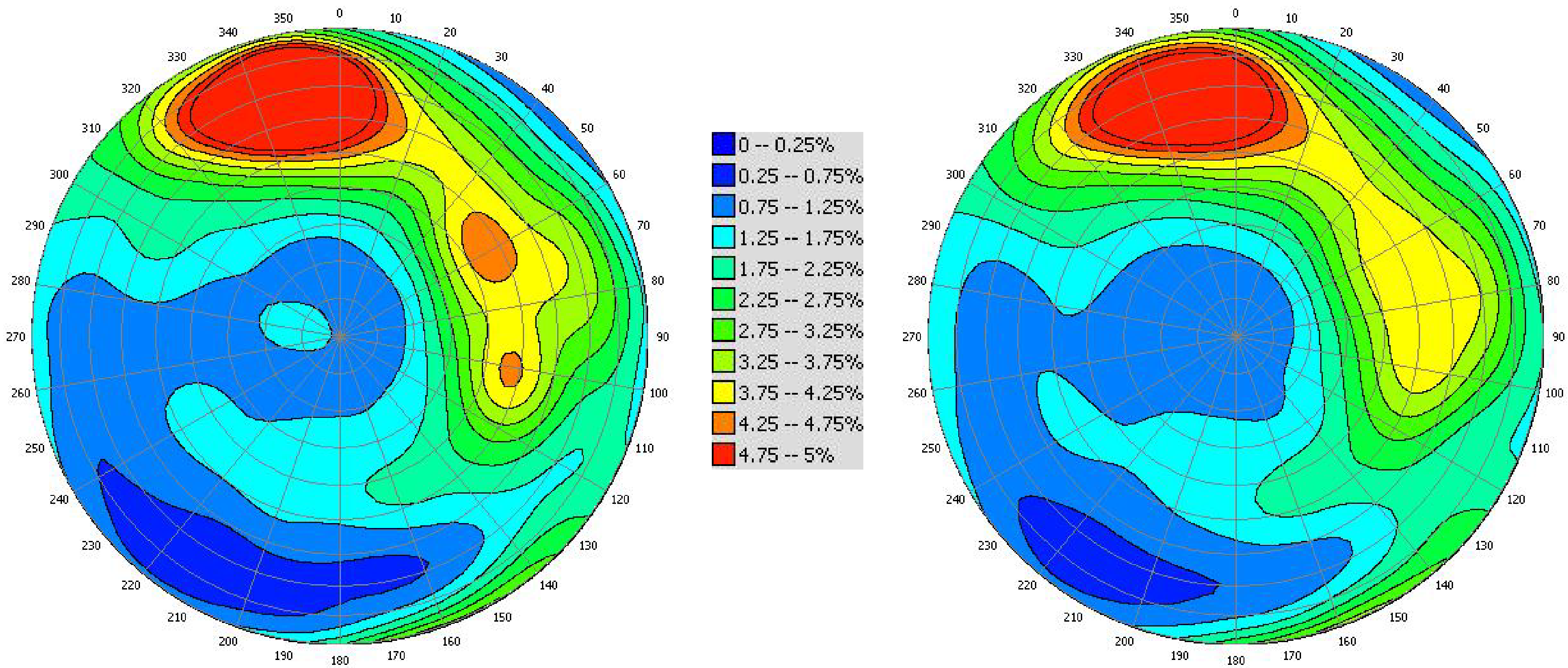
Map of geotechnical boreholes used in the analysis for Iron Cap

Fracture Orientation Analysis

- The major objective of the analysis of the fracture orientation data is to derive parameters for conditioning and extrapolation of fracturing throughout the mine volume. The main fracture types identified that are relevant to this study are Joints and Open Veins. The primary data used are core logging data from boreholes IC-10-014, IC-10-015, IC-10-016 (BGC)

Fracture Orientation Analysis

Fracture Orientation Analysis – Iron Cap

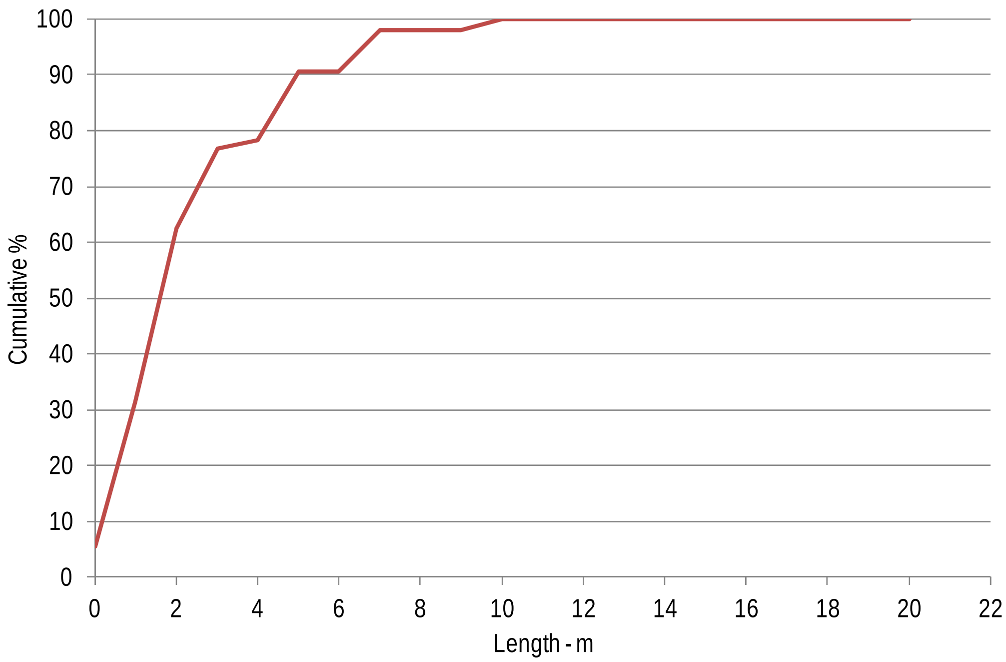


Stereonet projection of borehole data – comparison between mapped (left) and simulated (right) data for Iron Cap

Fracture Size Analysis

Fracture Size Analysis

- The primary fracture length data are provided from mapping carried out around the Mitchell site area.
- No mapped fracture length data was available for Iron Cap, therefore the same size distribution as Mitchell was used in the DFN model for Iron Cap.
- The main fracture types identified that are relevant to this study are Joints and Open Veins.
- As shown in the next two slides, it was found that an exponential distribution for fracture radius (mean of 2m) yielded a good agreement between the simulated and the mapped trace length data.

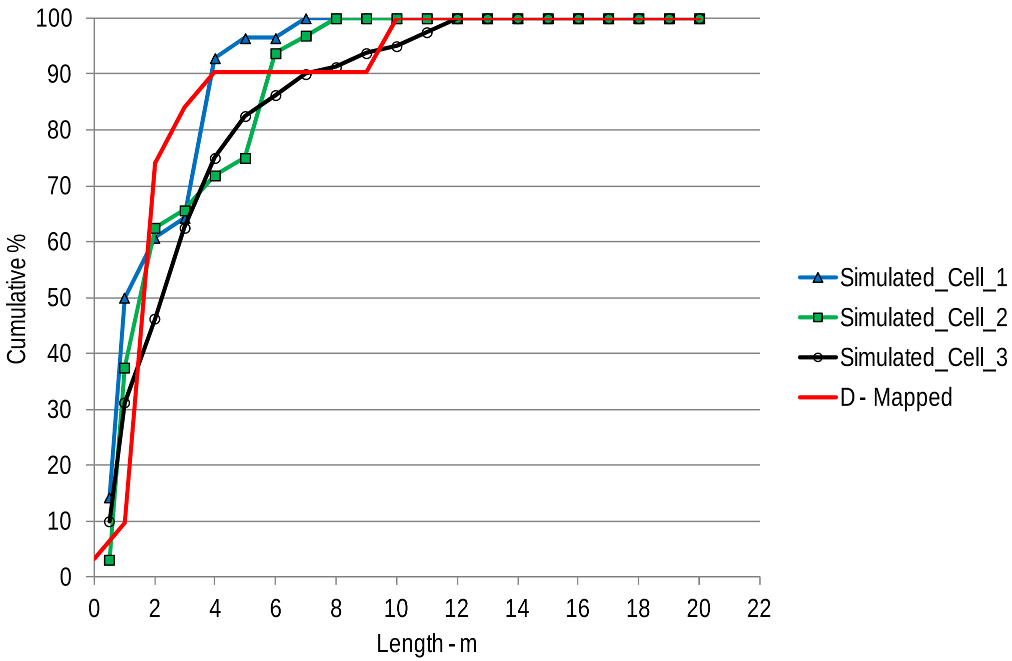


Cumulative frequency from mapped fracture trace lengths (Mitchell, all data)

Methodology – Data Analysis

Fracture Size Analysis

- The figure shows the comparison between the mapped data for Mitchell (Cell DD) and the simulated data in the DFN model.
- Since the mapped data included the actual length of traces extending outside the mapped cell, trace maps within a given cell (Cell_1, Cell_2 and Cell_3) were considered in the DFN model, and then compared to the mapped data.
- Cell_1 is 7 x 2 m, Cell_2 is 7 x 4 m and Cell_3 is 12 x 12 m
- The results show that there is a reasonably good agreement between the mapped and simulated fracture length over a range of simulated outcrop surfaces in the model.



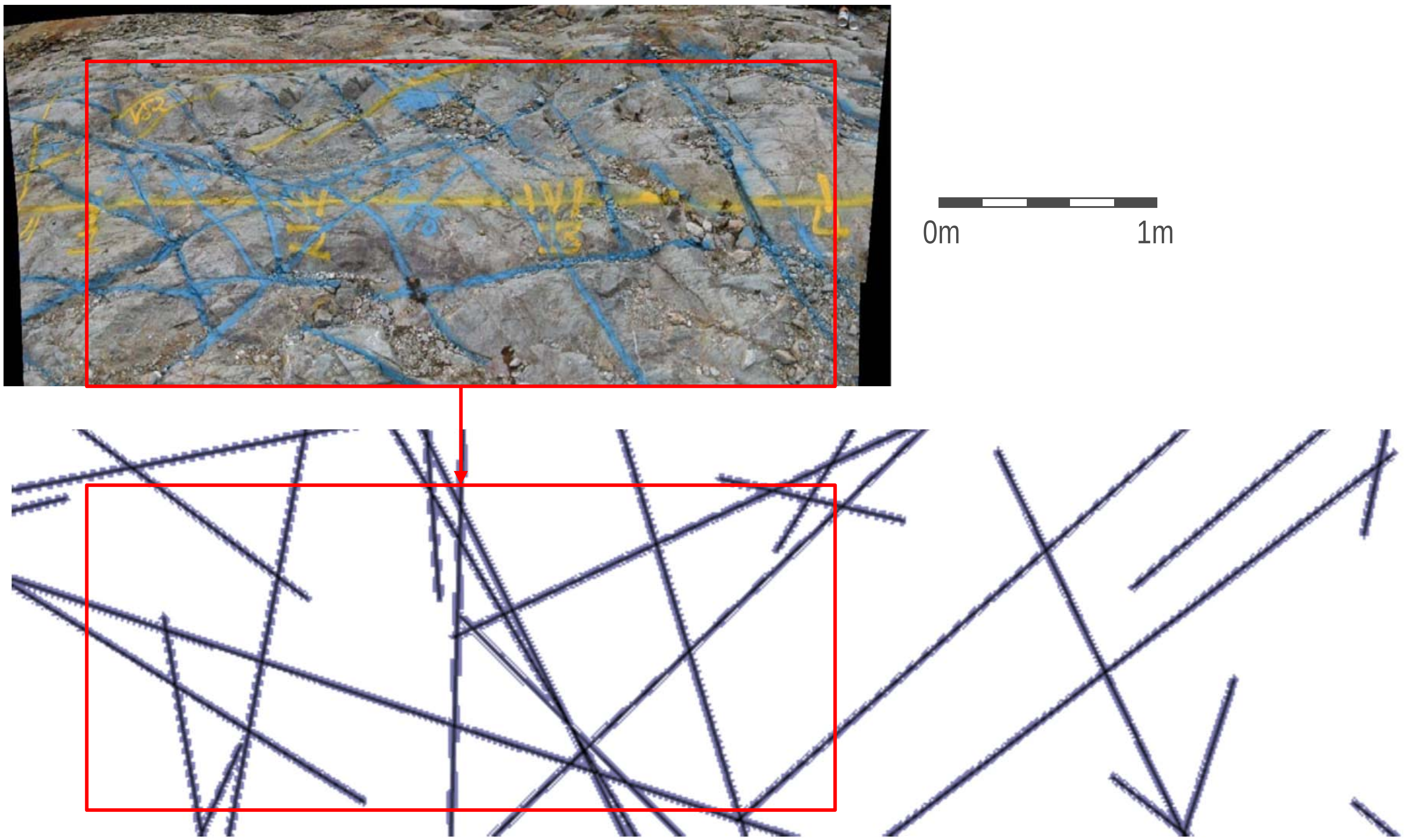
Comparison between mapped and simulated traces
Cell DD (Mitchell)

Golder Associates

Fracture Size Analysis

Fracture Size Analysis

- Visual comparison between mapped (Cell DD, Mitchell) and simulated data (Cell_1)



Fracture Intensity Analysis

- The primary data for fracture intensity available for modelling is the fracture frequency information from the geotech logs (P10 from with units m^{-1}).
- The methodology adopted to estimate the corrected fracture intensity to be used in the DFN model is as follows:
  1. Cumulative Fracture Intensity (CFI) plots are initially generated to establish variation of fracture frequency (P10) with depth.
  2. Since fracture frequency is defined relative to a borehole or scanline trajectory, and this may be heavily influenced by the orientation of fractures relative to that trajectory, a correction is applied to the fracture frequency data as part of the conversion from linear intensity P10 to volumetric intensity P32 (C31 calculation).
  3. For each borehole, cumulative frequency (P32) curves are plotted and a relative weight calculated over a given range [$P32_i$, $P32_{i-1}$]. The relative weight is subsequently used to obtain an averaged, weighted, fragmentation curve.

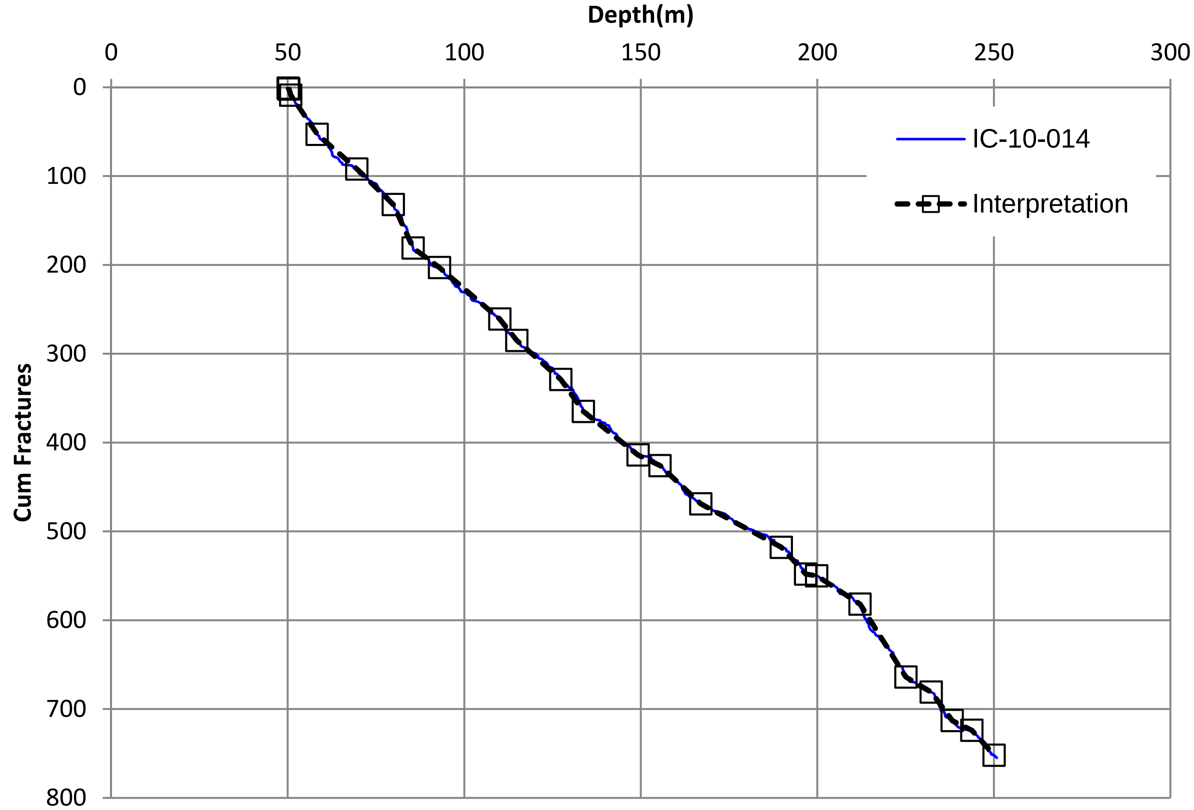
Fracture Intensity Analysis

Fracture Intensity Analysis – CFI

- Cumulative Fracture Intensity (CFI) plots have been generated for all of 3 geotechnical boreholes, with these displaying depths on the Y axis and cumulative fracture number on the X axis. They are interpreted as follows:
  - Where the slope (gradient) of the CFI curve is constant, the fracture frequency over that interval is constant. The measured gradient is the fracture frequency in fractures per metre (#/m);
  - Where the gradient of the curve is steepening, the fracture frequency is increasing; and
  - Where the gradient of the curve is flattening, the fracture frequency is decreasing.
- CFI plots emphasize common zones of fracture frequency rather than the variation and represent a practical way to approximate the variation of fracture frequency along the length of the boreholes.

Fracture Intensity Analysis

Fracture Intensity Analysis – CFI



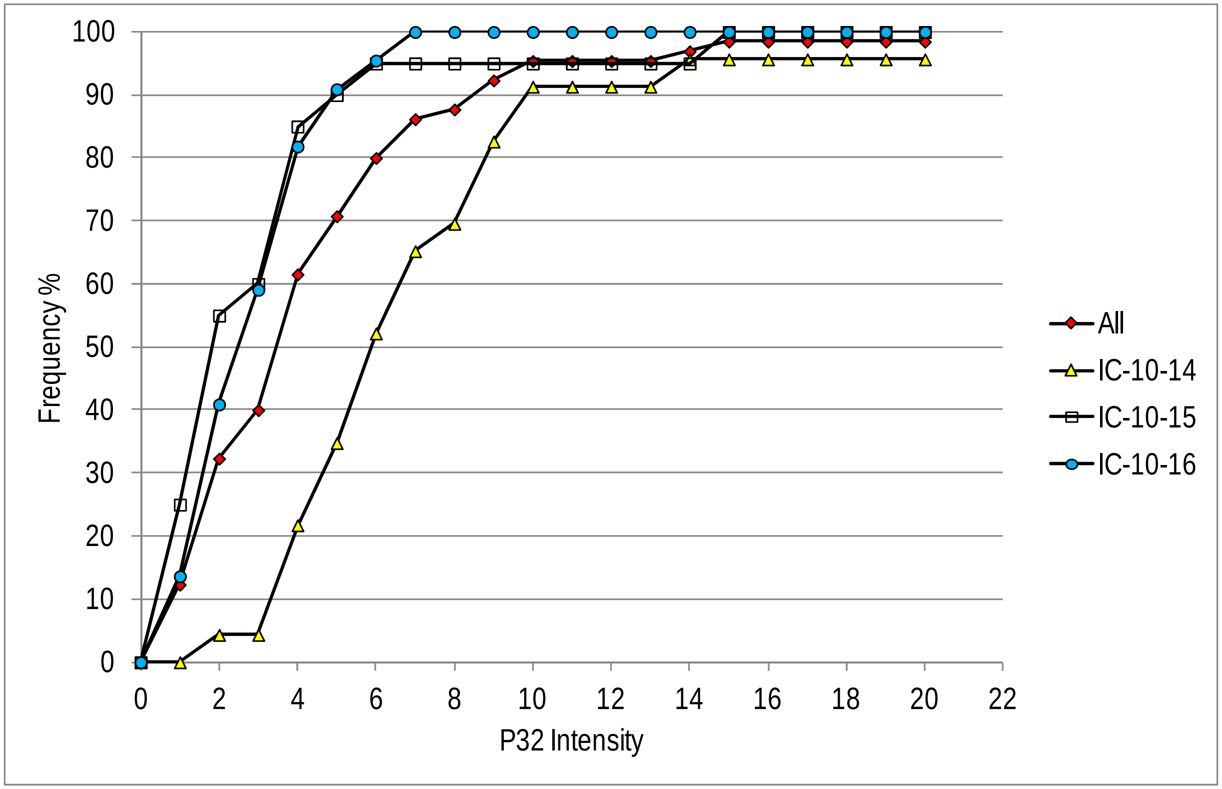
Example Cumulative Fracture Intensity plot showing both raw data (solid line) and interpretation (dashed line)

Fracture Intensity Analysis – P32 Computation

- Once the CFI curves and the P10 intervals have been completed for all boreholes a conversion factor (C31) is computed to be used to convert linear intensity (P10) to volumetric intensity (P32). This numerical approximation is based on the doctoral research by Wang (2005) on stereological relationships between fracture orientation and fracture intensity (for detail see FracMan Manual, 2011).

Fracture Intensity Analysis

Fracture Intensity Analysis – P32 Computation

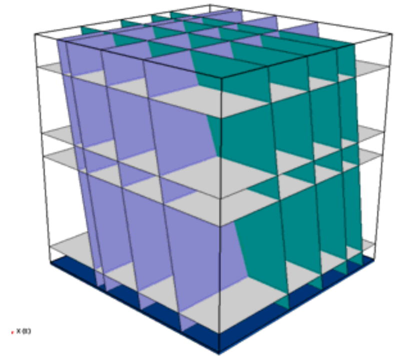


P32 Class	Class Weight
0-1	12.31%
1-2	20.00%
2-3	7.69%
3-4	21.54%
4-5	9.23%
5-6	9.23%
6-8	7.69%
8-10	7.69%
10-12	0.00%
12-14	1.54%
14-16	1.54%
16-18	0.00%
18-20	0.00%
20-21	1.54%

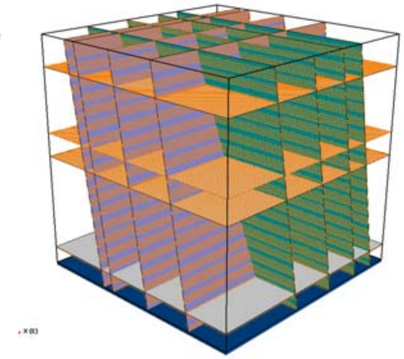
P32 frequency curves and table showing the relative P32 weights for different ranges (Iron Cap data)

Fragmentation Analysis

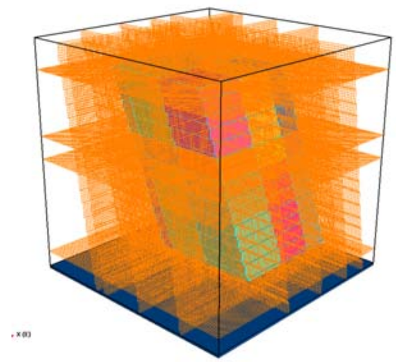
- Fragmentation is critical to the mining process, since fragmentation distribution strongly influences such issues as draw point sizing and equipment selection.
- The DFN model can be used to define the rock mass in situ (natural) fragmentation.
- An implicit cell mapping algorithm is used that identifies all fracture intersections with an underlying grid. This results in a collection of grid faces and connection information, which is then used to construct a rock block of contiguous grid cells.



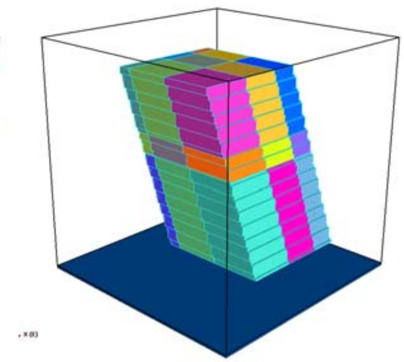
Initial fractures



Mapping fractures to grid cells



Regular block (Grid Block) is formed along grids with the initial fractures.



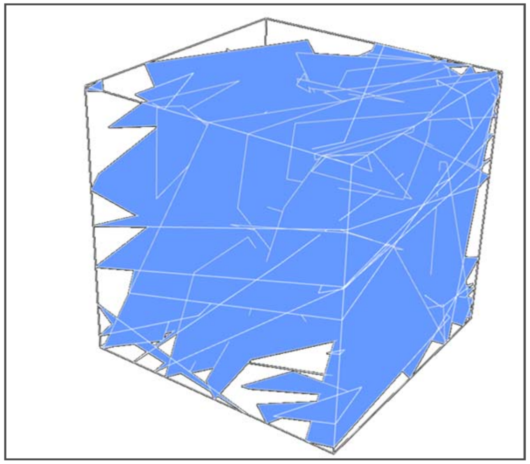
Grid Block

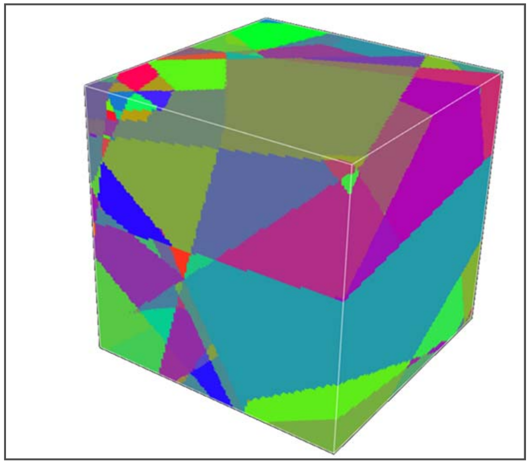
Cell mapping algorithm

Golder Associates

Fragmentation Analysis

- The fragmentation analysis has been carried out within a volume with dimensions 5x5x5m.

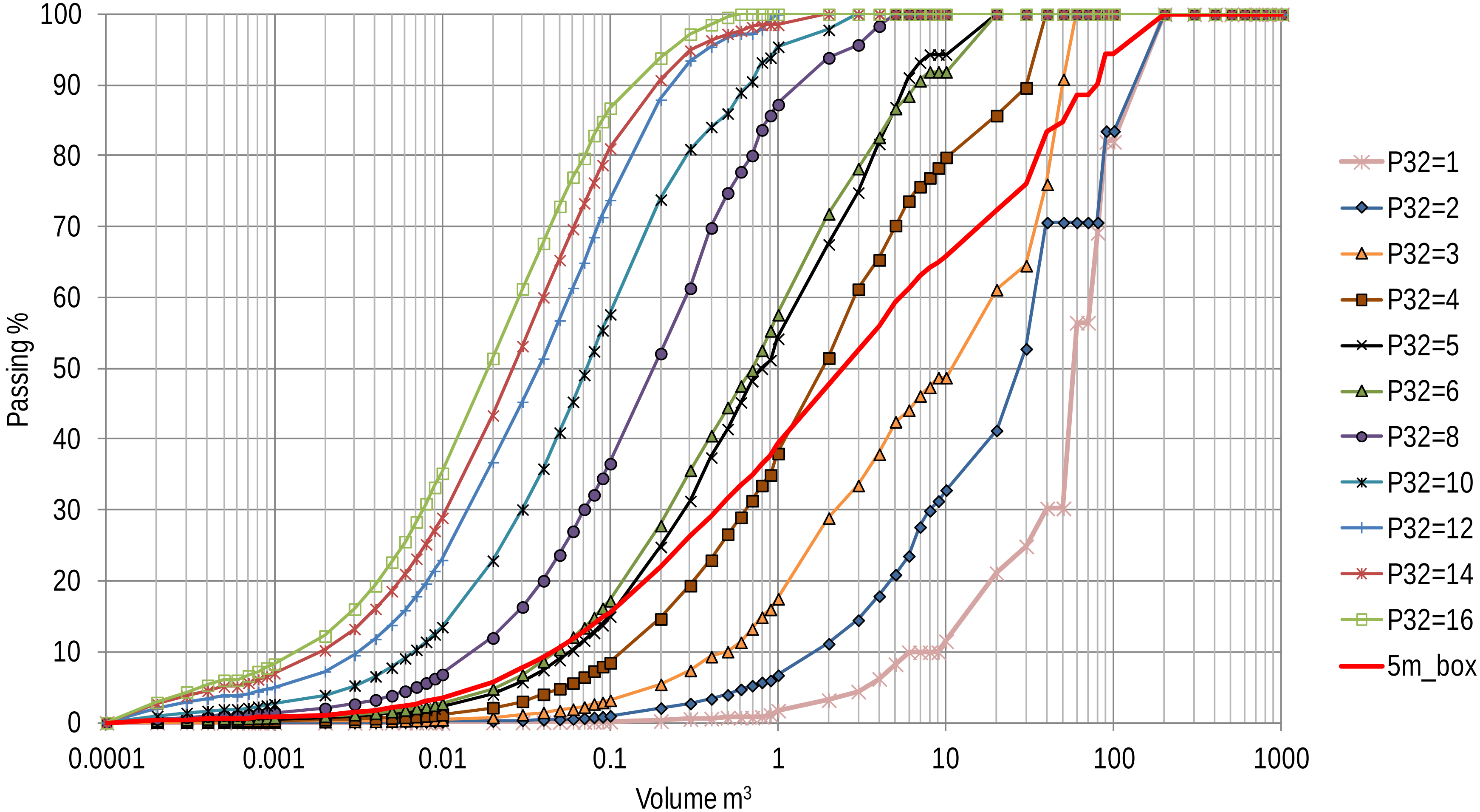




Example of cell mapping algorithm for the Iron Cap data (5x5x5 region)

Fragmentation Modelling Results

Fragmentation Curves for Varying Fracture Intensity

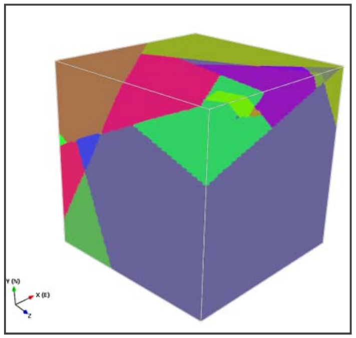


Iron Cap

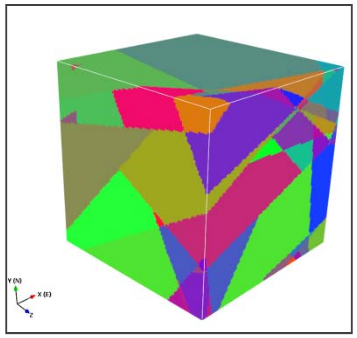
Block size percent passing curves

Fragmentation Results for Varying Fracture Intensity

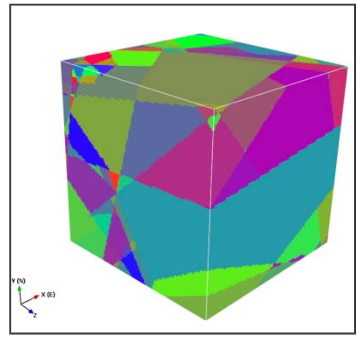
P32 =1



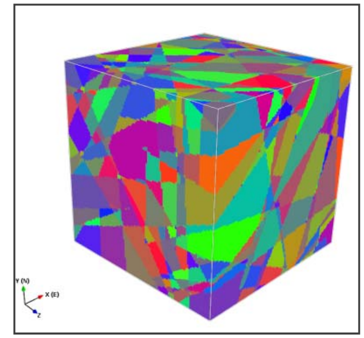
P32 =2



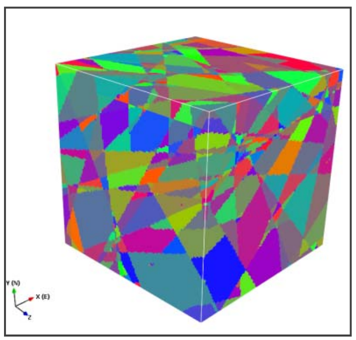
P32 =3



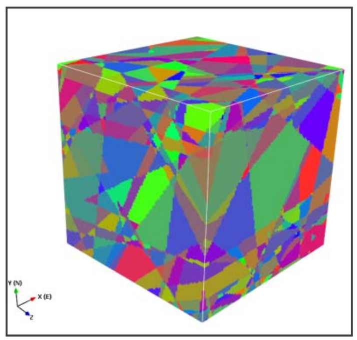
P32 =4



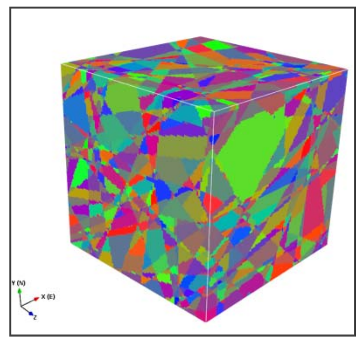
P32 =5



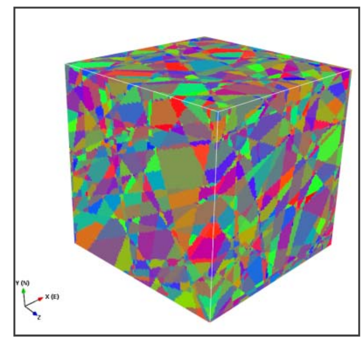
P32 =6



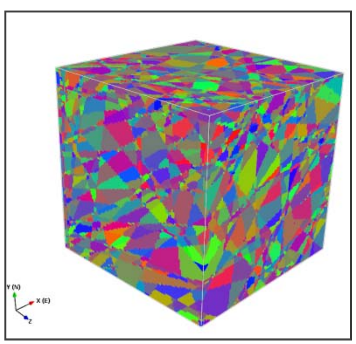
P32 =8



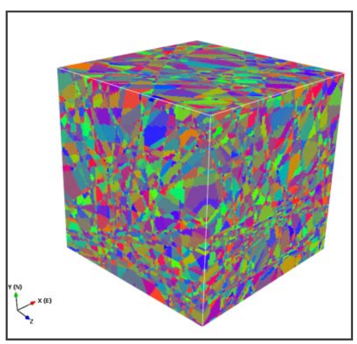
P32 =10



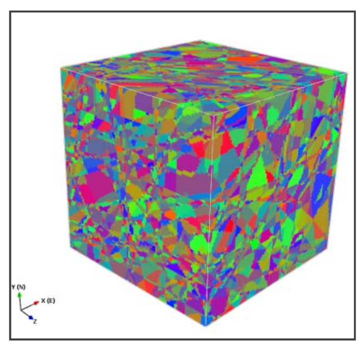
P32 =12



P32 =14



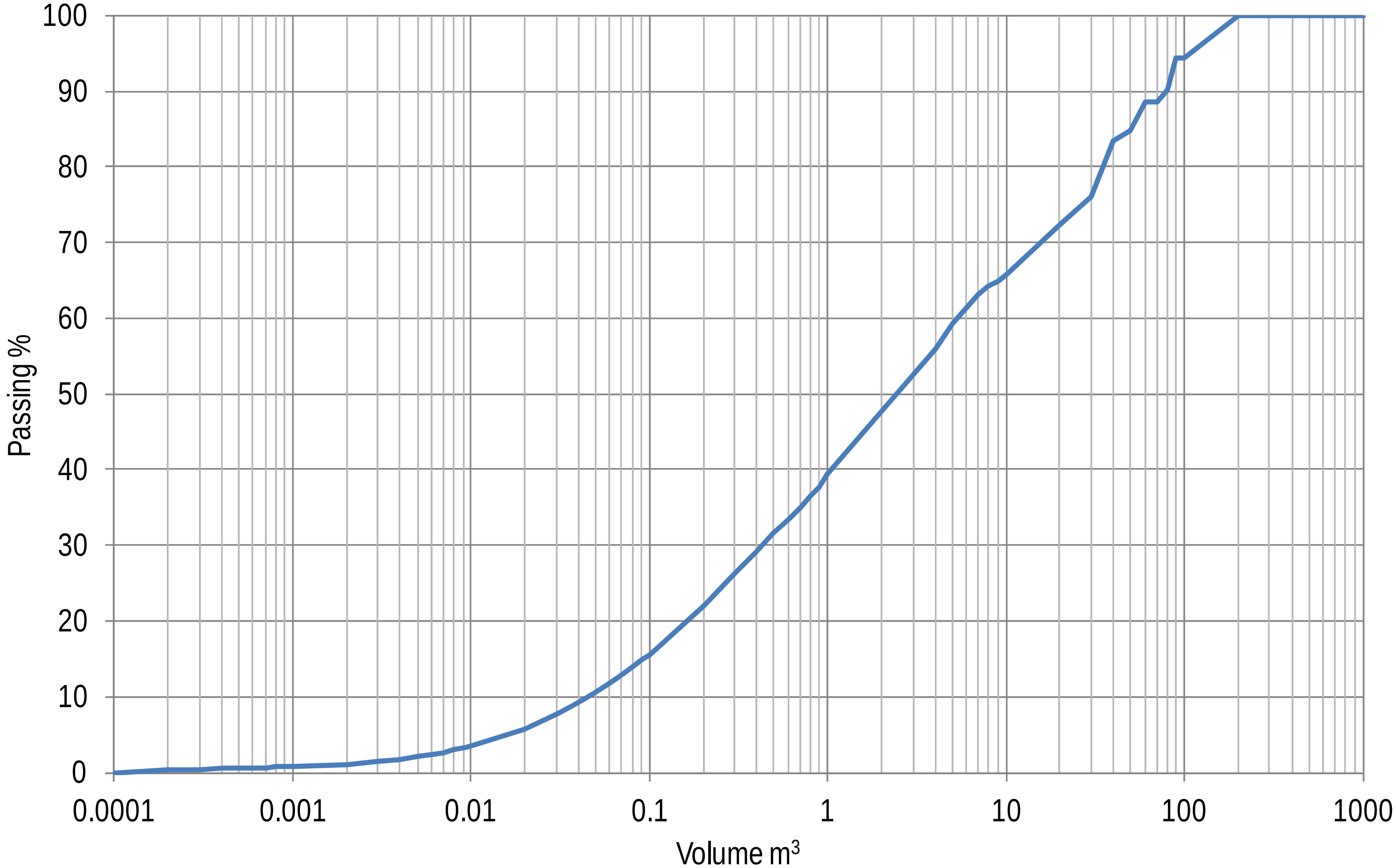
P32 =16



Block size generation for different P32 values based on DFN model

Iron Cap

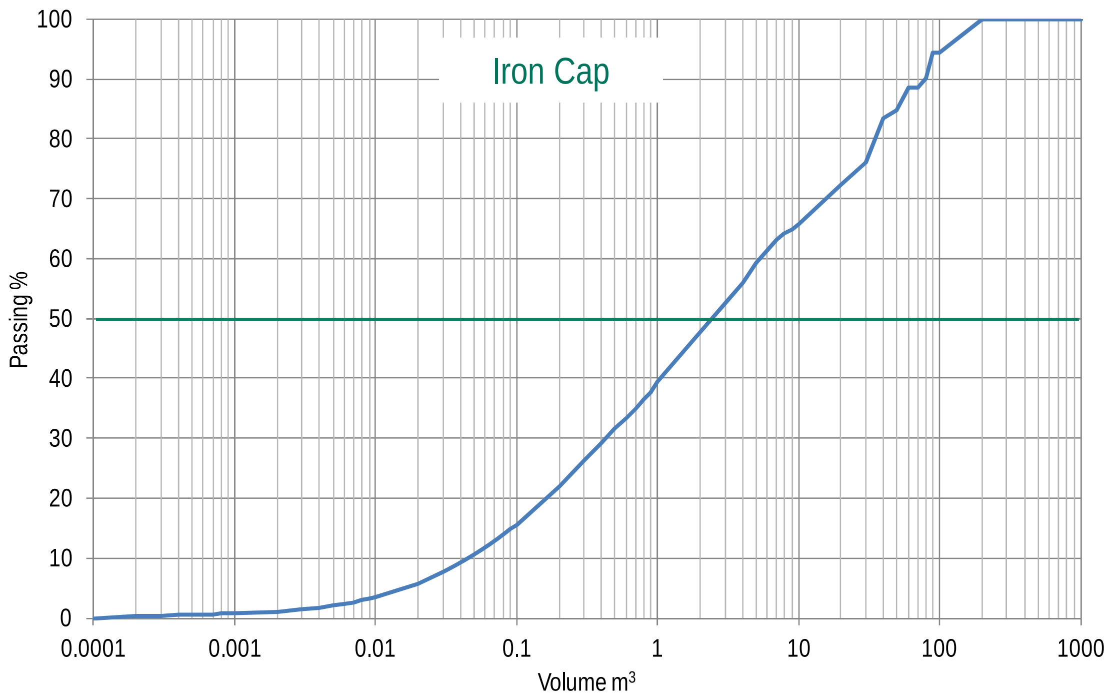
Fragmentation Results (Averaged Curve) – Iron Cap



Block size percent passing averaged curve

Golder Associates

Summary of Results

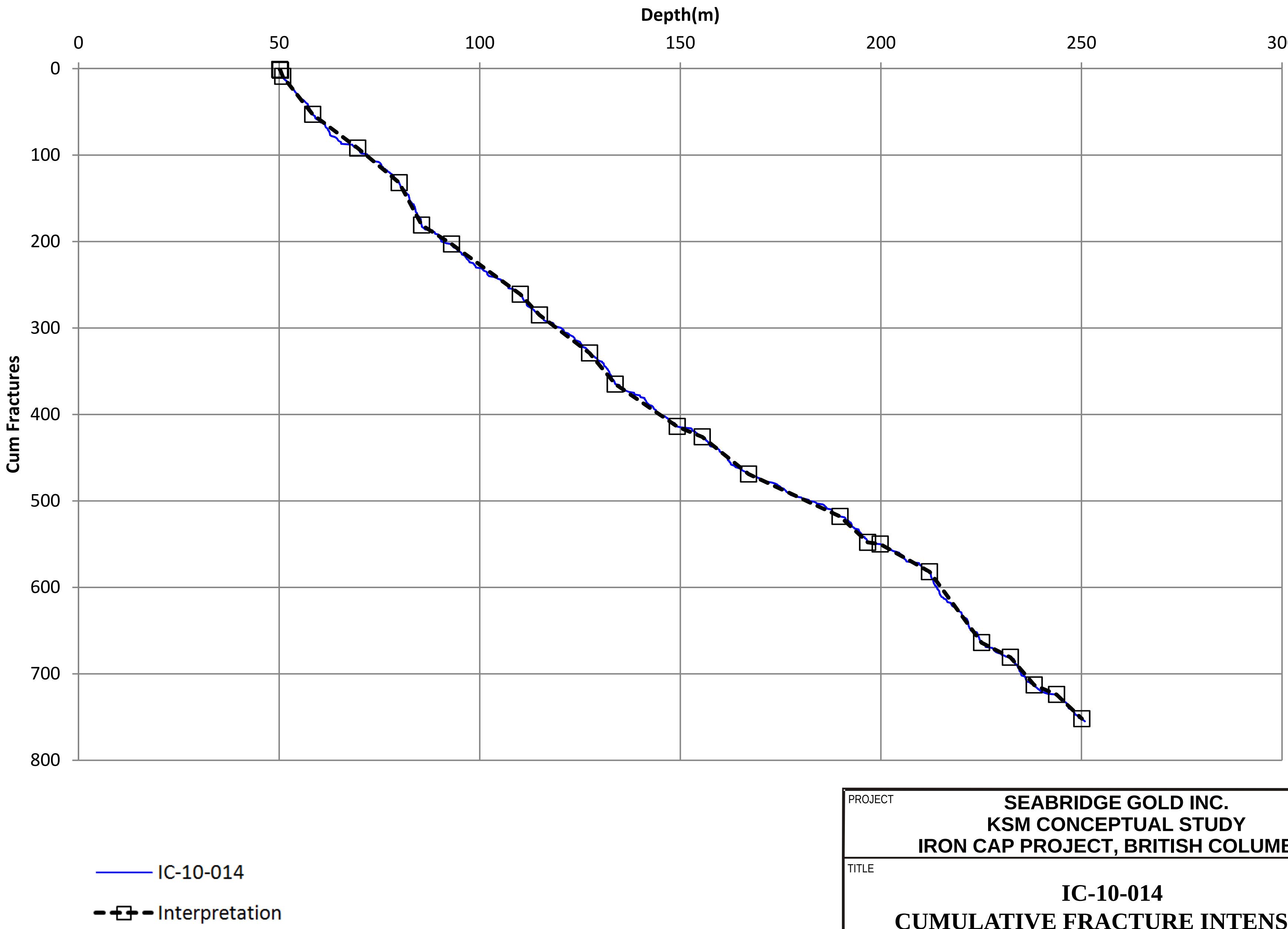


Percent Passing P50 (mean)	Region 5x5x5
Block Volume (m^3)	2.49

Golder Associates

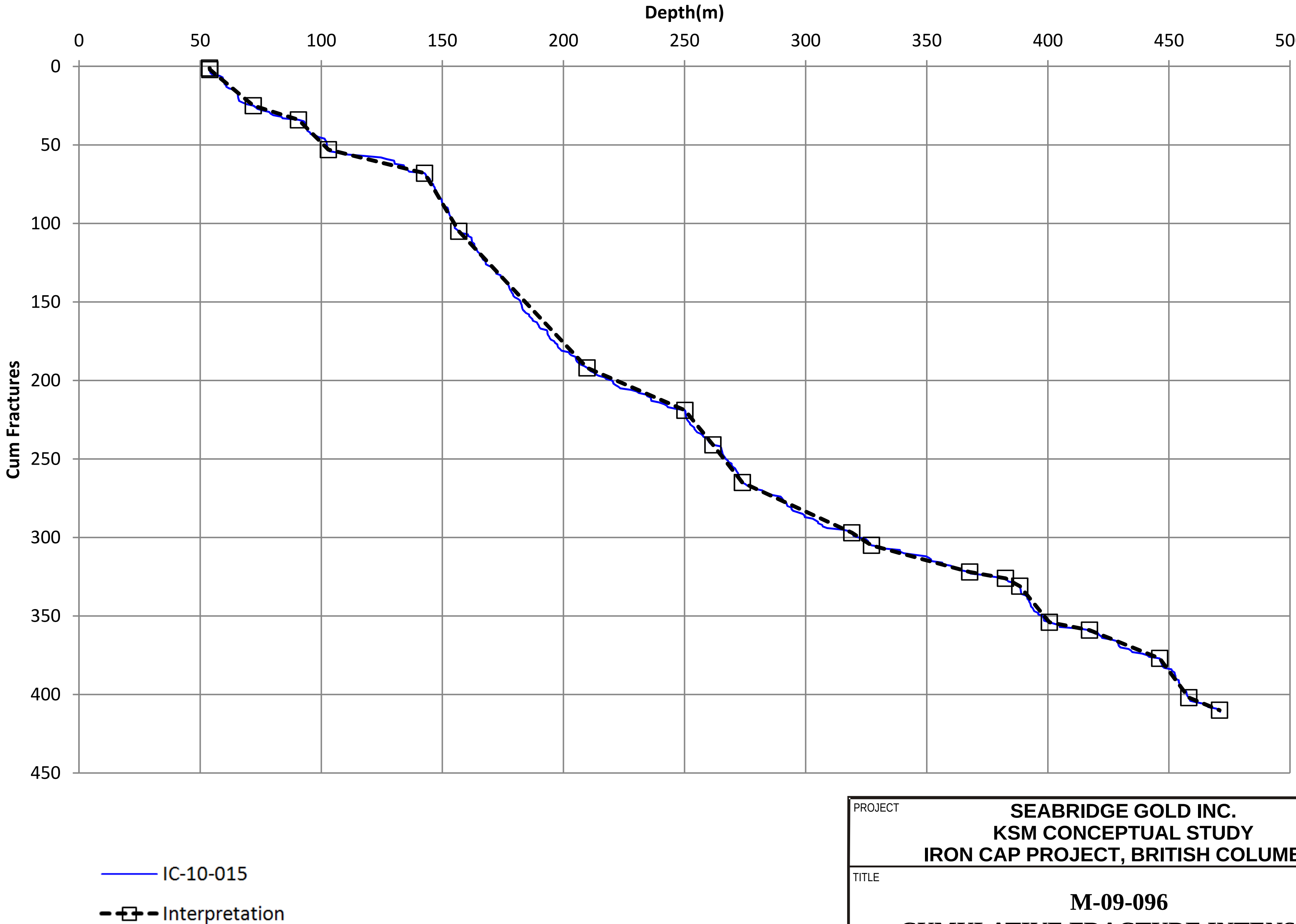
APPENDIX F

Cumulative Fracture Intensity Plots



PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	IC-10-014 CUMULATIVE FRACTURE INTENSITY

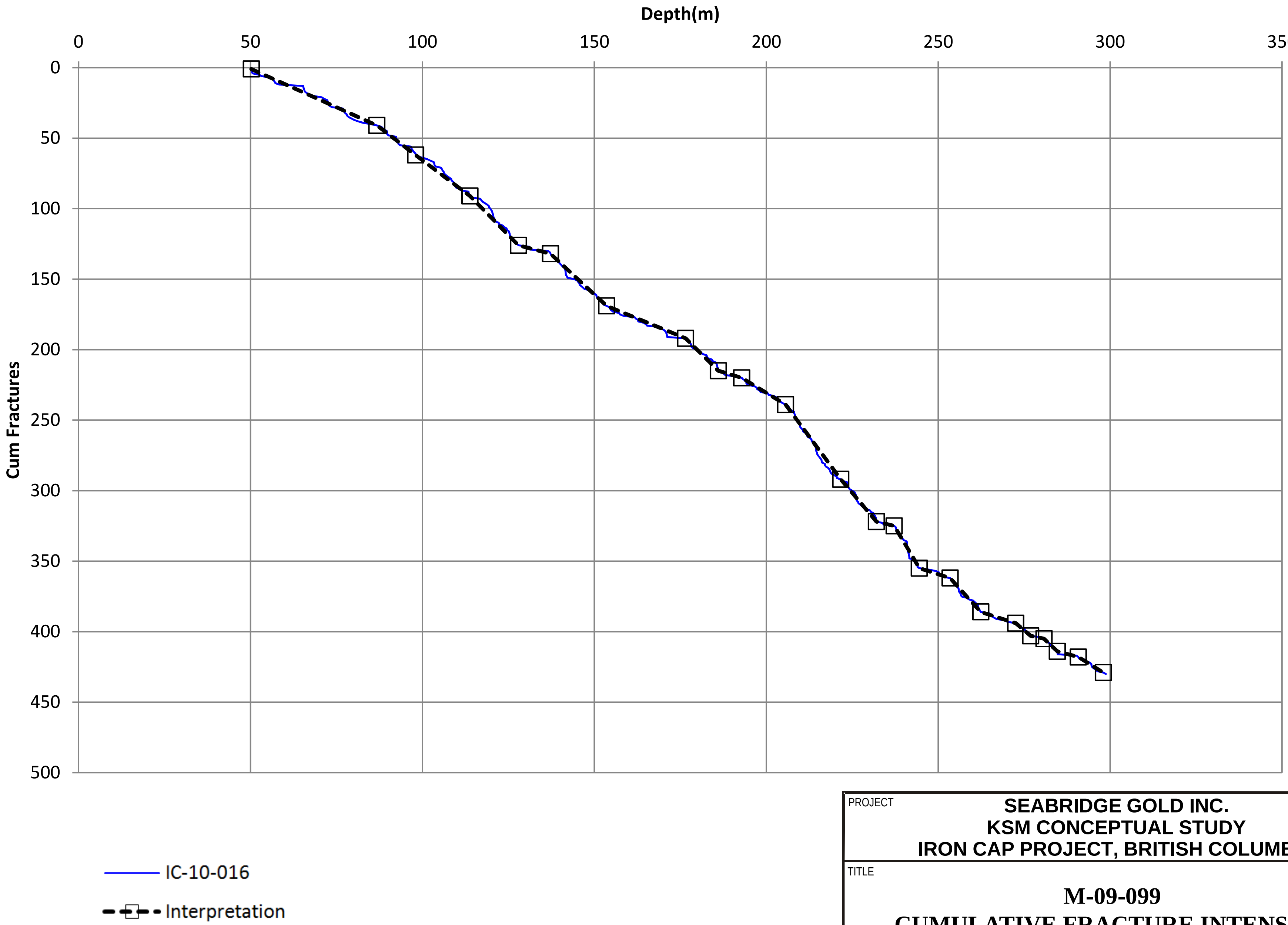
Golder Associates			
PROJECT No. 11-1439-0002			PHASE No. 10000
DESIGN	MV	30OCT11	SCALE NTS REV. --
CADD	MV	06JAN12	FIGURE F-1
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	



PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	M-09-096 CUMULATIVE FRACTURE INTENSITY

Golder Associates			
PROJECT No. 11-1439-0002			PHASE No. 10000
DESIGN	MV	30OCT11	SCALE NTS REV.--
CADD	MV	06JAN12	FIGURE F-2
CHECK	KMM	15FEB12	
REVIEW	RDH	15FEB12	

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



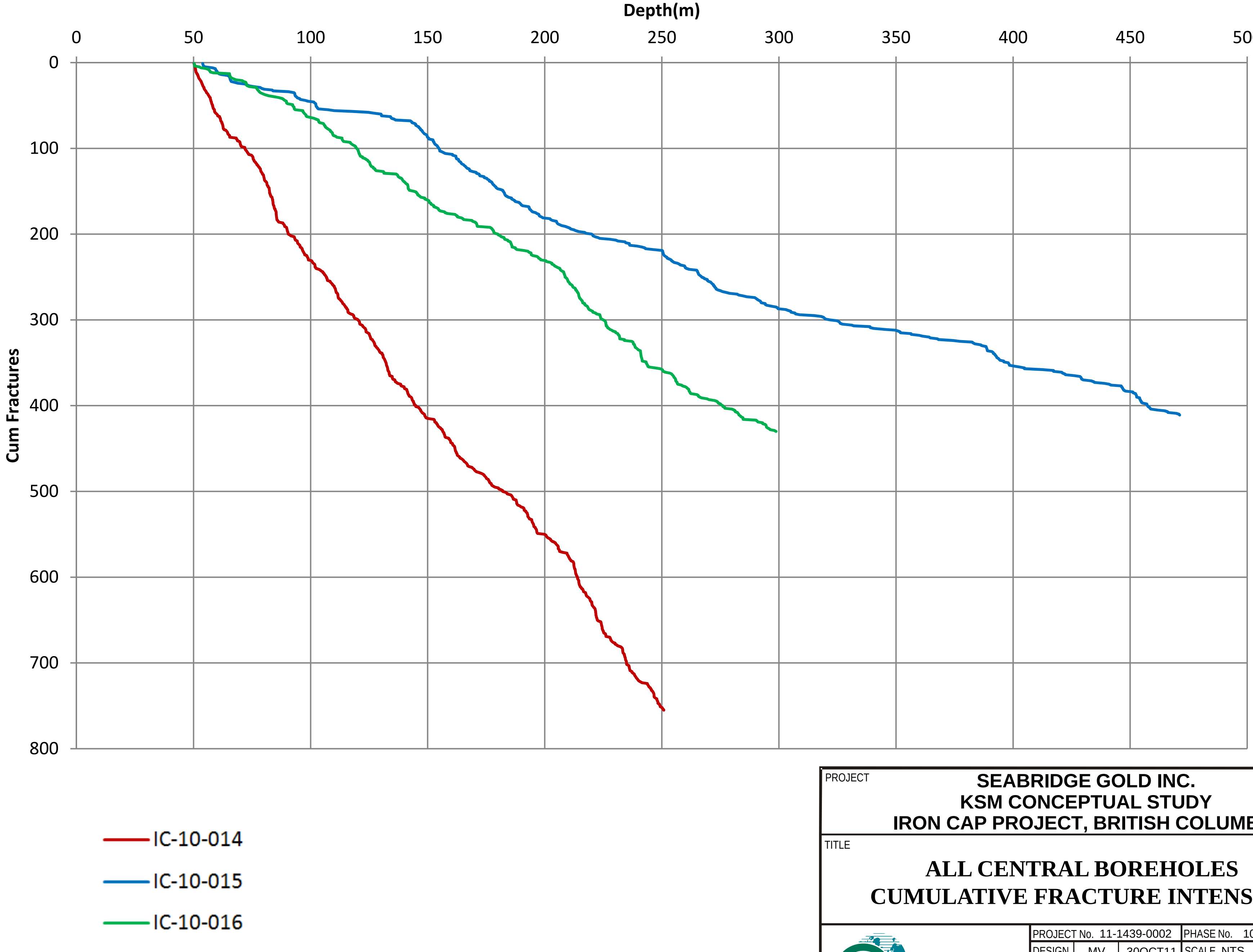
PROJECT
SEABRIDGE GOLD INC.
KSM CONCEPTUAL STUDY
IRON CAP PROJECT, BRITISH COLUMBIA

TITLE
M-09-099
CUMULATIVE FRACTURE INTENSITY

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	MV	30OCT11	SCALE NTS	REV. --
CADD	MV	06JAN12	FIGURE F-3	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

O:\Active_2011\1439\11-1439-0002 Seabridge PFS\10_Reporting\Iron Cap Geotechnical Characterization Report\Appendices



PROJECT	SEABRIDGE GOLD INC. KSM CONCEPTUAL STUDY IRON CAP PROJECT, BRITISH COLUMBIA
TITLE	ALL CENTRAL BOREHOLES CUMULATIVE FRACTURE INTENSITY

Golder Associates

PROJECT No. 11-1439-0002			PHASE No. 10000	
DESIGN	MV	30OCT11	SCALE NTS	REV. --
CADD	MV	06JAN12	FIGURE F-4	
CHECK	KMM	15FEB12		
REVIEW	RDH	15FEB12		

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

Golder Associates