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Haib Copper Project, Karas Region, Namibia

Amended NI 43-101 Technical Report

Preliminary Economic Assessment

Prepared for: Deep-South Resources Inc.

Qualified Persons :

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Effective Date: February 1st 2021

Amended Date: January 8th 2024

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DATE AND SIGNATURES PAGE

The effective date of this amended report is February 1st 2021 (“Amended Report”). See Qualified Person Certificates in section below, for certificates of qualified persons.

Damian Connelly, BAppSc FAusIMM CP (Met)	January 8th 2024 Date
Peter W.A. Walker, B.Sc. (Hons.) MBA, Pr.Sci.Nat.	January 8th 2024 Date
Mark Shane Gallagher, BTech, FSIAMM	January 8th 2024 Date

QUALIFIED PERSON CERTIFICATE

I, Peter W.A. Walker, B.Sc. (Hons) Geology, M.B.A., Pr. Sci. Nat., do hereby certify that:

I am an independent Consulting Geologist conducting work under the auspices of P&E Walker Consultancy cc of 41 Dennekamp, Main Road, Kenilworth 7708. Republic of South Africa. Tel Cell: +27 (72) 411 1108 e-mail: elipet@mweb.co.za

2. This certificate applies to the report titled “Haib Copper Project, Karas Region, Namibia: Amended 43-101 Report” with an effective date of February 1st 2021, amended January 8th 2024 for which I am a co-author.

3. I graduated with a Bachelor of Science (Hons.) degree in Geology in 1972 and an MBA in 1982, both from the University of Cape Town, South Africa.

4. I am a Professional Geologist registered with the South African Council for Natural Scientific Professions, registration No.400064/99.

I have worked as a geologist for a total of 42 years since my graduation from university. My relevant experience for the purposes of this Technical Report is:

- Seven years (1971 – 1978) as an exploration geologist in South Africa engaged in the mapping, drilling and evaluation of base metal deposits including basic resource estimation of deposits such as the Gamsberg zinc deposit near Pofadder, Northern Cape Province South Africa.
- Five years (1978 – 1982) as an exploration geologist in South Africa engaged in the exploration for Uranium and Tungsten deposits. During this period, I had mine visits to Climax Molybdenum mine amongst others in the USA, Australia, Canada and Brazil and also worked for three years on the discovery and evaluation of the Riviera porphyry Tungsten – Molybdenum deposit in the Southwestern Cape, South Africa. In 1982 for my MBA dissertation, I completed a preliminary economic appraisal of the deposit including a resource estimate.
- Six years (1989 – 1995) as a senior exploration geologist in Namibia in the exploration, drilling and evaluation of gold and base metal deposits, initially charged with evaluating extensions to the Navachab gold deposit, near Karibib, Namibia in 1989 and 1990.
- Seven years (1995 – 2002) as exploration manager for first Trans Hex International Ltd and then Group exploration manager for Trans Hex Group, engaged in the valuation and assessment of new alluvial and kimberlite diamond projects, their exploration and management through to production.
- Three years as an independent, sole practitioner consultant (2002 – 2004) advising and writing competent person reports for exploration & mining companies.
- Sixteen years (2004 – present) as Principal of P&E Walker Consultancy cc, an independent geological consulting closed corporation engaged in advising and writing competent person reports for exploration and mining companies. In 2009, I completed preliminary economic assessments including resource estimation of the Mandala alluvial diamond project, Guinea for Stellar Diamonds and, in collaboration with MPH, a Competent person report for the merger of West African Diamonds and Stellar Diamonds which included resource estimates of all of their properties. In 2008, I completed a resource estimate and preliminary economic assessment of the Lace Kimberlite mine, Kroonstad South Africa for Diamondcorp plc. In 2015 and 2016, I authored a technical report for the Issuer entitled “43-101 Technical Review: The Haib Copper Project, Namibia.

5. I visited the Haib Project site described in the report on various occasions between 1989 and 1995 on Geological Society of Namibia educational field trips and more recently on the 24th of January 2012 and on the 30th of June 2015.

6. I am solely responsible for sections 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 14, 15, 23 and 24. I am jointly responsible with the QP Damian Connelly for sections 5, 25, 26, & 27 of this amended independent technical review and Preliminary Economic Assessment report.

7. In terms of section 1.5 of NI 43-101 “Standards of Disclosure for Mineral Properties” I am independent of the commissioning entities, Deep South Mining (Pty) Ltd as well as of the Issuer, Deep South Resources Inc. their subsidiaries and associates applying all the standard tests of independence; P&E Walker Consultancy cc is also independent of the commissioning entities and the Issuer, their directors, senior management and advisors.

8. On 24th January 2012, I authored an independent valuation of the deposit on behalf of Deep South Mining Company (Pty) Ltd and on the 15th of February 2016 (Effective Date 23rd October 2015), I authored a 43-101 Independent Technical Review report titled “The Haib Copper Porphyry Project, Namibia” for the reverse takeover of Jet Gold Corp and the listing of the shares of Deep-South Resources Inc.

9. I have read the definition of a “Qualified Person” as set out in NI 43-101 and certify that by reason of my education, 42-years of experience in exploration geology and mining and my affiliation with a professional association I fulfill the requirements to be a “Qualified Person” for the purpose of preparing this Report.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the report contains all scientific and technical information that is required to be disclosed to make the report not misleading.

Peter W.A. Walker, *B.Sc. (Hons) Geology, M.B.A., Pr. Sci. Nat.*

Dated: January 8th 2024

QUALIFIED PERSON CERTIFICATE

I, Damian Edward Gerard Connelly, B.Sc. App Sc, FAusIMM, FIEAust, do hereby certify that:

1. I am an independent consulting metallurgist operating under the auspices of METS Engineering Group, located at Level 3, 44 Parliament Place, West Perth, 6005, Australia. Tel: +61 (08) 9421 9000.

2. This certificate applies to the report titled "Haib Copper Project, Karas Region, Namibia: Amended 43-101 Report" with an effective date of February 1st 2021, amended January 8th 2024 for which I am a co-author.

3. I graduated with a Bachelor of Science degree in Applied Science in 1973 from the University of Adelaide, in Australia.

4. I am a Professional Metallurgist registered as a Fellow of the Australasian Institute of Mining and Metallurgy and a Chartered Professional Engineer (met). I am also a Fellow of Engineers Australia.

I have worked as a metallurgist for a total of 45 years since my graduation from university and have been involved in resource project development. I currently lead a team of civil, mechanical, electrical, structural, estimators, drafts persons and process engineers.

I have worked as a consultant Metallurgical Consultant to the Mineral Processing Industry for the past 30 years, which has involved working on feasibility studies, detailed design, plant construction, due diligence work and more.

5. I visited the Haib Project site described in the report in January 2006.

6. I am solely responsible for sections 13 and 17 to 22. I am jointly responsible with the QP Peter Walker for sections 1, 2, 3, 5, 25, 26 and 27.

7. In terms of section 1.5 of NI 43-101 "Standards of Disclosure for Mineral Properties" I am independent of the commissioning entities, being the Issuer, Deep South Resources Inc., and its subsidiaries and associates Deep South Mining Company (Pty) Ltd and Haib Minerals (Pty) Ltd applying all the standard tests of independence.

8. On 22nd of March 2006, I authored an independent technical report called "Haib Copper Project, Project Options".

9. I have read the definition of a "Qualified Person" as set out in NI 43-101 and certify that by reason of my education, experience in the mining industry and my affiliation with a professional association I fulfill the requirements to be a "Qualified Person" for the purpose of preparing this Report.

10. As of the date of this certificate, I am not aware of any material fact or material change with respect to the subject matter of the Report, which is not reflected in the Report, the omission of which would make the report misleading.

DAMIAN E.G. CONNELLY *B.App.Sc. FAusIMM. (CP) Met. FIEAust.*

Dated: 8th January 2024

QUALIFIED PERSON CERTIFICATE

I, Mark Shane Gallagher, BTech , FSIAMM do hereby certify that:

1. I am an independent Principal Mining Engineer operating out of MSG Consulting, located at 23 Sheffield Beach Estate, Salt Rock, 4420, KwaZulu Natal, South Africa. Tel: +27 (0) 83 3080604, email msgallagher@mweb.co.za.
2. This certificate applies to the report titled "Haib Copper Project, Karas Region, Namibia: Amended 43-101 Report" with an effective date of February 1st 2021, amended January 8th 2024.
3. I graduated with a Bachelor of Technology in Mining Engineering in 2003 from the University of Johannesburg, South Africa.
4. I am a Mining Engineer registered as a Fellow of the South African Institute of Mining and Metallurgy.

   I have worked in the mining industry directly in open pit and underground mines since 1981, working for De Beers Diamond Mining Company for 24 years and then independently consulting to many large and junior mining companies locally and globally on a range of projects from diamonds to gold, copper, nickel and rare earths. I have worked independently, or as part of technical teams and also headed up mining technical teams on large projects from feasibility studies, mine optimisation studies, study implementation phases to brown field operational improvement studies.
5. I have not visited the Haib Project site described in the report and I have had no previous involvement with the Haib property, or with previous licence holders until commissioned to act as an independent qualified person for the Issuer – see paragraphs 7 & 8 below.
6. I am the Qualified Person responsible for section 16 of the report of this amended report.
7. In terms of section 1.5 of NI 43-101 "Standards of Disclosure for Mineral Properties" I am independent of the commissioning entities, Haib Minerals (Pty), Deep South Mining (Pty) Ltd as well as of the Issuer, Deep South Resources Inc. their subsidiaries and associates applying all the standard tests of independence; MSG Consulting is also independent of the commissioning entities and the Issuer, their directors, senior management and advisors.
8. I have read the definition of a Qualified Person as set out in NI 43-101 as amended in 2011 and certify that by reason of my education, 42 years of relevant experience and professional affiliations, I fulfil the requirements to be a Qualified Person for the sections reviewed by myself in the Report.
9. As of the date of this certificate, I am not aware of any material fact or material change with respect to the subject matter of the Report, which is not reflected in the Report, the omission of which would make the report misleading.
10. I have read NI 43-101 and confirm that Section 16 of the Report has been prepared in compliance with the Standards and Guidelines as set out in that document.

Mark S Gallagher.

Dated: 8th January 2024

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1. EXECUTIVE SUMMARY

1.1 Introduction

This amended report has been completed at the request of Deep-South Resources Inc (TSXV – DSM) ("DSM" or the "Issuer") Various sections of the technical report filed on February 1st 2021, have been clarified and corrected in this amended technical report. The resource estimate and preliminary economic conclusions do not change from the previous technical report.

The PEA update was carried out to incorporate the results from the Mintek metallurgical testwork program (2019/2020) and is based on the PEA report completed by Damian Connelly of METS, Dean Richards of Obsidian Consulting Services and Peter Walker of P & E Walker Consultancy in February 2018. This report presents the findings of the PEA update undertaken for the proposed development of the Haib Project, with a view that aims to maximise the positive aspects of the project and to minimise or manage any negative implications and risks. It is focussed only on the whole ore heap leaching process route.

The Issuer holds a 100% interest in Deep South Mining Company (Pty) Ltd. a Namibian subsidiary which has a 100% interest in Haib Minerals (Pty) Ltd ("HM") which in turn holds the exploration rights to the Haib Copper project in the Karas Region, southern Namibia. HM is the registered holder of Exclusive Prospecting Licence 3140 ("EPL") over the project.

As no drilling nor field exploration work have been conducted on the Haib Copper site between the first PEA filed in February 2018 and the updated PEA with an effective date of February 1st 2021, the resource estimation and economic estimations of this report remain current. The QP's have confirmed and verified this lack of further work by an examination of the Issuer's quarterly reports to the Namibian Ministry of Mines and Energy as well as audit reports filed with the Namibian Ministry of the Environment, Forestry and Tourism, Department of Environmental Affairs in April 2019 by SLR Environmental Consulting (Namibia) which confirms that no field work or further drilling was done at the Haib project since 15th August 2017, the expiry date of the previous Environmental Compliance Certificate which has a 3 year period of validity.

1.2 Location

The Haib copper deposit is in the extreme south of Namibia close to the border with South Africa, which is defined by the course of the Orange River (Figure 1-1). The deposit lies some 12-15 kilometres east of the main tarred interstate highway connecting South Africa and Namibia and the nearest railway station is at Grunau, which is approximately 120km north on the main highway. This rail connection could provide access to either the port of Lüderitz or to Walvis Bay via Windhoek. Noordoewer is the closest town, which is located on the Orange River approximately 25 km west of the Haib deposit.

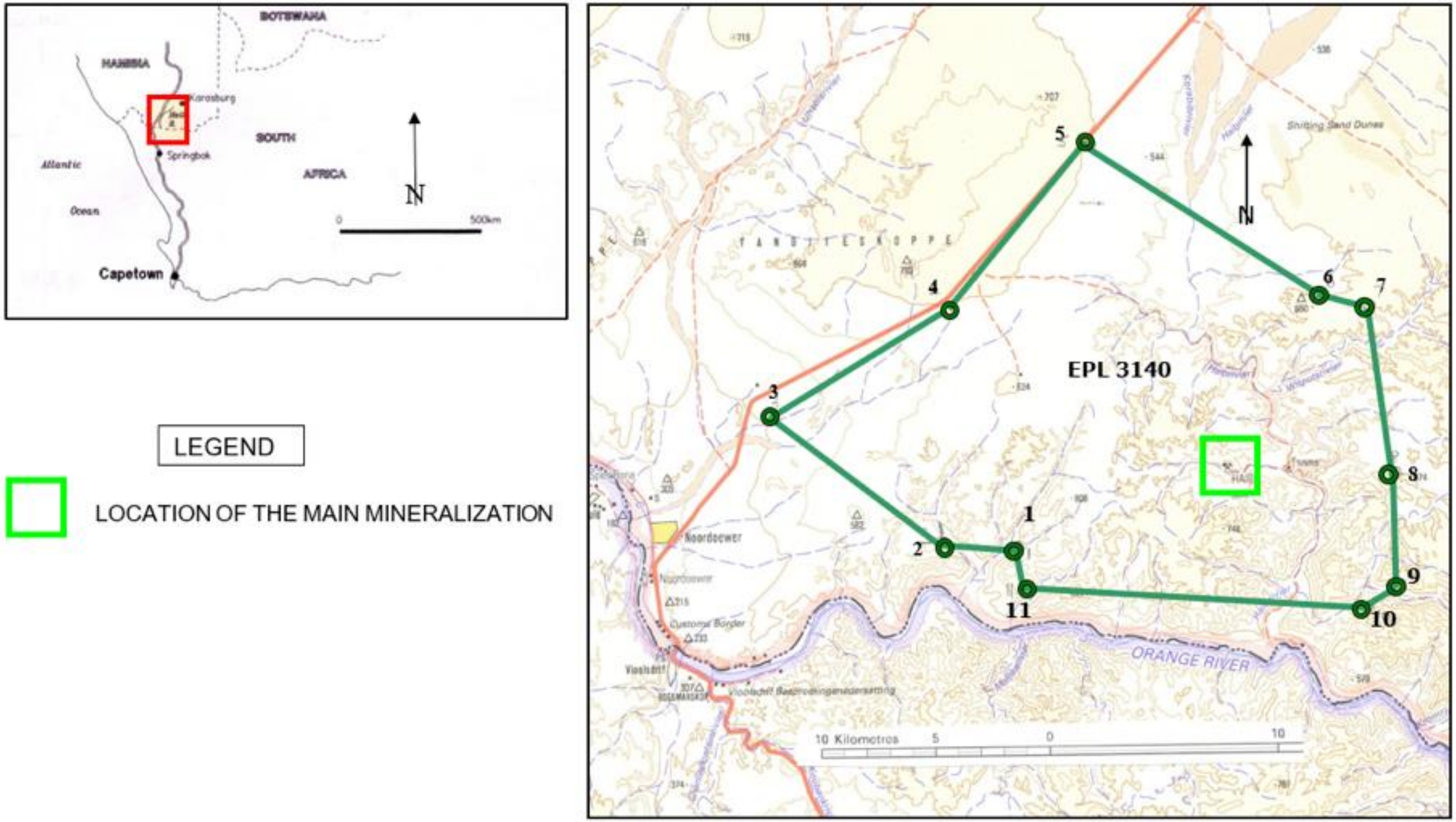


Figure 1-1 : Haib copper deposit location

1.3 Geology and Mineralization

The Haib deposit is located within part of the Namaqua-Natal Province called the Richtersveld geological sub-province which is further subdivided into a volcano-sedimentary sequence (locally, the Haib Subgroup), the Orange River Group and the intrusive Vioolsdrift suite which are closely related in space and time. The principal mineralized host rocks at the Haib are a Quartz Feldspar Porphyry (QFP) and a Feldspar Porphyry (FP).

The Haib deposit is in essence a very large volume of rock containing copper mineralization. The grade is variable from higher grade in the three core zones (possibly averaging >0.4%) progressively decreasing towards the margin of the deposit. The principal sulfide minerals within the Haib body are pyrite and chalcopyrite with minor molybdenite, bornite, digenite, chalcocite and covellite.

1.4 Exploration/Drilling

The deposit has a distinct surface expression with abundant copper staining on fractures and joint planes particularly in and around the dry riverbed of the Volstruis River. This led to German prospectors identifying the deposit around the late 1800's or early 1900's. Since then, several drilling programs have been conducted by several companies including Falconbridge, King Resources, Rio Tinto, Revere Resources, Great Fitzroy Mines NL, and latterly by the Teck/Haib Minerals joint venture.

1.5 Mineral Resource Estimate

In July 2017, Obsidian Consulting Services and P & E Walker Consultancy were contracted by DSM to compile a resource estimate based on Copper ("Cu") from various previously identified and modelled domains for their Haib Copper Project. The assignment included the compilation and validation of a drill hole database derived from historical core drillholes and more recent core drillholes and check assays of historical core samples completed over the past 9 years by Teck Namibia.

Estimation was done using Ordinary Kriging in a stepwise manner. A first kriging run was done using a search equal to the variogram ranges. A second pass was then done using a search double the variogram ranges. Almost all cells were estimated by the above 2 steps. Any remnants were either kriged by opening the search and increasing the minimum samples or assigned a background value such as the median.

A boundary analysis showed a mineralisation trend that correlates with the mineralisation model of the Haib deposit viz. Cu porphyry. The changes in grade are generally gradational and cross lithological contacts therefore the use of lithological boundaries was felt to be inappropriate while the use of a grade cut-off-based domain was considered arbitrary. Therefore, no domaining was applied in the mineral resource compilation with the extents being controlled by data proximity.

Ten metre composites were calculated from the drill hole data which approximates a horizontal grid of approximately 150m x 150m. Analysis of the composites showed that compositing does not fundamentally change the Cu grade distributions. Top cut analysis of the Cu grades showed the raw data to be relatively insensitive to the use of grade caps and no capping was applied during the compositing.

Variography revealed the presence of well supported spherical variogram models with anisotropic elements. The Cu values show that the maximum anisotropy is oriented along a strike of 135º dipping to the southwest at just under 60º. Estimates were conducted in a stepwise manner first at the modelled Ranges followed by a second estimation run at 2x the Ranges. In the case of Cu, 99% of the block model cells were estimated within the Ranges. Anomalously high grades were used as is but had their volume of influence significantly reduced to avoid overestimation and the introduction of bias. During estimation, the quality of the estimates was tracked using kriging parameters such as kriging variance, slope of regression and kriging efficiency. Post-estimate validations were done use QQ Plots, Swath Plots and comparison with nearest neighbour and inverse distance estimates.

Density was not estimated but rather an average of 2.8T/m^3 taken from the mean of the 99 Specific Gravity determinations that had been done. These showed a normal distribution around a mean of 2.75 T/m^3 with a very low coefficient of variation (0.04) therefore the default density approach is considered appropriate.

The mineral resources for Haib have been classified according to the Institute of Mining, Metallurgy and Petroleum ("CIM") Definition Standards adopted on 19th May 2014 by the CIM Council and is based primarily on proximity to data with the last line of samples forming the lateral and vertical extent of the resources. Secondary considerations included slope of regression and kriging efficiency. The preliminary economic Appraisal presented in this report showed that given the current price of copper, mineralized material at an average grade of 0,3% Cu can be mined and treated economically. A cut-off grade of 0,25% Cu was selected using an iterative process to produce an overall average grade of 0,3%Cu and was applied to the mineral resources presented in Table 1-1 below.

Table 1-1: Summary of the Measured and Indicated Resource Estimate

Resource Class	Volume (xMillion m^3)	Density	xMillion Tonnes	Cu(%)
Measured	-	-	-	-
Indicated	163.2	2.8	456.9	0.31
M+I	**163.2**	**2.8**	**456.9**	**0.31**
Inferred	122.3	2.8	342.4	0.29
Rounding has been applied as appropriate to reflect limits of precision and accuracy				

Please note that: Mineral Resources are not Mineral Reserves and do not have <u>demonstrated</u> economic viability as may be obtained once a pre-feasibility or feasibility studies have been completed and all modifying factors have been taken into account. The estimates do not account fully for mineability, selectivity, mining loss and dilution. These estimates contain inferred Mineral Resources that are considered too speculative geologically in terms of grade continuity between drillholes to have the economic considerations applied to them to be categorized as mineral reserves. There is no certainty that the preliminary economic assessment will be realized.

1.6 Mineral Processing and Metallurgical Testing

Basic processing tests were conducted on the Haib deposit including:

- Comminution
- Heavy Liquid Separation (HLS)
- Bio-Heap Amenability
- Flotation
- Ore Sorting
- Geotechnical

The results from the original comminution testwork produced by Minproc in the 1997 Feasibility Study based on grinding and flotation is shown in Table 1-2.

Table 1-2: Haib comminution data

Comminution Data	
Head Grade	0.31% Cu
In-Situ Density	2.6 t/m^3
Specific Gravity	2.7
Ore Density	1.8 t/m^3
Crushing Work Index (Cwi)	22.3 kWh/t
Unconfined Compressive Strength (UCS)	150 Mpa
Abrasion Index (Ai)	0.485
Angle of Repose	36º
Angle of Reclaim	55º
Ball Mill Work Index (Bwi)	18.0 kWh/t
Rod Mill Work Index (Rwi)	21.6 kWh/t

1.7 Mining Methods

Considering the Haib copper deposit characteristics, the suitable mine design is based on an open pit mining method. As the deposit is basically composed by low grade hard rock material, the mining operations will involve drill and blast of all excavated material, which will be grade controlled by cut-off grade.

1.8 Metallurgical Testwork

The Mintek detailed metallurgical testwork, data, results, general conclusions and recommendations used as the basis for this updated PEA have been summarized in section 13 of this amended report.

1.9 Recovery Methods

For the recovery of copper from the Haib deposit, heap leaching was considered. The primary reasons for the selection of heap leaching are the low-grade nature of the deposit and the vast volume of the mineralization. Previous work conducted on the Haib project suggests that a conventional crush-grind-float and sale of copper concentrate is not economically feasible due to the low grade and hardness of the mineralized material – requiring a significant amount of energy for grinding. The low costs associated with heap leaching compared to a whole ore flotation circuit is believed to improve the viability of the project. Heap leaching is traditionally performed on oxide material, although there has been increasing development in the application to acid insoluble sulfides. Previous sighter amenability testwork suggests the Haib material can extract high amounts of copper, up to 95.2% via bacterial assisted leaching, although additional testwork is required to determine the optimal operating parameters. Given these results there is no reason to suggest the chalcopyrite in the Haib deposit will not be amenable to bacterial assisted heap leaching.

Column leach testwork has been ongoing at Mintek in South Africa during 2019/2020. Mintek has significant expertise and a long history of bacterial leaching of copper sulfide ores. Six options were established for whole ore heap leaching at different copper recoveries, different final products (copper cathode and copper sulfate) and copper prices for the purpose of the economic evaluation. The base case is considered as the most conservative and attainable option:

- Base case: 20 Mtpa with 80% copper recovery with $CuSO_4$

1.10 Marketing

Copper is the main product that will be obtained from the process which will exist in the form of chalcopyrite or chalcocite concentrate from flotation, copper metal from electrowinning and copper sulfate from crystallisation.

Copper is one of the most widely used metals on the planet. China, Europe and the USA are the main global consumers of copper. Copper will be produced on the cathode of the electrowinning cell as pure LME cathode sheets which will be a pure (99% Cu) solid. Pure copper metal is used for a variety of purposes with the major purpose being electrical wiring due to its great electrical conductivity.

Copper sulfate will be sold as a blue powder when the crystals are crushed and dried. Copper sulfate is used in multiple industries such as arts, mining, chemical, pharmaceutical, healthcare, and agricultural fertiliser. The biggest use is for farming as a herbicide or fungicide as it can be used to control fungus on grapes, melons, and berries. High purity copper sulfate has a 25% premium price based on the copper content in the sulfate.

1.11 Environmental and Permitting

A future, more comprehensive environmental study will be required to assess the impact of mining and processing on the property; these studies will include:

- Baseline study extended to areas identified as suitable for plant and processing
- Environmental management plan
- Project environmental assessment
- Environmental issues (dust, noise etc.)

1.12 Capital and Operating Costs

In summary, the capital and operating costs for the six options assessed are summarised in 1-3 and 1-**4**.

Table 1-3: Capital cost summary

Cost	Base case
Direct, US$	$246,625,080
Indirect, US$	$94,163,884
Total, US$	**$340,788,964**

Table 1-4: Operating cost summary

Area		Base case
Mining		0.40
Processing		0.80
Product Freight		0.03
Wharfage and Shiploading		0.004
Administration		0.04
Royalty	$2.00	0.06
	$2.25	0.07
	$2.50	0.08
	$2.85	0.09
	$3.00	0.09
	$3.25	0.10
	$3.50	0.11
	$3.75	0.11
	$4.00	0.12
Total (US$/lb Cu Eq)	$2.00	**1.33**
	$2.25	**1.34**
	$2.50	**1.34**
	$2.85	**1.35**
	$3.00	**1.36**
	$3.25	**1.37**
	$3.50	**1.37**
	$3.75	**1.38**
	$4.00	**1.39**

1.13 Economic Analysis

Based on the economic analysis, The base case – 20 Mtpa at a copper recovery of 80% and producing both LME copper and copper sulfate is considered the most conservative and attainable option.

Table 1-5: Economic Summary

Scenar					Base case				
Pre-					$341				
Total					$0.80				
Copper	$2.00	$2.25	$2.50	$2.85	$3.00	$3.25	$3.50	$3.75	$4.00
$NPV_{7.5}$	$424	$701	$977	$1,364	$1,530	$1,807	$2,083	$2,360	$2,636
$IRR_{7.5\%,}$	18.6%	24.6%	30.1%	37.3%	40.2%	44.9%	49.4%	53.8%	58.1%
Paybac	6.91	5.21	4.22	3.38	3.13	2.8	2.5	2.3	2.2

1.14 Interpretation and Conclusions

In the co-authors' opinion, the Issuer is exploring a large volume porphyry copper deposit situated in an ideal location adjacent to modern infrastructure which has the potential to become a large copper producer. There already exists a significant body of technical data concerning the Haib mineralisation and the period between resource estimation, pre-feasibility and definitive feasibility studies could be relatively short.

The QP Damian Connelly believes the low-grade nature of the Haib porphyry copper deposit makes it an ideal candidate for heap leaching. Developments in heap leaching of refractory ores, particularly bio-heap leaching, in conjunction with modern ore sorting technology have the ability to maximise the economic potential of the Haib project.

1.15 Recommendations

The results from the Preliminary Economic Assessment were very promising and we now have results from laboratory column leach tests undertaken at Mintek that confirms copper recovery and the amenability of the Haib mineralized material to heap leaching. Going forward METS recommend Deep-South Resources move to conduct a Pre-Feasibility Study (PFS) as the next phase of the project. Following further resource drilling, metallurgical test work and resource estimation as proposed in the budget below, Table 1.5

To improve confidence in the PFS results, more detailed metallurgical testwork will be required. Most work to date has focussed on the potential of processing options and was performed on high grade copper mineralized material and is not sufficient or representative enough to truly evaluate their feasibility with confidence on the lower grade mineralized material in the deposit.

We have set ourselves a target of achieving 85% copper recovery as a basis of design. Some of the parameters we will evaluate in the future are:

- Fully recycled column and no single pass processing
- Operate at a higher temperature
- Finer crush size
- Different bacterial strains
- Resting after 200 days for 30 days and then irrigation for another 30 days
- Vary the pH to find an ideal range for the bacteria.
- Additional nutrients

In this regard, we will make use of the services of Mintek, CSIRO in Perth and Professor Sue Harrison at the University of Cape Town because they are centres of research excellence in the technology of bacterial leaching of ores and minerals. Further drilling of the deposit to map out higher grade zones which can be included in the early part of the mine schedule is recommended as this will improve the project economics in the financial model.

The work conducted to date provides confidence to move forward and there is every possibility of improving copper recovery and the further reduction of operating costs.

2. INTRODUCTION

2.1 Purpose

The purpose of this updated technical report is to present the results from the current metallurgical testwork programme and use them to update the 2018 Preliminary Economic Assessment ("PEA") for the Deep-South Resources Haib Project. This report assesses Option 4 of the 2018 PEA; a straight heap leach to identify the economic viability of whole ore leaching with different throughputs, copper recovery and copper pricing. Additionally, this report gives recommendations for further work to enhance the accuracy and viability of the project. This technical report supersedes any previous reports provided by METS Engineering although sections of those reports have been reproduced here from the original.

These reports were prepared at the request of Deep-South Resources Inc (TSXV – DSM) ("DSM or The Issuer") which is listed on the TSX Venture Exchange (the "Exchange"). DSM has a 100% interest in Deep South Mining Company (Pty) Ltd. A Namibian subsidiary which has a 100% interest in Haib Minerals (Pty) Ltd ("HM") which in turn holds the exploration rights to the Haib Porphyry Copper property in the Karas Region, southern Namibia. HM is the registered holder of Exclusive Prospecting Licence 3140 ("EPL") over the property.

2.2 Sources of Information

In order to prepare the content of this report, the authors worked closely with, and received information from, Mr Pierre Leveille, Deep-South Resources CEO and Mr. Vivian Stuart-Williams, Deep-South Resources Vice President, Exploration. Mr Leveille, Mr Stuart-Williams and Mr. Dean Richards assisted with the mineral resource statements with updated resources estimates, water costs and labour costs.

The information, conclusions, opinions, and estimates contained herein are based on:

- Data, geological reports, maps, documents, technical reports, and other information provided by Deep-South Resources.
- Field observations of the site based on past site visits of the authors.
- Past reports in the Deep South Resources and METS databases
- Past Haib studies on the METS database
- A column leach testwork program undertaken at Mintek

The effective date of this report is February 1st 2021. The Qualified Persons and authors of this Report and their business entities have no direct or indirect interest in the subject or any nearby mineral property and are entirely independent of DSM, its shareholders and subsidiaries.

2.3 Site Visit

The QP Peter Walker visited the Haib Project site described in this report on various occasions on Geological Society of Namibia excursions between 1989 and 1995 and on the 24th of January 2012 in the company of Mr. Nuri Ceyhan, exploration manager of Teck Namibia and with Mr. Neil Grumbley, Teck's Haib Project manager and again on the June 30th 2015 with Mr. Neil Grumbley. The 2012 and 2015 visits were made on behalf of the Issuer for the completion of a technical report titled "43-101 Technical Review: The Haib Copper Project, Namibia." This was a qualification report for the reverse takeover of Jet Gold Corp., listed on the TSVX. The visits also served to collect data and verify data collection and that drill core sampling QC/QA procedures were in place and adhered to by the Teck personnel.

No field work or material change have occurred at the Haib project site since his June 2015 visit and only metallurgical samples from the NCJV bulk sample heap were collected and used for the desk-top and laboratory appraisal studies as outlined in this report. In addition to the confirmation by HM management that no field work occurred at the Haib project and in order to verify this confirmation, the QP has read many documents from the Ministry of Mines and Energy of Namibia, notably quarterly reports from June 2015 to February 2021 and confirmed that no field work has occurred during this period. Furthermore, the QP read an audit report by SLR Consulting (Namibia), an independent environmental consultancy reporting to the Namibian Department of Environmental Affairs to renew the Environmental Clearance Certificate ("ECC") who visited the site in April 2019 and confirmed that no drilling or field work had been done since August 15, 2017, the expiry date of the previous ECC. The ECC was approved by the Ministry of Environment in February 2021 on the basis that no exploration work was conducted for the period of August 2017 to January 2021.

The QP Damian Connelly visited the Haib site in 2006. The objective of the site visit was to assess the surrounding infrastructure, view drill core samples and obtain a general feel for the site.

The contributing QP, Mark Gallagher, has not conducted a site visit.

3. RELIANCE ON OTHER EXPERTS

The Report Contributors have relied on Hanno Bossau from H.D. Bossau & Co., a legal adviser of Windhoek, Namibia. Hanno Bossau produced an opinion on the validity of the license EPL 3140.

The Report Contributors have not relied on any other experts in compiling this report.

4. PROPERTY DESCRIPTION AND LOCATION

4.1 General

Namibia in South-West Africa is one of the driest and most sparsely populated countries on Earth. It is bounded by the South Atlantic Ocean on the west, Angola to the north, Botswana to the east and South Africa to the south. The Caprivi Strip, a narrow extension of land in the extreme north-east connects it to Zambia.

Namibia comprises thirteen regions (from south to north): Karas, Hardap, Khomas, Erongo, Omaheke, Otjozondjupa, Kunene, Oshikoto, Okavango, Omusati, Oshana, Caprivi and Ohangwena.

The Haib Copper deposit is located in Karas, which is the least densely populated of the thirteen regions of Namibia. The region is a predominantly small stock farming area, consisting mostly of animals such as sheep or goats. Game farming and crop farming along the Naute Dam and the Orange River are significant to the region's economics while alluvial diamond mining along the banks of the lower reaches of the Orange river and along the western coastline and zinc/lead mining at Rosh Pinah are other major employers in the Karas region.

4.2 Property Description

In April 2007, the extent of ground held was reduced in accordance with the renewal obligations to an area of 36 502.4ha. Details of the location are given in the Location Map, Figure 4-1.

The surface rights of the property covering portions of the farms de Villierspunt 353, Tsams 360 and Withoek 387 are owned by the State. The EPL boundaries have not been surveyed or physically beaconed but the current corner coordinates have been provided by the Namibian government in the EPL grant documents.

Peter Walker QP is not aware of any environmental obligations or liabilities except those listed in the EPL grant documents which states:

- That the holder of the exclusive prospecting licence shall observe any requirements, limitations or prohibitions on his or her prospecting operations as may, in the interests of environmental protection be imposed by the Minister from time to time.
- That the of the exclusive prospecting licence shall enter into an Environmental Contract with the Ministry of Environment and Tourism and that of Mines and Energy within one (1) month of the date of issue of the licence."

The Environmental Contract and clearance certificate (ECC) has been concluded with the respective Ministries and we have had sight of these documents, which are dated 15 August 2017 and are valid for 3 years. We have also been provided with a copy of the Environmental Management Plan produced by SLR Consultants which was submitted in support of HM's application to the Ministries, and which now forms part of the accepted commitment towards

HM's environmental obligations. The application for the renewal of the ECC was lodged in August 2020.

The co-authors' are not aware of any additional permits required in respect of exploration activities on the property apart from water abstraction permits that will need to be obtained from time to time from the Ministry of Water Affairs in order to pump water from the Orange River for drilling or metallurgical test purposes. I have been provided with a copy of the last water abstraction permit which was valid from March 28th 2014 to the March 27th 2017 and that the only significant conditions attaching to this permit are for the installation of an approved water meter, monthly readings of the meter and payment at a tariff rate of 1.5 Namibian cents per cubic metre of water consumed.

As the subject property is State land, no access permits or contracts are required in terms of the grant of the EPL.

In order to retain title to the EPL, HM have to spend at least 80% of the committed budget for the 2017 / 2018 work programme which has been agreed with the Namibian Ministry of Mines & Energy. As at December 14th 2017, I am assured by a letter received from the Directors of HM that their current expenditure on the project will meet and possibly exceed this minimum expenditure commitment. This letter also states that all obligations and requirements in regard to compliance with licence conditions have been met and that the future obligations of HM to report progress and abide by the agreed work programme have also been noted and will be complied with within the time frames agreed with the Ministry.

The EPL was renewed on April 21st 2019 for a period of two years. Between April 2019 and the effective date of this report on February 1st 2021, no field work has been conducted on the Haib Copper site apart the removal of 1 tonne of samples from a stockpile area. The main work program during this period was 16 months of metallurgical test work that has resulted in the completion of this updated PEA.

The Issuer provided the author with a copy of the renewed EPL licence document dated April 2019. We have also obtained a legal opinion from H.D. Bossau & Co, a legal adviser from Windhoek Namibia. Bossau has produced a report concerning the validity of the licence which confirms the license is valid and in good standing. Furthermore, on December 15th 2020, the Ministry of Mines and Energy's cadastre portal was declaring the EPL valid and in good standing. Therefore, on the executive date of this report, February 1st 2020, the license is valid and in good standing.

4.3 Location

The Haib copper deposit is in the extreme south of Namibia close to the border with South Africa which is defined by the course of the Orange River (see Figure 4-1). The deposit lies some 12 – 15 kilometres east of the main tarred interstate highway connecting South Africa and Namibia and the nearest railway station is at Grunau, some 120km north on the main highway. This rail connection could provide access to either the port of Lüderitz or to Walvis Bay via Windhoek or to South African ports or facilities via Upington.

4.4 Project Ownership

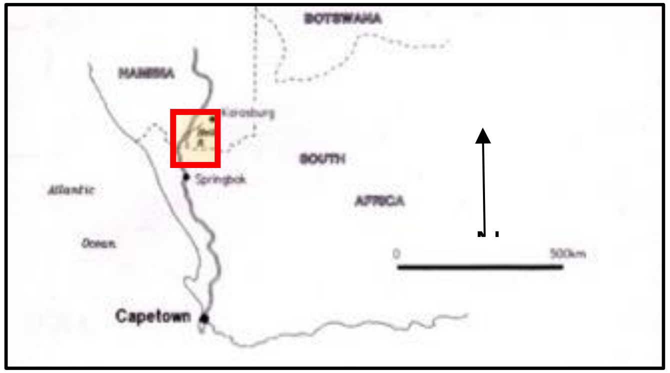
DSM has a 100% interest in Deep South Mining Company (Pty) Ltd. A Namibian subsidiary which has a 100% interest in Haib Minerals (Pty) Ltd ("HM") which in turn holds the exploration rights to the Haib Porphyry Copper property in the Karas Region, southern Namibia. HM is the registered holder of Exclusive Prospecting Licence 3140 ("EPL") over the property.

On June 20th 2008, Teck Resources Ltd concluded a joint-venture agreement to acquire 70% of the shares of Haib Minerals (holder of the EPL 3140). Teck acted as the exploration manager up to May 2017 when its interest was acquired by DSM.

The exploration approach taken by Teck was to prospect for adjacent, additional mineralization by means of remote sensing, regional geophysical and geochemical stream and soil sampling programmes and / or to increase the tonnage and / or the grade by further core drilling to explore the already identified higher-grade portions of the mineralization since these are poorly defined by the historical vertical drilling. Teck also completed an extensive programme of quality control and data checks by means of modern surveying of the historical drillhole collars as well as resampling and assays of many of the RTZ drill cores. The Teck exploration programme described in this report is the result of that exploration approach.

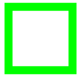
4.5 QP Comment

The co-authors are not aware of any significant risk factors that may impede the progress of the exploration activities proposed for the property which may involve access, title or availability of contractors. The co-authors have been informed by the Directors of Haib Minerals that the only field exploration work that has taken place over the license area between January 2018 and the updated PEA filed on February 1st 2021 was the removal of 1 tonne of sample from a stockpile which was used for the metallurgical test work carried out by Mintek from May 2019 to May 2020.



LEGEND

______Location of the Main Haib mineralization



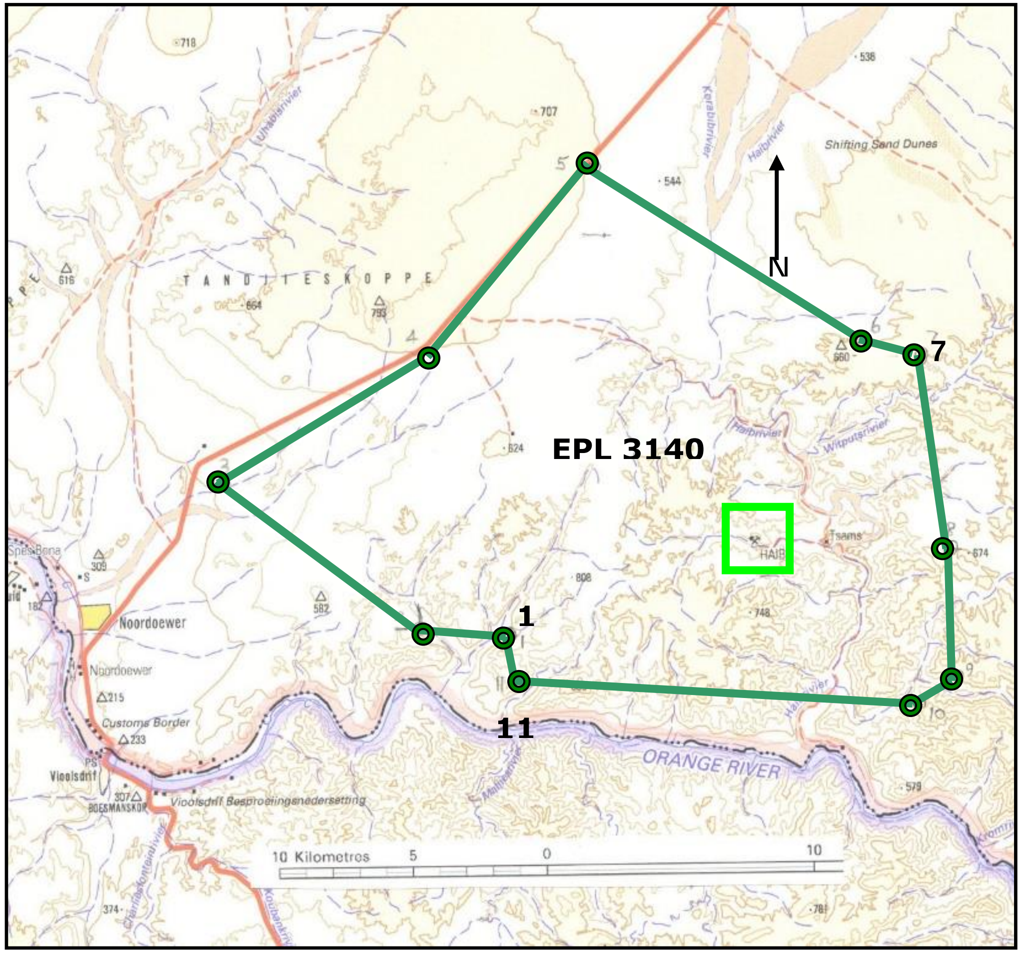


Figure 4-1: Location Map

The Haib deposit is situated some 12-15 kilometres east of the main tar road connecting South Africa and Namibia. Access from the tar road to site is via variable quality all-weather gravel road, the last section requiring all wheel drive. The current area of EPL 3140 is 36,502.4ha. (Map taken from 1:50 000 scale topocadastral map produced by the government of Namibia)

5. ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE & PHYSIOGRAPHY

5.1 Physiography

The Haib deposit straddles the Volstruis River (meaning the Ostrich River in Afrikaans), which is a tributary of the Haib River. Both are ephemeral tributaries of the Orange River which lies south of Haib.

The Orange River is a deeply incised drainage with several nick-points. Haib lies below all of the main nick-points at a location where the Orange River elevation is approximately 200 metres above sea level. The Haib deposit lies at elevations from a floor elevation of just under 375 metres amsl to over 600 metres amsl. The surrounding area is up to about 650 metres amsl at the highest point. The area is rugged with steep sided valleys and rapid local relief.

The vegetation around the deposit is essentially *xerophytic* in nature with sparse semi-desert shrubs and grasses with some stunted trees (Adenolobus garipensis, Euclea pseudebenus or wild ebony and others) along water courses.

5.2 Accessibility

Access to the Haib property is via a 10-km graded gravel road from the main interstate tarred highway to the camp site at the old Rio Tinto Zinc Corporation ("RTZ") exploration campsite. This road is accessible to conventional cars. From the campsite to the Haib copper deposit (another 5 km) is a four-wheel drive gravel track that is relatively slow but essentially all-weather. The site itself is very rugged and there is only limited access along the numerous bulldozed drill-site access roads. Access to other parts of the site is largely by foot. There is an existing gravel airstrip, some 1,500m long on the property which is in unknown condition and would require inspection before light aircraft could safely make use of this facility.

5.3 Local Resources and Infrastructure

There is reasonable infrastructure surrounding Haib to support the proposed project. The Haib deposit is relatively close to the main international tar road so the only construction required would be an upgrade of the graded access road to the RTZ campsite, with a minor deviation to the proposed process plant site and the construction of a suitable road for mine site access. The main north-south national power grid lies some 85km to the east of the Haib. An 85 km link would likely be required should the project develop. Water is expected to be available from the Orange River (about 15 km by pipeline south of the Haib deposit). The nearest rail link is located at Grunau, approximately 120 km north of the deposit. The area between the Haib and Grunau is almost completely flat, and the local rail authority has confirmed that a link could be laid relatively easily. Suitable areas for heap leach pads and waste rock dumps are available dependant on eventual plant design. The nearest town of Noordoewer is some 20 km by road to the southwest of Haib on the Orange River.

5.4 Economy and Taxation

The country's sophisticated formal economy is based on capital-intensive industry and farming. However, Namibia's economy is heavily dependent on the earnings generated from primary commodity exports in a few vital sectors, including minerals, especially diamonds, gold, uranium, lead and zinc, livestock and fish, which make Namibia's economy completely vulnerable to world commodity price fluctuations. Mining accounts for 11.5% of Gross Domestic Product (GDP) but provides more than 50% of foreign exchange earnings. Rich alluvial and marine diamond deposits make Namibia a primary source for gem-quality diamonds.

Namibia is the world's fourth-largest producer of uranium due to the Rio Tinto owned Rossing and Chinese owned Husab uranium mines. Namibia also produces large quantities of zinc and is a smaller producer of gold and copper. The mining and quarrying sectors employ 2% of the population.

Namibia normally imports about 50% of its cereal requirements; in drought years food shortages can be a problem in rural areas. A high per capita GDP, relative to the region, hides one of the world's most unequal income distributions. A priority of the current government is poverty eradication.

In terms of taxation, Namibia has a source-based tax system, which means that income from a source within Namibia or deemed to be within Namibia will be subject to tax in Namibia, unless a specific exemption is available. For non-diamond miners, the taxation rate is set at 37.5% of taxable income.

5.5 Climate and Geography

With an average of 300 days of sunshine annually, Namibia is one of the sunniest countries in the world. In general, Namibia's climate can be described as hot and dry, but substantial fluctuations during the seasons or even within one day are typical. The different regions show considerable climatic differences regarding precipitation and temperature. The amount of precipitation increases from the southwest to the northeast regions from an annual 0 mm to a maximum of 600 mm.

The Haib copper deposit is situated in the extreme south of Namibia and is unusual in that it is located on the boundary between the summer and winter rainfall areas. In summer the temperature can go as high as the mid 40°C, while in winter it can go as low as freezing point. Rainfall in winter is generally light drizzle with occasional harder falls. In summer the rainfall is associated with occasional thunderstorms and is of short duration but can be of very high intensity. All the streams within the area are ephemeral and can flow very strongly after summer rainfall. Average annual rainfall is 25-50 mm. Access to site is possible throughout the year.

Namibia rests in the middle of a tectonic plate on a passive continental margin, called the African Plate, and has little earthquake activity and no volcanism. According to the website https://earthquakes.zone/namibia, in the last 35 years, Namibia was hit by 13 earthquakes with magnitudes between 4.1-5.3 on the Richter scale. The closest earthquake epicentre from the Haib copper deposit was in 1993, located in Warmbad, with a peak magnitude of 4.3 on the Richter scale.

5.5.1 Demographics and Labour

According to the 2019 revision of the World Population Prospects the total Namibian population was 2,495,000, compared to only 485,000 in 1950. The proportion of children below the age of 15 in 2019 was 36.9%, 59.5% was between 15 and 65 years of age while 3.6% was 65 years or older. Most Namibians are rural dwellers (about 55%) and live in the better-watered north and northeast parts of the country. According to the Namibia Labour Force Survey 2018 Report, the Namibia labour force has 1,090,153 people, and those who work in the mining and quarrying industry represent only 1.1% (12,087 labourers).

Migrant workers, historically male-dominated, generally come from northern communal areas – non-agricultural lands, where blacks were sequestered under the apartheid system – to provide labour for agricultural, mining, and manufacturing centres in the centre and south.

Regarding the Haib deposit area, the nearest settlement is Noordoewer, around 12 km south of the Haib entrance gate, a village of some 5,000 people with only basic services and facilities. Noordoewer is known for grape production and tourism (canoeing) and is an important border post on a crucial transport route between Namibia and South Africa.

5.5.2 Cultural Issues

Unemployment – Despite the abundance of natural resources, the Republic of Namibia remains one of the poorest countries in all of Africa. About 56% of Namibia's population live below the poverty line (live on less than $2 a day with the majority living on less than $1.25 a day) and about 43% of Namibians remain unemployed.

AIDS – The most serious health problem in Namibia is the high incidence of AIDS, which was first recorded in 1986 when four people were diagnosed HIV positive. Namibia has reached pandemic proportions with incidence rates in Africa higher than any other continent and since 1996 AIDS has become the number one cause of death in Namibia.

Water Supply – Namibia is an arid country that is regularly afflicted by droughts. Large rivers flow only along its Northern and Southern border, but they are far from the population centres. To confront this challenge, the country has built dams to capture the flow from ephemeral rivers, constructed pipelines and concrete canals to transport water over large distances, pioneered potable water reuse in its capital Windhoek located in the central part of Namibia, and built Sub-Saharan Africa's first large seawater desalination plant to supply a uranium mine and the city of Swakopmund with water.

Food Supply – Namibia produces about 40% of the food it consumes and is highly dependent on imports. This means that while food is available, price fluctuations can make it difficult to access for 26% of Namibian families. This particularly affects the 80% of the population who depend on markets to fulfil their food needs. Smallholder farmers also have limited access to nutritious food due to recurrent droughts and floods, low productivity, and access to land issues. These limitations translate into poorly diversified diets with insufficient consumption of vitamins and minerals, which are at the root of persistent malnutrition.

Namibian food imports include various categories of vegetables, potatoes, tomatoes, apples, tea, spices, wheat, maize, roasted malt, sunflower seed and oil, margarine, prepared foods, bulgar wheat, sweet biscuits, all types of juices, water and other non-alcoholic beverages. Looking at the figures from 2004 to 2014, in 2004 the value of food imports was around US$114 million. This rose to about US$253 million in 2010 and in 2014 this had risen to around US$688 million.

In contrast, the clean, cold South Atlantic waters off the coast of Namibia are home to some of the richest fishing grounds in the world, with the potential for sustainable yields of 1.5 million metric tonnes per year. Commercial fishing and fish processing is the fastest-growing sector of the Namibian economy in terms of employment, export earnings, and contribution to GDP.

5.5.3 Sovereign/Country Risk

In 1990, Namibia became an independent nation. Since then, it has enjoyed relative stability.

Companies face a moderate risk of corruption in Namibia. While the country suffers from less corruption compared to other countries in the region, corruption remains common. The country’s public procurement sector is particularly susceptible to corruption due to the monopoly of state-owned companies (parastatals).

In terms of security, even though Namibia has a high rate of domestic violence, particularly against women and children, there is no risk of civil war, and the last war was the Namibia War of Independence, in 1990.

5.6 Political / Legal / Judicial System

The Political system in Namibia is described as a presidential representative democratic republic, whereby the President of Namibia is both head of state and head of government, within a pluriform multi-party system. Executive power is exercised by the government. Legislative power is vested in both the government and the two chambers of parliament. The Judiciary is independent of the executive and the legislature.

According to Namibia’s constitution, the President is elected by direct universal adult suffrage at intervals of not more than five years and must receive more than 50 per cent of the votes cast. He or she appoints the government, the armed forces chief of staff and members of a Public Service Commission, but the National Assembly may revoke any appointment. The President can only serve two successive directly elected five-year terms. The President may dissolve the National Assembly and may also proclaim a state of national emergency and rule by decree, subject to the approval of the National Assembly.

The judiciary of Namibia consists of a three-tiered set of courts: the Lower, High and Supreme Courts.

- *The Lower Courts* are established by an act of Parliament and are bound by the four corners of legislation. There are several lower courts in Namibia. They are the magistrates' courts, the (labour) arbitration tribunals and the customary courts.
- *The High Court* exercises original jurisdiction. It can act both as a court of appeal and a court of first instance over civil and criminal prosecutions and in cases concerning the interpretation, implementation, and preservation of the Constitution. The High Court is presided over by the Judge-President. A full sitting of the High Court consists of the Judge-President and 6 other judges. Its jurisdiction regarding appeals shall be determined by Acts of Parliament. Decisions of the High Court, which bind lower courts, are recorded both in Namibian and South African law reports. The decisions are recorded and summarized in the same way as Supreme Court decisions.
- *The Supreme Court* is the highest national forum of appeal. It has inherent jurisdiction over all legal matters in Namibia. It adjudicates, according to article 79 of the Constitution, appeals emanating from the High Court, including appeals which involve the interpretation, implementation and upholding of the Constitution and the fundamental rights and freedoms guaranteed therein.

5.7 Mining Journal Investment Risk

Based on the Mining Journal 2017 World Risk report, Namibia sits mid-range of regions to invest in (see Figure 5-1). Saskatchewan is the best and Guinea is the worst.

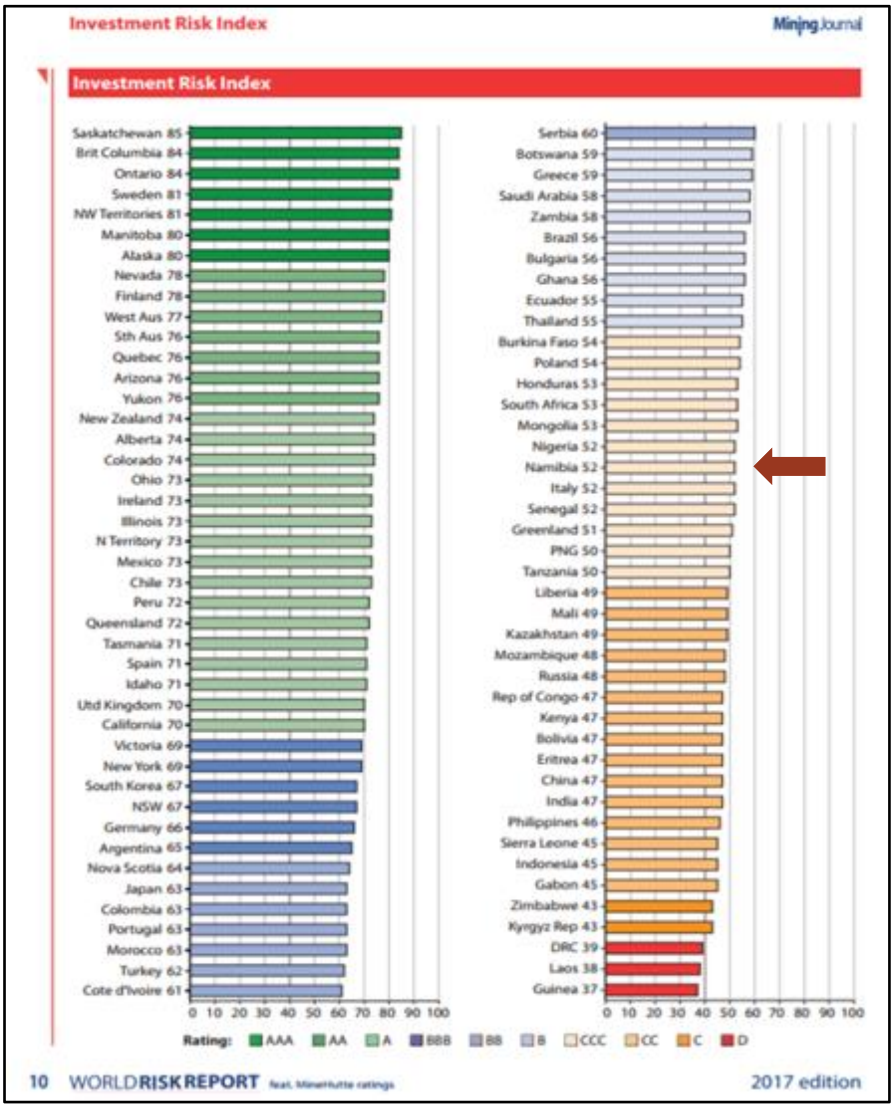


Figure 5-1: Investment risk index

6. HISTORY

6.1 Sources of Historical Exploration Data

The contributing author draws his knowledge for this section from a Behre Dolbear report; from a Namibian Copper Mines report, from the South African Committee for Stratigraphy (SACS) and from a Gordon / McIlwraith report, and from personal knowledge. The author has only seen extracts of reports and third-party reports on the early mining at Haib and information referred to is gained from these reports and discussions with the late Mr. George Swanson (see below).

6.2 Early Mining

The deposit has a distinct surface expression with abundant copper staining on fractures and joint planes particularly in and around the dry riverbed of the Volstruis River. This led to German prospectors identifying the deposit around the late 1800s or early 1900s. Small tonnages of high-grade copper carbonate ore were mined at this time. The word Haib is probably from a local language although the Haib Pforte (fort) is shown on the original German military maps of German West Africa, dating from about 1907. The fort appears to have been a place rather than a structure and the location on the ground is unknown.

After World War II, the prospect owner George Swanson carried out small scale mining and tank leaching operations. Copper carbonate ore was leached with acid. The acid was then run over iron scrap and the copper precipitated as “copper cement”. This copper cement was sold for further refining.

6.3 Exploration – post 1963

In 1963 – 1964 Falconbridge of Africa (Pty) Ltd (Falconbridge) completed a detailed exploration programme looking at the higher-grade zones within the Haib deposit. They drilled some eleven boreholes totalling 1,012 metres of drilling. During 1968-69 King Resources of South Africa Pty Ltd (KRC) conducted a further drilling programme. They examined both lower and higher-grade sulfide zones, as well as the higher-grade oxide shear zones. Some leach test work was carried out. KRC abandoned their licence area in 1969.

Between 1972 and 1975, Rio Tinto Zinc conducted the first extensive and systematic investigation of the Haib deposit. They drilled one hundred and twenty holes (120) totalled 45,903 metres. They conducted various sampling programmes including geochemical and geophysical prospecting.

In 1991-1992, Revere Resources SA Ltd, produced a technical brochure and promoted the Haib as a “potential world class copper producer for the 1990’s”. The intent was to list the Haib as a mining company, possibly on the Johannesburg Stock Exchange. For reasons unknown to the author this listing never materialised.

In November 1993, Rand Merchant Bank Ltd (of South Africa) (RMB) acquired an option over the Haib property. Venmyn Rand Pty Ltd., mining management consultants to RMB, then undertook a study of the project. Work terminated in 1995.

In March 1995 Great Fitzroy Mines NL (GFM) and RMB executed an agreement in association with George Swanson to acquire 100% of the Haib project. GFM agreed terms with RMB whereby GFM could earn 90% of the project. Subsequently GFM agreed to transfer a 70% interest in the deposit to Namibian Copper Mines Inc. (NCM) in exchange for NCM reimbursing past expenditure and providing GFM with a free 20% carried interest. NCM then purchased the remaining RMB interest leaving GFM with a 20% free carried interest and the management, and NCM held 80%. The operating company was called the Namibian Copper Joint Venture (NCJV). From 1995-99 the NCJV prospected the Haib, managed by GFM. The names NCJV and GFM can be read as synonymous.

The mineral rights were held by Copper Mines of Southern Africa (Pty) Ltd (CMSA) as EPL 2152 and worked by the NCJV. The NCJV ran into financial difficulties and work was stopped at the Haib deposit in late 1998 to early 1999.

Rusina Mining Ltd of Perth, Australia, acquired the concession from GFM/ NCJV during 1999-2000 and they took over ownership of the Haib data. The transfer of the mineral rights to Rusina was apparently not ratified by the Namibian Government. Rusina performed no further exploration work on the Haib deposit.

In 2003 (date uncertain) in response to the Namibian government enforcing the new Namibian Minerals Act, George Swanson was forced to relinquish his Haib claims which allowed Haib Minerals (Pty) Ltd (HM), registered in Namibia, to consolidate a single mineral rights entity over the entire Haib deposit. An initial Exclusive Prospecting licence 3140 was granted for 3 years from 22 April 2004 to 21 April 2007 over an area of 74,563 ha covering the deposit and a very large surrounding area. In 2008 DSM concluded a joint venture agreement with Teck, which was amended in 2009 (the “Agreement”). Teck then acted as the exploration operator and manager for HM.

The Agreement with Teck provided that Teck had the right to earn a 70% undivided interest in the Haib copper project in Namibia if it completed an agreed programme of exploration which it duly complied with; Teck then agreed to relinquish exploration management and its 70% interest in HM in exchange for a 35% shareholding in DSM. In May 2017, DSM acquired all of the shares in HM from Teck and now holds a 100% interest of the Haib exploration licence EPL 3140.

The exploration approach taken by Teck was to prospect for adjacent, additional mineralization by means of remote sensing, regional geophysical and geochemical stream and soil sampling programmes and / or to increase the tonnage and / or the grade by further core drilling to explore the already identified higher-grade portions of the mineralization since these are poorly defined by the historical vertical drilling. Teck also completed an extensive programme of quality control and data checks by means of modern surveying of the historical drillhole collars as well as resampling and assays of many of the RTZ drill cores.

In 2017, METS Engineering Group assisted Deep-South Resources Inc. in the development of a Preliminary Economic Analysis (PEA) for the Haib copper project. The PEA report was to present the findings needed for the development of the Haib project with aims to minimise or manage any possible risks or negative implications. The PEA report was completed in February 2018.

6.4 Historical Estimates

Four sets of historical estimates were prepared in the past by different authors. These will each be examined in turn. They are relevant in that they show the thinking of the investigators at that time and provide insight into the areal extent and expected tenor of mineralization.

6.5 RTZ Historical Estimate

In 1975, RTZ, using the sample results from the 120 drillholes drilled by them, calculated an estimate of tonnage and grade for the Haib deposit. The figures reported suggest a very large volume of contained copper amounting to over 2 million tonnes of metal at a fairly low average grade of 0.27% Cu. RTZ used various cut-offs, but it is not reported what method of determination they used. The figures were considered by RTZ to be an Indicated Resource; however, they should be viewed as an Historical Estimate only (see Table 6-1)

Table 6-1: RTZ – Haib Historical Estimate

Cut-Off (% Cu)	Tonnage (Mt)	Grade (% Cu)	Contained Cu (t)
0.15	831	0.27	2,244,000
0.20	563	0.32	1,802,000
0.25	374	0.37	1,384,000

(Note: This is a Historical Estimate; a qualified person has not done sufficient work to classify this historical estimate as current mineral resources or mineral reserves and the Issuer is not treating them as current mineral resources or mineral reserves)

Interestingly, RTZ seems to have concentrated on higher tonnages and not on the higher-grade zones. There is no evidence that they attempted estimates at any higher-grade cut-offs (such as 0.3% Cu). Clearly RTZ was interested in developing large volume mining resources.

6.6 Venmyn Rand Historical Estimate

In August 1994 Venmyn Rand Pty Ltd prepared an information memorandum on the Haib deposit and estimated an in-pit “reserve” using a computer model, although the exact methodology is unknown. They generated the historical estimate presented in Table 6-2 below.

Table 6-2: Venmyn Rand – Haib Historical Estimate

Cut-Off (% Cu)	Tonnage (Mt)	Grade (% Cu)	Contained Cu (t)
0.3	400	0.4	1,600,000

(Note: This is a Historical Estimate; a qualified person has not done sufficient work to classify this historical estimate as current mineral resources or mineral reserves and the Issuer is not treating them as current mineral resources or mineral reserves).

The pit design used by Venmyn Rand was essentially conceptual and very large, being well beyond subsequent pit boundary designs. The Venmyn Rand estimate is thus considered to be effectively a global Historical Estimate above the 0.3% Cu cut-off.

6.7 NCJV / GFM Historical Estimate (1996)

The NCJV used the Venmyn Rand computer database and recalculated their estimate around a more realistic geological and pit model. The pit model was designed to provide some 22 years of mineable material within a 2-year and 8-year mining pit plan. Geostatistical block modelling was carried out and tonnage and grades reported at a range of cut-offs within the various pit outlines. All drillhole assay results were composited over 7.5 metre down-hole intervals prior to variography and block kriging; the pit outlines were used to constrain the reporting of the block tonnes and grade which were thus reported as resource tonnages within a specified pit. The estimates were made in August 1996 and considered by GFM to be Indicated Resources although this category was chosen “in accordance with accepted mineral industry practices” at that time.

The In-pit Historical Estimates as determined by GFM in August 1996 (and approved by BD in a later report) were based on the drilling to the end of 1975 are tabulated below in Table 6-3.

Table 6-3: GFM – Haib In-Pit Historical Estimate – August 1996

Pit	Cut-Off 0.3% Cu		0.1%-0.3% Cu		Cut-Off 0.1% Cu		Waste
	Mt	% Cu	Mt	% Cu	Mt	% Cu	Mt
Year 2	21.4	0.39	27.9	0.20	49.1	0.28	2.1
Year 8	73.4	0.36	289.2	0.20	362.4	0.23	21.8
Year 22	135.5	0.38	803.4	0.19	939.1	0.22	95.7
Total	**230.2**	**0.37**	**1120.5**	**0.19**	**1350.7**	**0.22**	**119.5**

(Note: This is a Historical Estimate; a qualified person has not done sufficient work to classify this historical estimate as current mineral resources or mineral reserves and the Issuer is not treating them as current mineral resources or mineral reserves)

6.8 Behre Dolbear Historical Estimate

Behre Dolbear ("BD") viewed the Haib deposits as resources not reserves, because at the time of assessment they could not be demonstrated to be economic since no feasibility study had been completed. Therefore, BD undertook, after discussion with GFM, to review potentially mineable resources after the additional work had been completed, all or part of which could then be upgraded to a reserve status. This work was never completed. BD did not independently check the accuracy of the data provided by GFM but accepted the data as supplied for this work.

The drillhole data set provided to BD consisted of assay and survey data from 152 drillholes. The location of the drillholes was based on a local coordinate system. Included in the assay database were primarily the copper assays.

The historical mineral models generated by BD in January 1998 were estimated by generating three separate three–dimensional block models using nearest neighbour, inverse distance squared and kriging estimation techniques. Their results are compared with the GFM estimate in Table 6-4 below:

Table 6-4: Haib Historical Estimate – Behre Dolbear/GSM

Minimum Block Grade	GFM Model		Behre Dolbear's Model					
			Kriging		Inverse Distance Squared		Nearest Neighbour	
	M Tonnes	Grade % Cu	M Tonnes	Grade % Cu	M Tonnes	Grade % Cu	M Tonnes	Grade % Cu
0.1	1350	0.23	1353	0.23	1331	0.23	1184	0.25
0.2	730	0.28	739	0.29	726	0.29	630	0.34
0.3	230	0.37	244	0.37	262	0.38	292	0.46

(Note: This is a Historical Estimate; a qualified person has not done sufficient work to classify this historical estimate as current mineral resources or mineral reserves and the Issuer is not treating them as current mineral resources or mineral reserves)

6.9 QP's Comments on the Various Historical Models and Estimates

Both the GFM model and one of the BD models used Kriging methods as the basis for their estimate calculations. The figures generated are very comparable, the BD numbers being very slightly more generous in both grade and tonnes. Kriging as a statistical estimation technique is widely used in porphyry deposits.

When calculating block values with the inverse distance model, the arithmetic process decreases grade on an inverse basis away from the point of measurement. In simple terms this means that the grade initially decreases rapidly away from the data source then flattens off with distance. Parameters for the X, Y and Z axes are operator chosen and can be varied in different directions in the event of mineralization being obviously controlled by any geological factor, such as faulting, unconformity contact or bedding.

The Haib deposit Is not bedded, although some structural control over higher grade mineralization is apparent and has a fairly uniform grade distribution.

The nearest neighbour technique assigns the grade of the sample nearest the centre of the block to the block and provides a global check on the estimates.

It should also be noted from comments made elsewhere in this report during discussions of the recent Teck drilling that the historical, vertical drilling used for all of the above historical estimates may have incorrectly estimated both the extent and the grade of the high-grade zones because the high-grade zones lie within a dipping set of fractures and require inclined drillholes to obtain a true thickness estimate.

The most significant and well documented historical mineral estimate derives from the report by Behre-Dolbear (1998) that was commissioned near the end of the NCJV tenure at the Haib and is summarized in Table 6-4 above. Please note: -

- That this estimate was prepared prior to publication of the National Instrument 43-101 guidelines and the CIM definitions and Standards for reporting of mineral reserves and resources in 2000 and their subsequent amendments in 2005, 2010 & 2014, and perhaps more importantly,

- The Historical Estimates developed by Behre Dolbear (1998) for the Haib deposit have been reviewed here by the author; however, the underlying data and evidence, particularly assay certificates, required for the author to validate and classify these Historical Estimates as current mineral resources are not available. Therefore, the historical grades and resources terminology from the historical original reports are to be used only as a reference and are to be considered as Historical Estimates as per the NI 43-101 Rules and Policies Part 1 definition of Historical Exploration Information. Neither DSM nor HM are treating the historical estimate as a current mineral resource or mineral reserve and do not rely on this estimate in any financial studies.

7. GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The Haib deposit is located within part of the Namaqua-Natal Province called the Richtersveld geological sub-province which is further subdivided into a volcano-sedimentary sequence (locally, the Haib Subgroup), the Orange River Group and the intrusive Vioolsdrift suite which are closely related in space and time

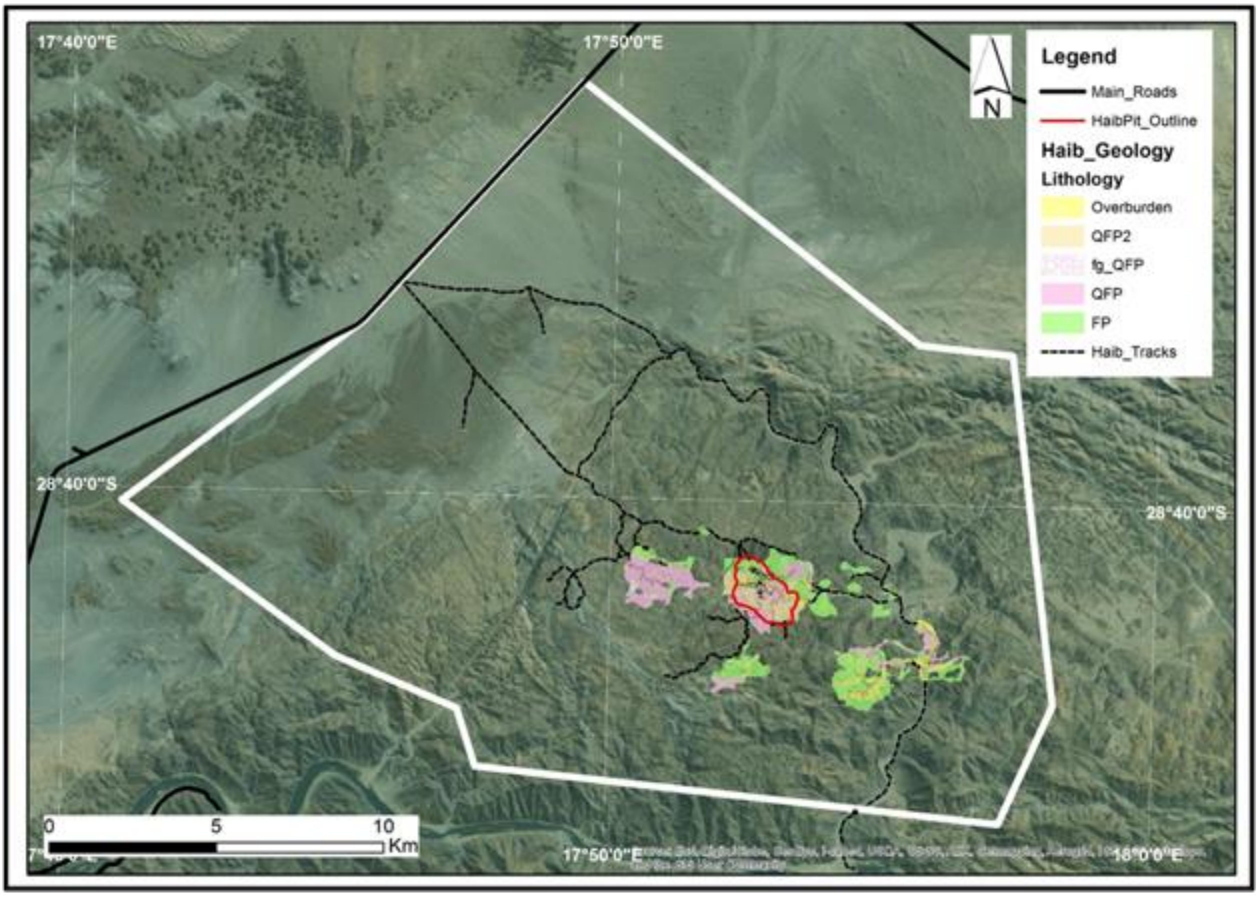


Figure 7-4: Intrusive Rocks: This map shows the detailed intrusive rock units of the Haib deposit. (Source: Teck 2015)

The Orange River Group is composed of sub-aerial volcanic rocks and reworked volcaniclastic sediments; deformation caused displacements along stratigraphic contacts before intrusion of the Vioolsdrift suite. The predominance of andesitic and calc-alkaline magmatic rocks with tectonic compression prevailing throughout the magmatic episode has led to an interpretation of an island-arc model for the region. Recent age dating of Haib rocks by separation of zircon and apatite on which laser ablation and inductively coupled plasma mass spectrography was used to derive the U/Pb ratios was performed at Trinity College, Dublin by Neil Grumbley and indicated an age of 1,880 Ma for the volcanics. The sequence has undergone low grade regional metamorphism to greenschist facies. Most of the rock exhibits typical porphyry copper type alteration zones associated with mineralization. A potassic hydrothermal alteration zone coincides with the main mineralized area surrounded by phyllic and propylitic alteration haloes. Propylitic sericite alteration appears to overprint the earlier potassic zones. Silicification, chloritization and epidotisation are widespread. Although not present in the immediate area of the Haib deposit, some kilometres to the east of the area are outcrops of Karoo age (early Permian) mudstones, siltstones and sandstones of the Prince Albert Formation. These create very flat topography and would by their nature be very well suited to the production of heap leach pads.

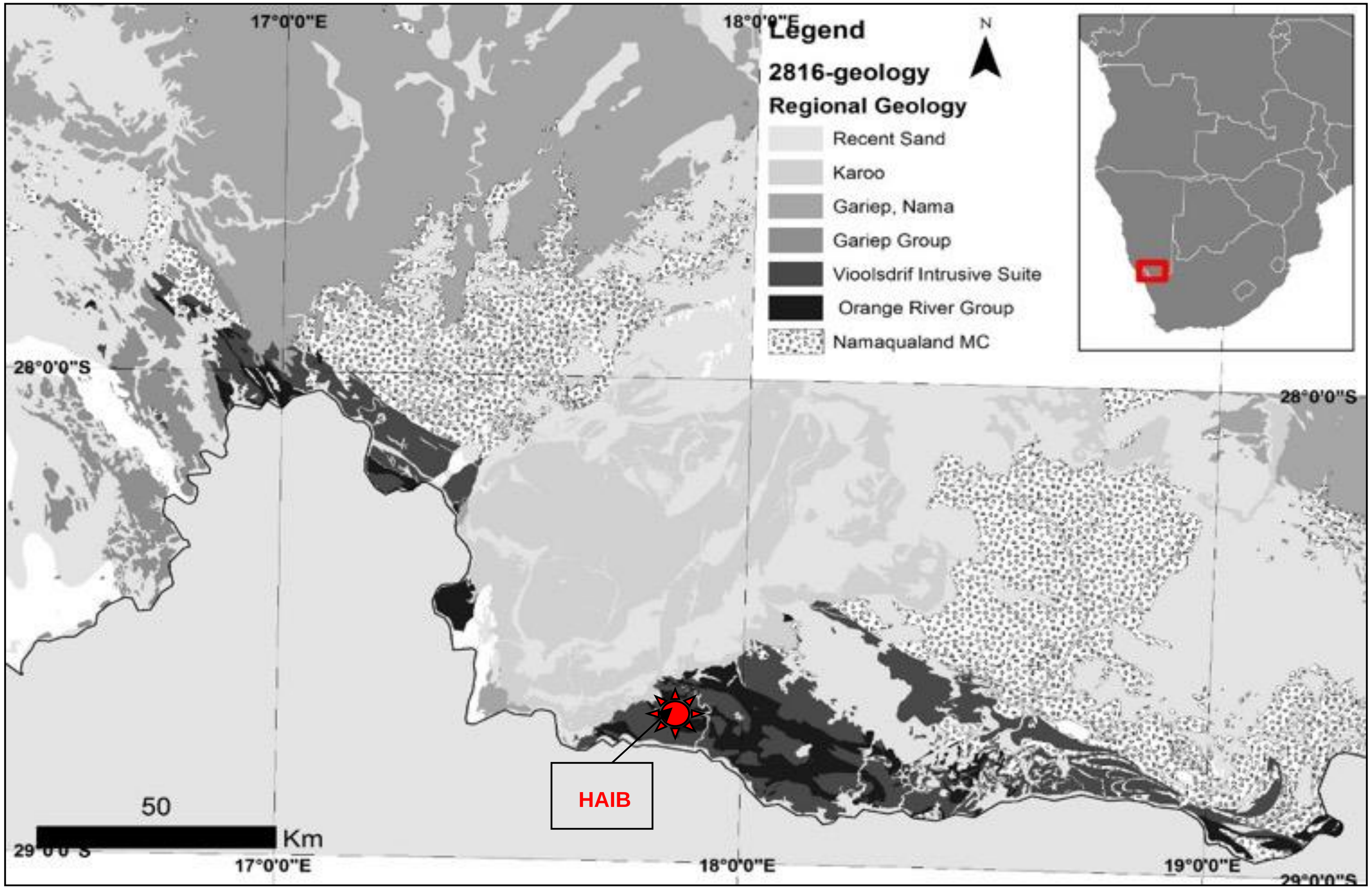


Figure 7-1: Regional Geology: Map showing the general distribution of the Vioolsdrif and Orange River rocks in relation to the Haib deposit. (Source: Teck Namibia, 2015).

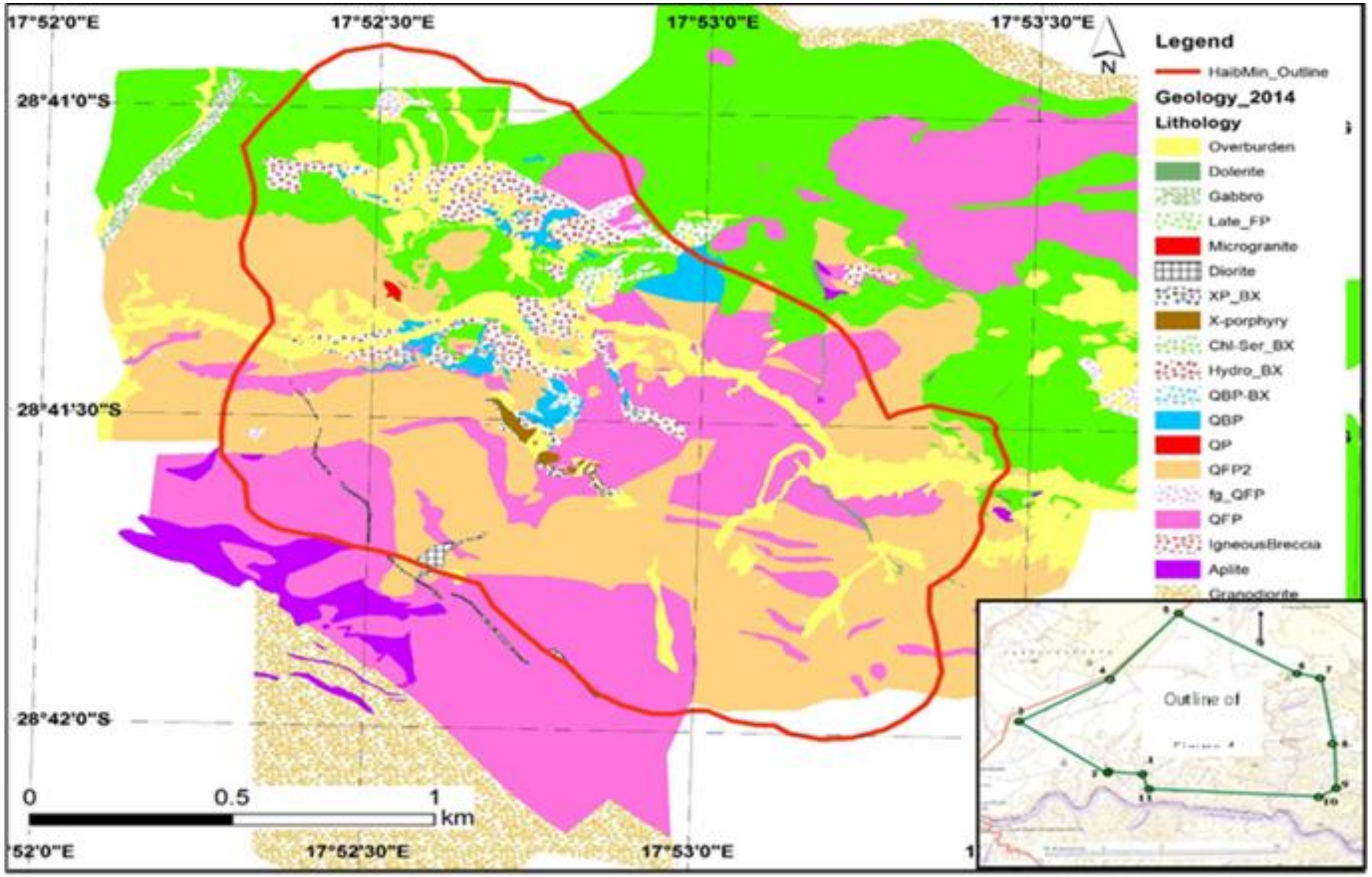


Figure 7-2: Detailed Geology of The Haib (from Teck 2015)

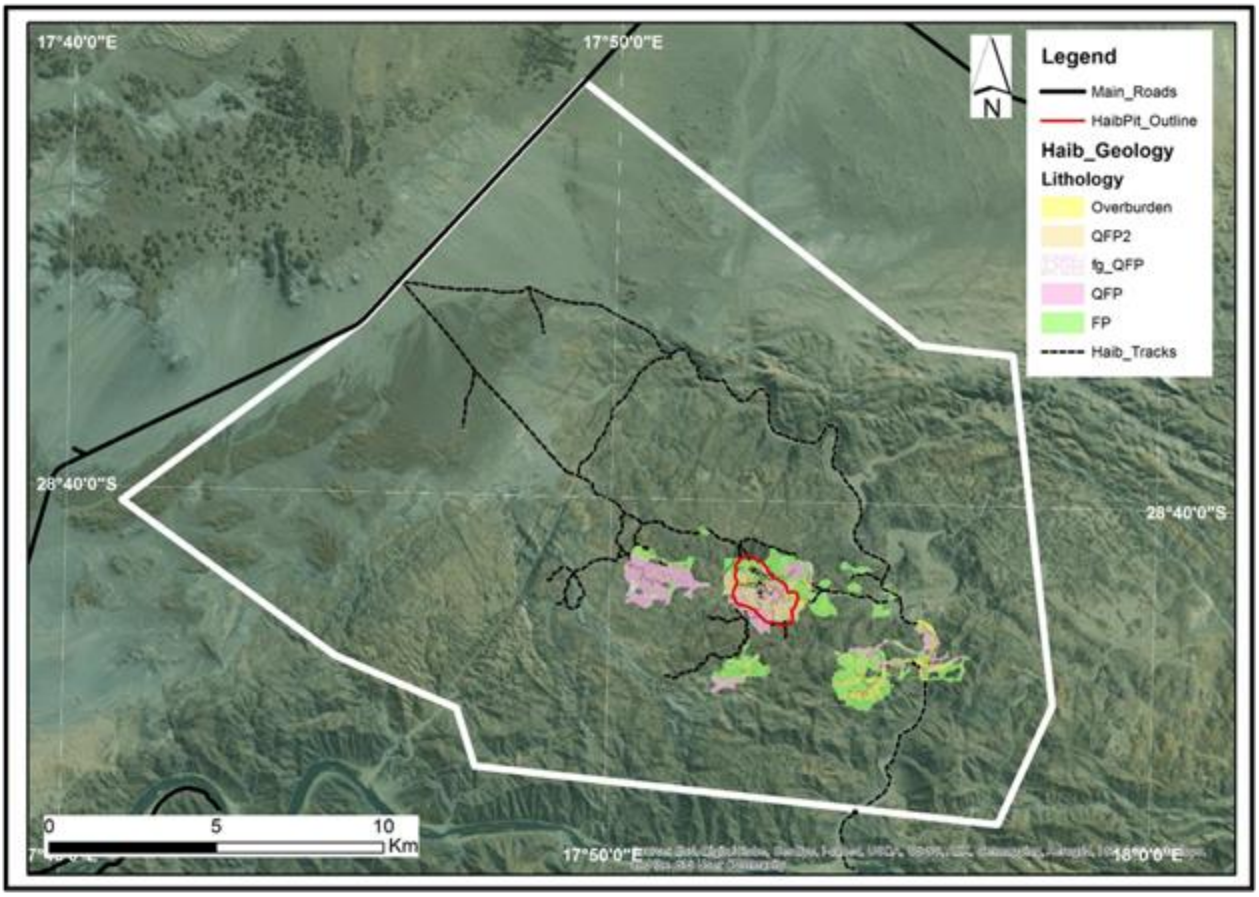


Figure 7-4: Intrusive Rocks: This map shows the detailed intrusive rock units of the Haib deposit. (Source: Teck 2015)

7.2 Local Geology of the Haib Deposit

The principal mineralised hosts at the Haib are a Quartz Feldspar Porphyry (QFP) and a Feldspar Porphyry (FP) as shown in figure 7- 1 and 3. The QFP is interpreted as a quartz diorite body which intruded the feldspar porphyry some 1,868 ± 7Ma ago. The FP is generally interpreted as being part of the suite of andesitic rocks although some workers have suggested that it too, may be partially of intrusive origin. The QFP is elongated along the orientation of the Volstruis Valley, largely coincident with the location and orientation of many of the higher-grade intersections within the deposit.

The QFP comprise typically blue quartz and feldspar phenocrysts within a medium grained rock mass of quartz, feldspar, sericite, biotite, chlorite, epidote and calcite. The FP is generally a medium to fine grained rock of similar composition but without the quartz phenocrysts and with a higher proportion of chlorite and epidote; please note that the sericite, epidote, chlorite and calcite are alteration products and not the original igneous composition of the QFP or the FP (Figures 7-2 and 7-3 above). Minor basic dykes and quartz veins traverse the area.

Rocks within the Haib area are hard and competent but generally well jointed with both flat and steeply dipping joint sets being well developed. Striking east-west along the Volstruis River is a well-developed zone of steeply dipping shears. The orientation and location of the main mineralization coincides with the fracture zone which is interpreted as fractures providing a focus of the intrusion and then channel-ways for late-stage mineralising fluids. The fracture zones likely represent the local stress regime at the time of porphyry formation and control the orientation of high-grade zones and were later re-activated by the Namaqua deformation event circa 1,100 Ma ago.

7.3 Structural Controls on Copper Mineralization

Mineralization at Haib is typical of a porphyry copper deposit and despite the age of the deposit, and the fact that the mineralization has been subjected to local post-mineral deformation, the deposit remains relatively intact. Detailed mapping by Teck geologists within the main deposit area has shown that high-grade copper mineralization is controlled by a fracture/vein set that parallels a regional structural trend and strikes N60^{0}W and dips steeply (-70^0) to the southwest. This high-grade zone also appears to plunge at 30^0 to 40^0 towards the south-east. This model has significant economic implications as it suggests that the higher-grade zone of copper mineralization has not been adequately tested by the historical vertical drillholes and that inclined drillholes will better define the extent and tenor of this mineralised zone. If this model is correct, then systematic inclined drilling could better define the high-grade sections leading to better pit design to exploit near-surface high-grade mineralization at the start of mining operations.

Teck has also defined four new target areas near to the main deposit and three other target areas on the property, namely the SW alteration feature, the NW IP anomaly and the E alteration feature that are, as yet, poorly defined. The well-defined targets, referred to as the eastern, southern, south-western and western anomalies, have been defined using geological mapping, stream and soil sample geochemistry and geophysical surveys using IP with several diamond drillholes in three anomalies (east, south and west) to determine the extent and tenor of mineralization.

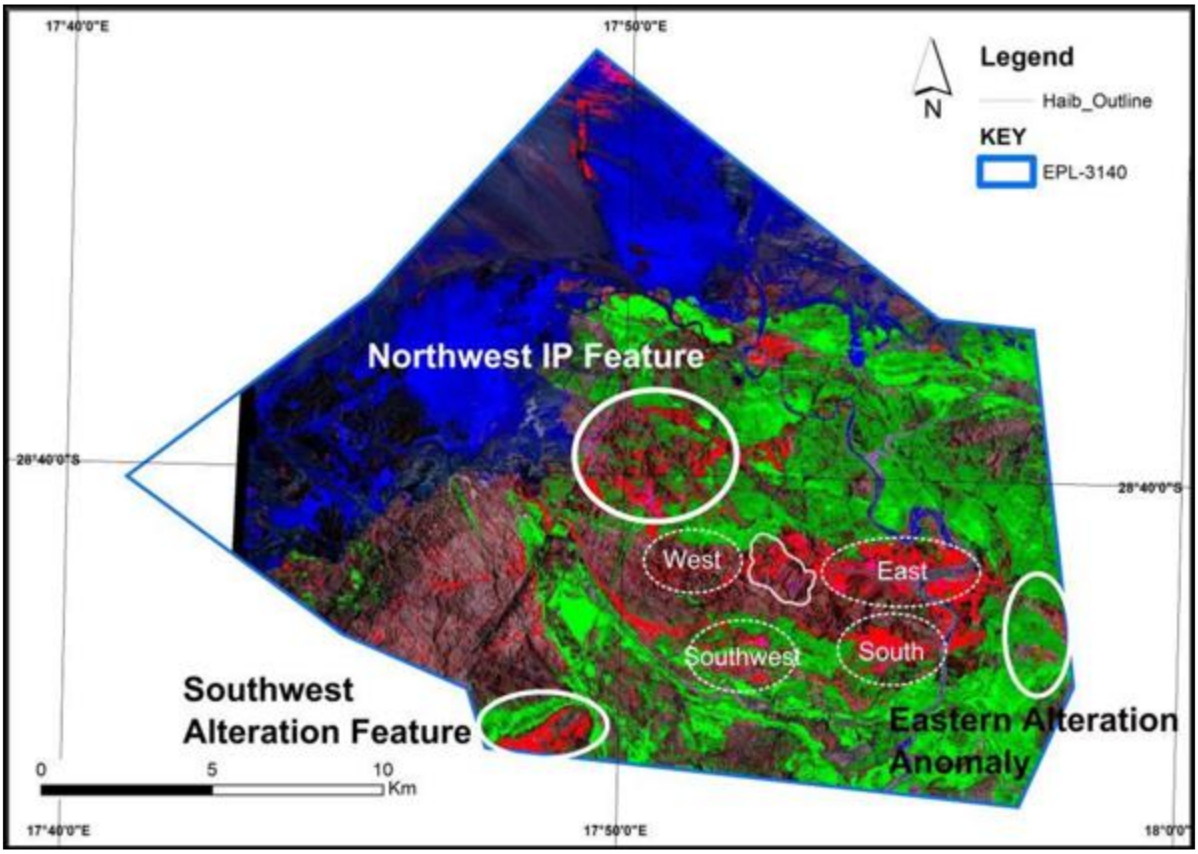


Figure 7-4: Haib deposit anomaly map (Teck, 2015)

7.4 Mineralization

The Haib deposit is in essence a very large volume of rock containing copper mineralization. The grade is variable from higher grade in the three core zones (possibly averaging >0.4%) progressively decreasing towards the margin of the deposit. The area in which mineralization has been identified equates approximately to the outer ring of the GFM 22-year pit design. This gives a pit size of 2200x1250x400 metres equating to some 1300 million tonnes of mineralized rock. The deposit is still partially open to the west (at surface) and to the south at depth.

Mineralization is not confined to any specific units although the quartz feldspar porphyry tends to contain the three higher grade zones. Mineralization is clearly secondary and post-dates the formation of the original volcanic pile. Mineralization is widespread throughout although frequently associated with fractures and joints.

The principal sulfides within the Haib body are pyrite and chalcopyrite with minor molybdenite. Bornite, digenite, chalcocite and covellite are also occasionally recorded. There is no major development of a supergene zone, probably due to high rates of erosion associated with the Orange River canyons. Near surface oxidation has led to the formation of malachite, azurite, chrysocolla, minor cuprite and chalcocite, generally along fracture zones. Oxide copper rarely extends to depths in excess of 30 metres on these fracture zones. While the oxide zone volumetrically represents a fairly minor proportion of the deposit, grades are significantly above average giving the potential for some leachable copper from the oxide material. These portions of the deposit have not been examined in detail and there is significant potential to improve their volume and grade.

In addition, there is a variable thickness of transition zone generated over large parts of the deposit, between the surface and a pure sulfide (un-oxidised) zone of some 10-20 metres thickness.

Sulfide minerals are disseminated within the rock mass and found concentrated in blebs and along veinlets and fractures. Significant mineralization commonly occurs along joint planes.

Gold, silver and molybdenum are trace constituents associated with the copper mineralization. Molybdenite is occasionally seen as disseminated flakes and veinlets associated with other sulfides and in minor shears and quartz veins. Assaying for gold, silver and molybdenum was not routinely conducted on drill samples but has been carried out on composite samples prepared for metallurgical testing, giving an approximate indication of the likely values. Values determined were: - 0.02 g/t gold; 0.9 g/t silver; and 25 g/t molybdenum.

8. DEPOSIT TYPES

The Haib copper deposit is a porphyry copper deposit of palaeo-Proterozoic age. Porphyry copper deposits are a major world source of copper (also molybdenum, silver and gold) with the best-known examples being concentrated around the Pacific Rim, in North America, South America, and areas such as the Philippines. Most of these deposits are relatively young, of Tertiary or Cretaceous age. The United States Geological Survey defines a porphyry copper deposit as follows –

- *"One wherein copper-bearing sulphides are localized in a network of fracture-controlled stockwork veinlets and as disseminated grains in the adjacent altered rock matrix.*
- *Alteration and ore mineralization at 1–4-km depth is genetically related to magma reservoirs emplaced into the shallow crust (6–8+ km), predominantly intermediate to silicic in composition, in magmatic arcs above subduction zones.*
- *Intrusive rock complexes that are emplaced immediately before porphyry deposit formation and that host the deposits are predominantly in the form of upright-vertical cylindrical stocks and(or) complexes of dikes.*
- *Zones of phyllic-argillic and marginal propylitic alteration overlap or surround a potassic alteration assemblage; and,*
- *Copper may also be introduced during overprinting phyllic-argillic alteration events.*

The Haib deposit has all of the above defined geological characteristics (see Section 7 above) and is therefore a porphyry copper deposit, being formed within intrusive Proterozoic rocks at 1 880my BP. Porphyry copper systems usually occur along subducted zones and commonly occur in clusters. It is interesting to note therefore, that:- The Lorelei Deposit, some 120km WNW of the Haib (Figure 7-4), is another low grade copper-molybdenum porphyry showing similar alteration zonation and is of a similar age to the Haib and the Tatasberg deposit, some 80 km WNW of the Haib across the border in South Africa (Figure 7-4) is reportedly also a porphyry style Cu-Mo deposit showing typical alteration zoning but is reported to be only some 540my old, although the source of this dating is not reliable; the deposit was explored between 1974 & 1976 by African Selection Trust Exploration ("ASTE") and some 9 diamond drillholes were completed with the best intersection yielding 6% Cu and 32% Mo over a 1m interval but the general average is reportedly some 0.2% Cu . Unfortunately, the detailed reports of ASTE's exploration could not be obtained from the South African Geological Survey as they are apparently "lost" in their library.

9. EXPLORATION

From 2008 to 2017, Teck held 70% of HM, the holder of EPL 3140, and as discussed previously in the Background Sections of this Report, optioned the property and assumed management of the exploration programme.

9.1 The Teck Exploration Programme

Teck took a more regional view of the project than previous operators and did not only focus on the work completed by the NCJV. Their exploration objective was to provide the required data to show that the deposit had potential for large-scale mining, particularly if the tonnage or grade, or both, could be improved and that early-stage mining could exploit sufficient high-grade mineralization to improve the economics of mining. They started a new exploration programme both to investigate the open-ended parts of the deposit (deep drilling and extension drilling) and to explore for new, undiscovered outlying mineralization. This had not been previously attempted. Teck, following this model, from 2008 to date, have completed the following work: -

- A regional stream sediment sampling programme collected 276 samples aiming to sample all first and second order streams every 300m-500m over an area of 320sq.km. This was conducted in 2008 over outlying areas of alteration around the existing Haib deposit. This led to the discovery of four adjacent anomalous zones spaced some 2km from the main Haib mineralization and it is these anomalous zones that have been geophysically investigated as discussed in later sections. Three of these zones (shown in Figure 7.4 above) have recently been evaluated by diamond drilling and found to be of low grade and caused by distal veining from some unknown porphyry intrusive.
- A total of 32 diamond drillholes (totalling 14,252 metres). These were drilled within the historically defined main mineralization and on the Eastern, Southern and Western IP / soil geochemical anomalies (discussed in Sections 9.4 & 10.2 below).
- Using the Anaconda mapping method, which maps in detail the lithology, alteration, vein type, orientation and intensity on separate overlays, they have mapped about 75% (205 ha) of the area around the 275 ha. Main deposit (at a scale of 1:10,000) and all (90 ha.) of the main deposit at 1: 2,000 scales; Teck have also mapped the Eastern and Southern IP defined anomalies at 1: 10,000 scales, while the vein zone at Haib West has been mapped at 1: 2,000 scales (Locations are shown in Figure 7.4 above).
- They have re-logged all of the available (108 out of 120) old RTZ drillholes in detail, again using the Anaconda method. These were all located within the Main Haib deposit.

- They have re-sampled 14 of the old RTZ drillholes to compare the assay results obtained by RTZ for copper and also to determine the grade of gold, silver and molybdenum (Figure 10-2 below).
- They completed some 83-line kms. Of pole-dipole Reconnaissance Induced Polarization (RIP); and another 6-line kms. Of Audio Magnetotellurics (AMT).
- *(Note: - AMT is a high-frequency magneto-telluric technique for shallower investigations. While AMT has less depth penetration than MT, AMT measurements often take only about one hour to perform, although deep AMT measurements during low-signal strength periods may take up to 24 hours and use smaller and lighter magnetic sensors.)*
- They collected 636 soil samples on grid lines 150m apart with sample spacing of 50m covering an area of 400 hectare across three of the satellite targets – the South, Southwest and West anomalies (Location – Figure 7.4 above).
- They constructed a 3-D geological model of the Main Haib zone using Leapfrog geo-modeling software (see Figure 9-1 below). This model combines all the surface and down hole geology, assays and geochemistry to constrain the grade envelope for a resource estimate.

9.2 Teck's Geophysics

Various geophysical techniques have been applied over the Haib deposit on several occasions. The earliest documented geophysics for which records exist was an Electromagnetic survey (EM) conducted by J. Shepherd of Falconbridge in March 1964.

A further significantly more detailed IP and resistivity survey was conducted by RTZ in December/ January 1974-75. This covered the bulk of the main mineralised area.

Teck proceeded to complete RIP, PDP and AMT geophysical surveys initially over the main Haib mineralization and then extended their surveys to cover targets generated by a study of alteration patterns in the Proterozoic country rocks in EPL 3140. These programmes were conducted in-house. Figure 9-2 below shows the location of RIP sections completed across the main Haib mineralised zone with a 3D representation showing the Haib drilling. The impact of the disseminated sulphides in the main Haib body is well represented by the zones of red and pink (high chargeability).

The fairly extensive geophysical survey programme over alteration anomalies around the main Haib mineralised body determined several additional zones of high chargeability. These geophysical anomalies, together with detailed geological mapping to show alteration and geochemical soil, stream and rock chip sampling results allowed Teck to prioritise follow-up evaluation programmes of these anomalies which are on-going (for their location see Figure 7.4 above).

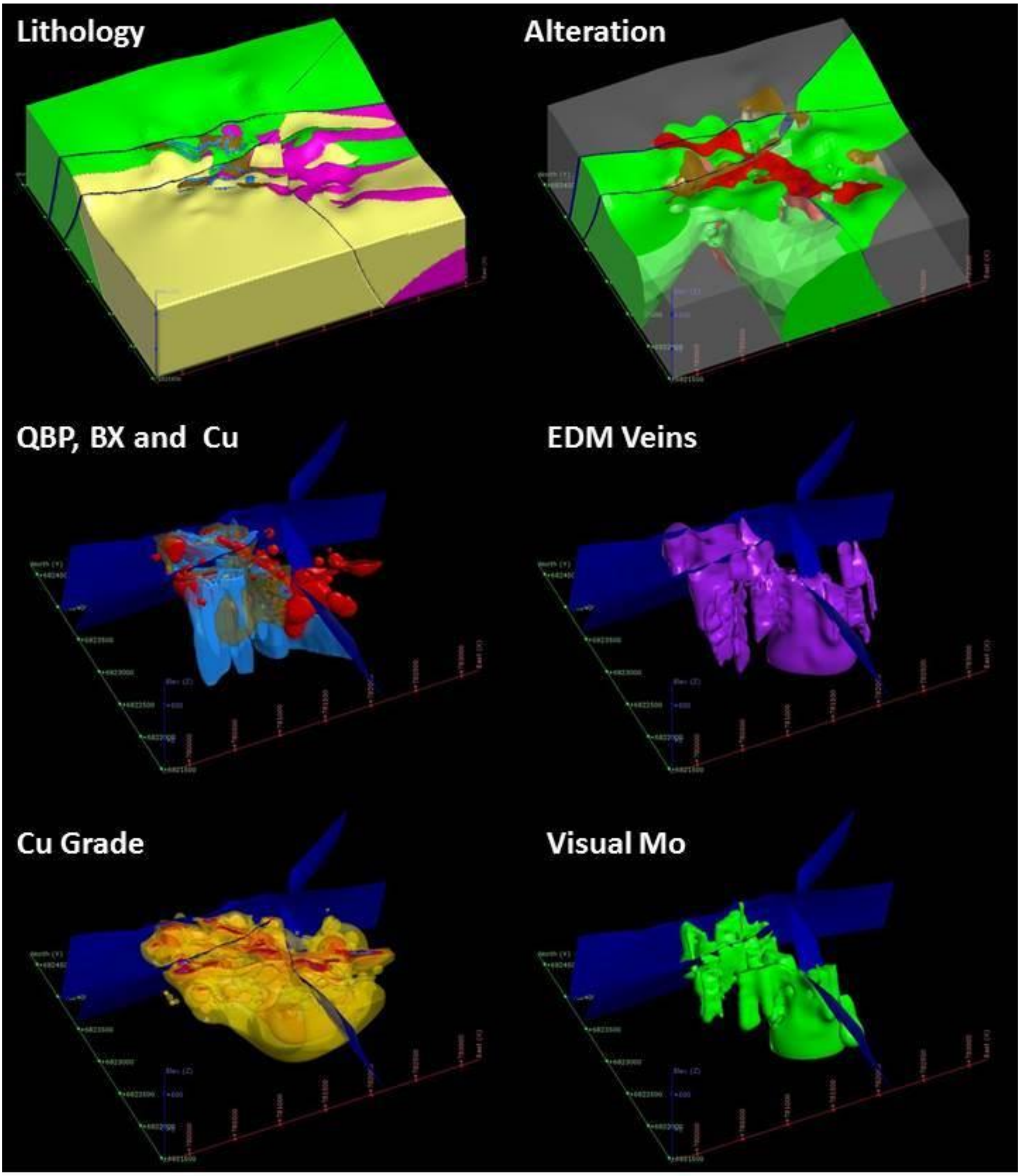


Figure 9-1: Three Dimensional Models: A compilation of 3-D models of the Main Haib deposit (Source: Teck, 2015)

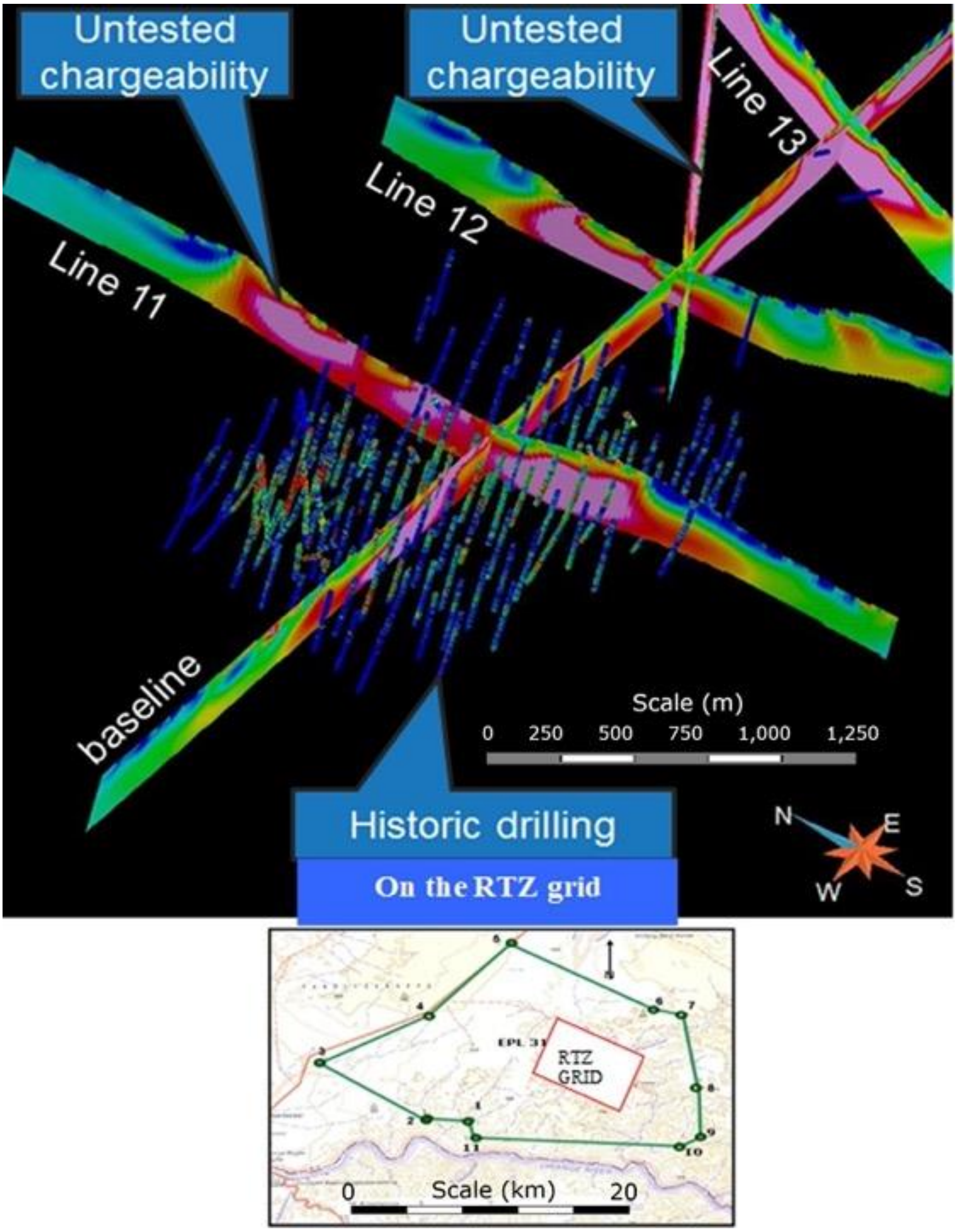


Figure 9-2: A 3-D diagrammatic representation of the Teck IP geophysical section lines across the main Haib deposit. The pink and red zones adjacent to the drillholes show the zone of mineralization with a high chargeability. (Source Teck 2012)

9.3 Teck's Geochemical Surveys

9.3.1 Stream Sampling

This sampling campaign was aimed at evaluating the outlying areas of the licence and none of the main Haib mineralization area was sampled by Teck. The sampling was completed in 2008 and all the large third-order streams were avoided since these would be much diluted. First and second-order streams were sampled every 300m to 500m by collecting roughly 1-2Kg of sample from trap sites using a stainless-steel shovel, dry sieving these to -2mm and further to -80# size using stainless steel sieves (brushing the sieves between samples and washing them every day) and packaging these in a brown paper sample bag with a sample number tag inside and outside of the bag. The GPS location was taken and recorded. Every 20th sample is duplicated by taking another sample within 1 or 2 metres of the first site. Standard and Blank samples are inserted later on a 1:20 frequency but randomly inserted in the sampling sequence.

9.3.2 Soil Sampling

Since RTZ soil sampling coverage around the main Haib body was quite extensive, Teck have extended their grid lines into the outer regions of the licence using the same orientation. The samples were collected on 150m line spacing using 50m sample spacing. This campaign has collected 636 samples over an area of 400 hectare. The procedure employed is to dig a hole to a depth of some 10cm. using a stainless-steel shovel, dry sieving these to -2mm and then -80# size using stainless steel sieves (brushing the sieves between samples and washing them every day) and packaging these in a brown paper sample bag with a sample number tag inside and outside of the bag. The GPS location is taken and recorded. Every 20th sample is duplicated by taking another sample within 1 or 2 metres of the first site. Standard and Blank samples are inserted later on a 1:20 frequency but randomly inserted in the sampling sequence.

9.3.3 Teck's Geological Mapping

Teck use a geological mapping method which results in at least 3-overlays for mapping of structural, lithological and alteration features. The more detailed mapping in and around highly mineralised areas add another "vein" overlay to this map. The various features are colour coded.

9.3.4 Teck's Other Targets

Outside of the main Haib deposit Teck outlined three satellite targets, as indicated on Figure 7.4 above. The eastern anomaly, with extensive sericite alteration zones, high molybdenum geochemical results and a defined IP anomaly, has been evaluated by four vertical diamond drillholes with a total depth of 1,525.35m (see Table 10.2 below) with only minor traces of mineralization.

The southern anomaly (Figures 7.4 above and 9.3, 9.4 below) is also well defined by extensive sericite alteration, some copper staining with haematite/limonite and gypsum associated with quartz vein sets, so-called D-veins in porphyry system terminology and a distinctive IP response. On surface this anomaly extends over 1.2km along strike and 350m – 500m across strike; it appears to be steeply dipping to the south. Four diamond drillholes totalling 1,484.34m of which 3 holes were angled to the north and one to the south were used to evaluate this anomaly, (see Figure 9-5 below) but assay results indicated less than 0.2% Cu in zones where there is a high density of D-veins and <0.1% Cu elsewhere. The strong IP anomaly is probably the result of the abundant pyrite in the veins. This vein zone has been interpreted as being distal from a further porphyry system but because of thrusting and late-stage normal faulting, the location and depth of this body are difficult to estimate. The drilling clearly defines a lower contact for the vein zone.

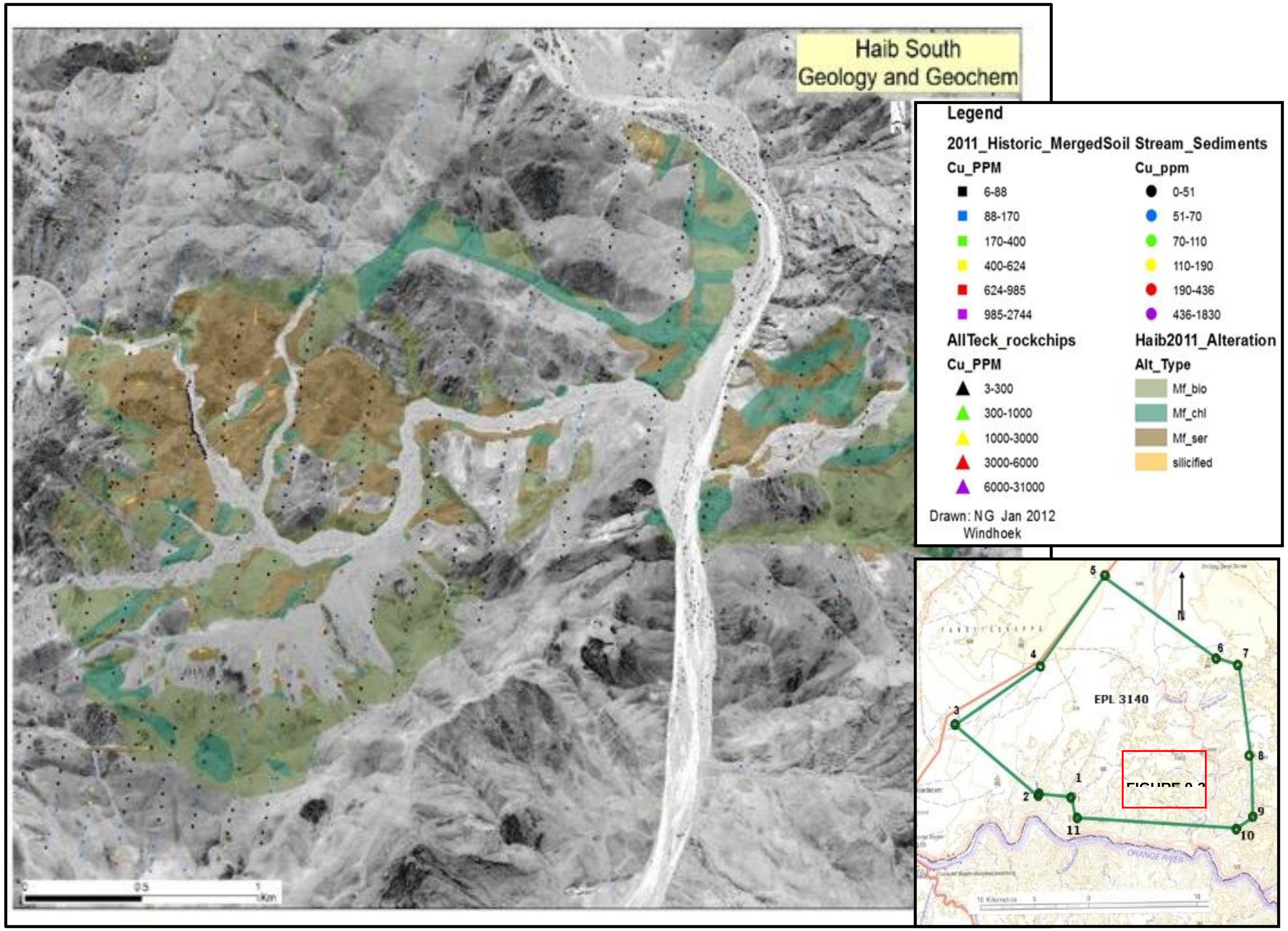


Figure 9-3: Alteration Geology: Map showing the alteration geology and geochemical sampling of the Haib South anomaly (Source Teck 2012)

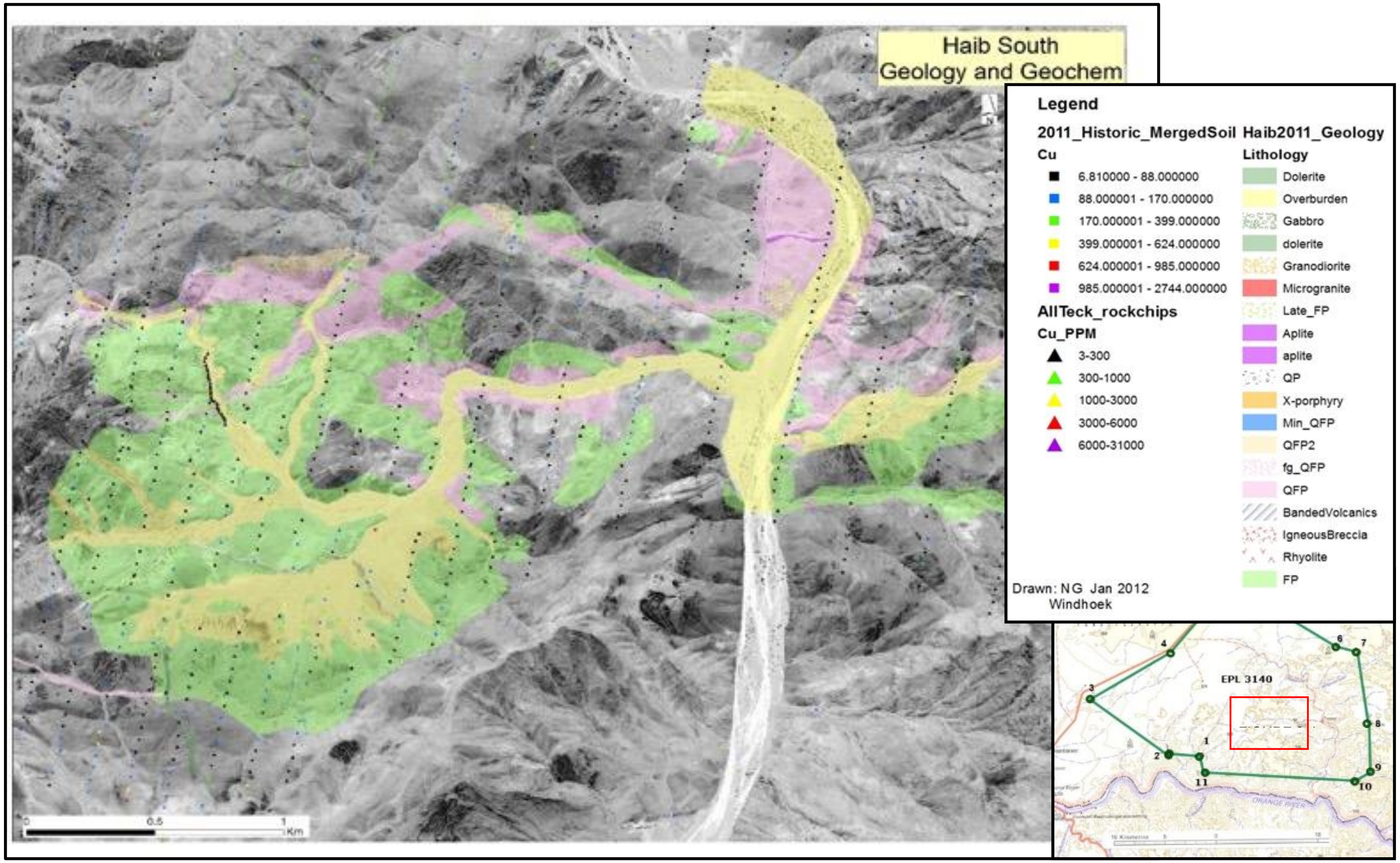


Figure 9-4: Map showing the lithology of the Haib South anomaly (Source Teck 2012)

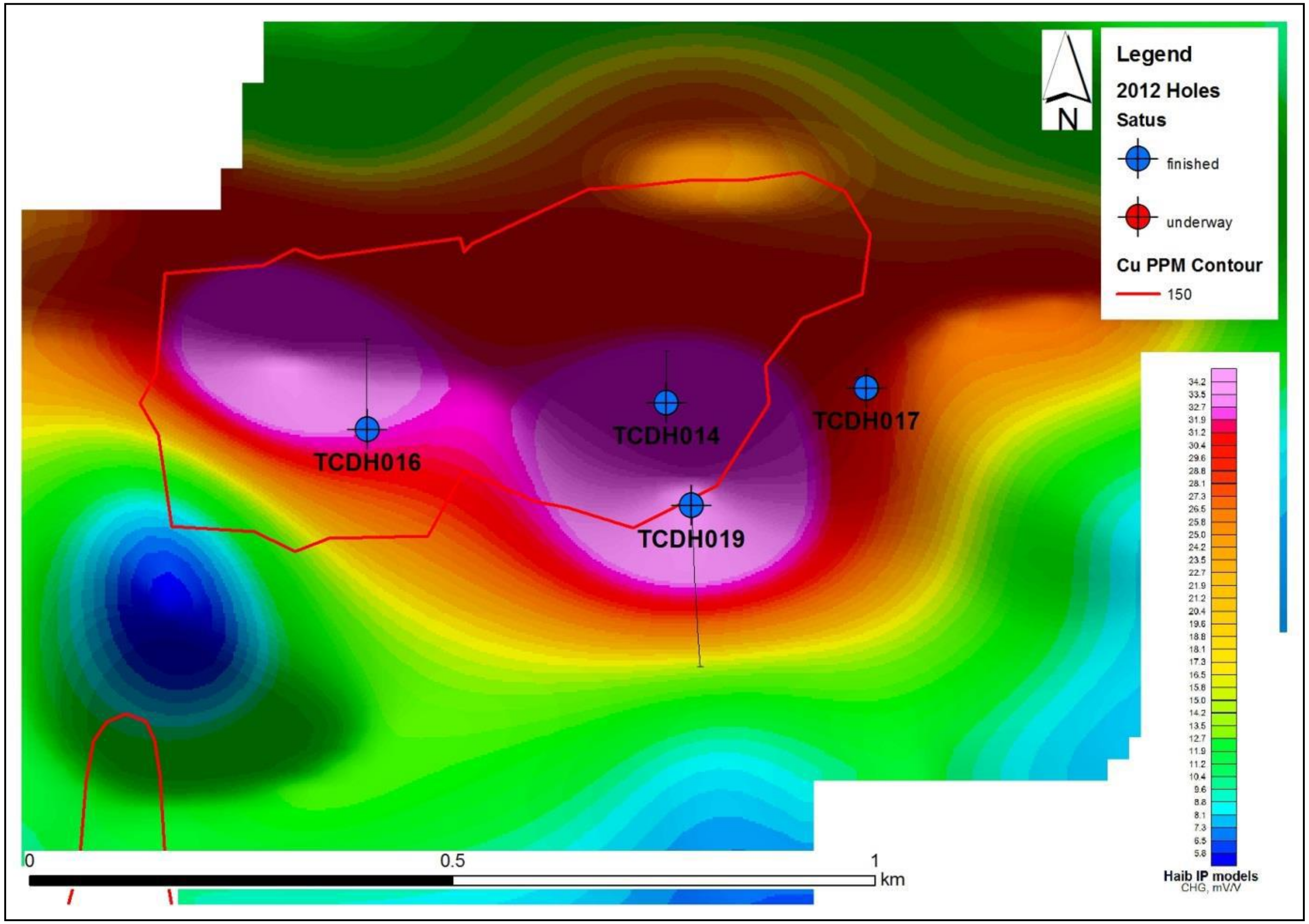


Figure 9-5: Map showing the location of drillhole collars overlaid on the IP Chargeability contours (50m depth slice of pole-dipole lines) & the Cu in soil >150ppm contour line – Haib South Anomaly (Source Teck 2012)

The Western anomaly (Location – see Figure 7.4 above) consists of a km-scale soil anomaly coincident with an 800m long, NE trending and SE dipping quartz vein zone truncated in the Northeast by a shear zone. The veins are predominantly A- and B-type quartz veins with only minor EDM veins and are analogous to those found at the main Haib deposit. The Western anomaly was drilled by RTZ using a single vertical hole. Teck have now drilled two inclined diamond drillholes totalling 735.37m but these were completed before the detailed mapping programme and may not have been sited optimally (see Figures 9.6, 9.7, and 9.8 below). The one Teck hole intersected 44m of 0.22% Cu with a high-grade section of 4m at 0.4% Cu. Again, this anomaly has been interpreted as a distal portion of a separate porphyritic intrusive.

There is some alteration and IP evidence which outlines a further four targets (see Figure 7.4 above) which will require follow-up geophysical, geological mapping and geochemistry work to confirm their potential as exploration targets for drill investigation: -

- The North-western IP anomaly has poorly defined soil geochemistry and has not yet been drilled by HM.
- The South-western anomaly contains extensive sericitic alteration with zones of pyrophyllite and alunite indicating it is very high in the porphyry intrusive alteration system but with no indications of near surface mineralization.
- The Eastern alteration feature consists of a quartz-rich sericitic alteration zone with minor copper staining within the FP to the immediate south of a dyke of QFP dipping steeply (75 – 80^0) to the Southwest.

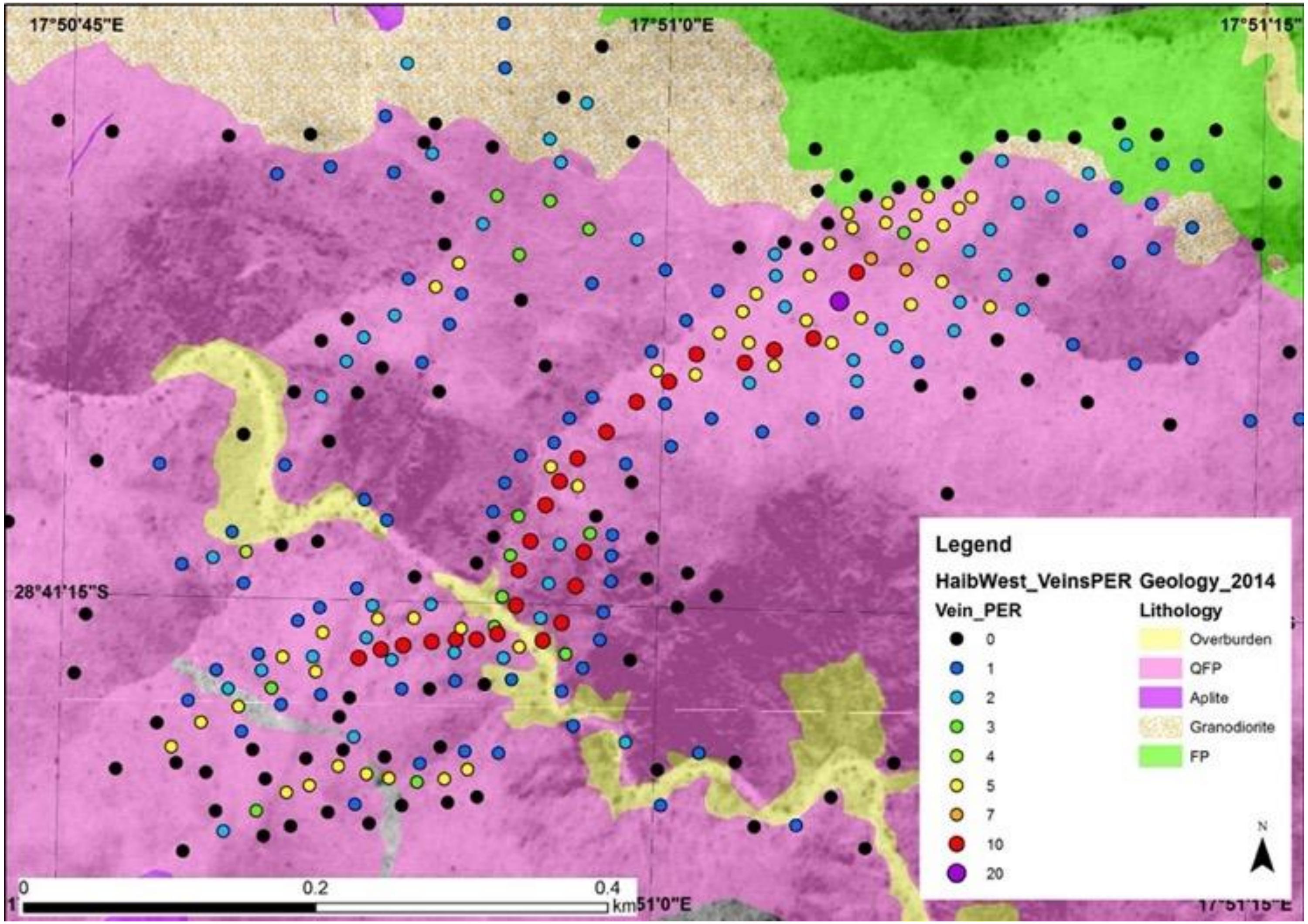


Figure 9-6: Map showing the geology and vein densities (%) at Haib West (Source Teck 2015)

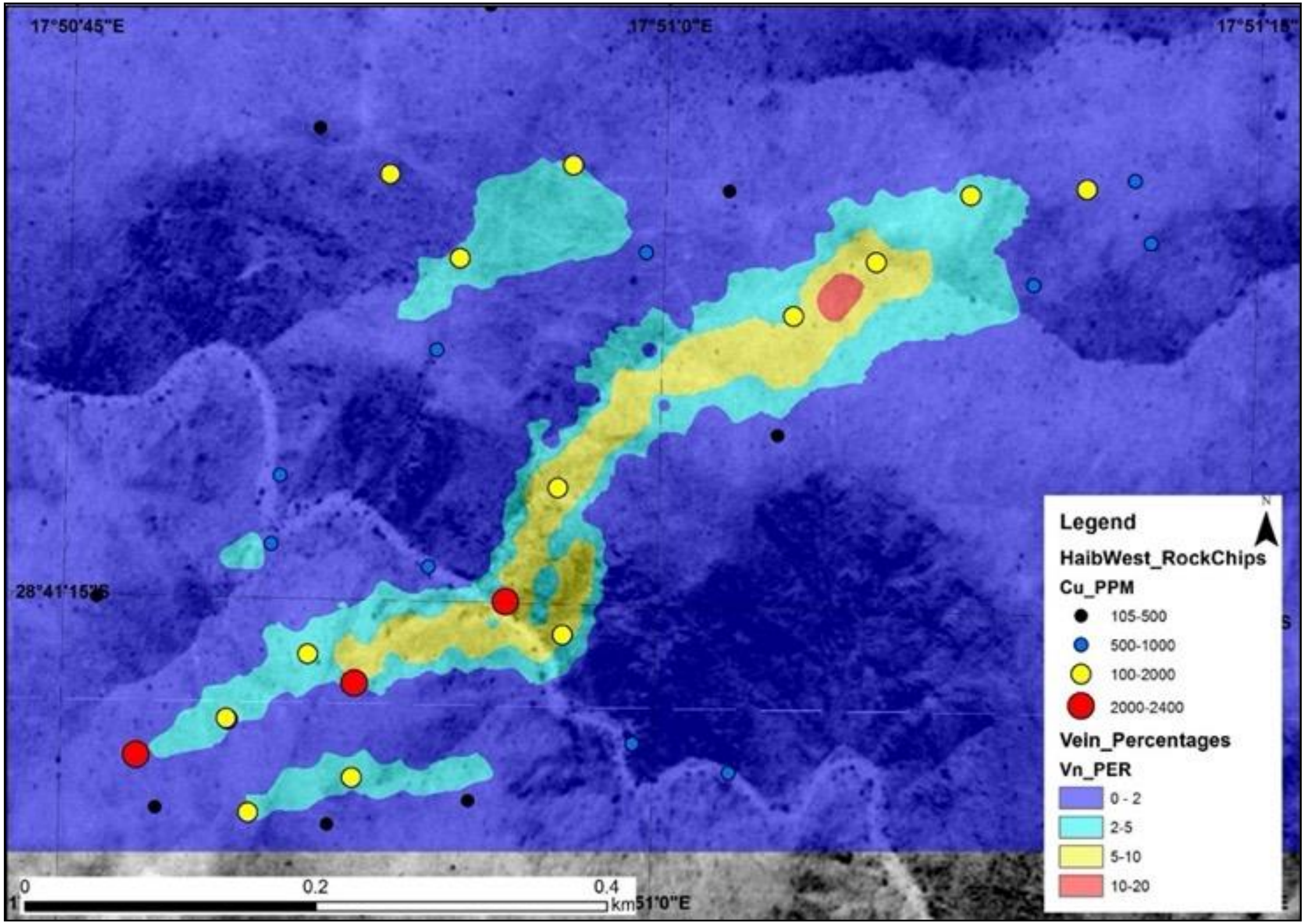


Figure 9-7: Rock Chip samples collected across the vein zone identified at Haib West, with a background image of contoured vein percentages estimated from outcrop locations in Figure 9.8 below (Source Teck 2015).

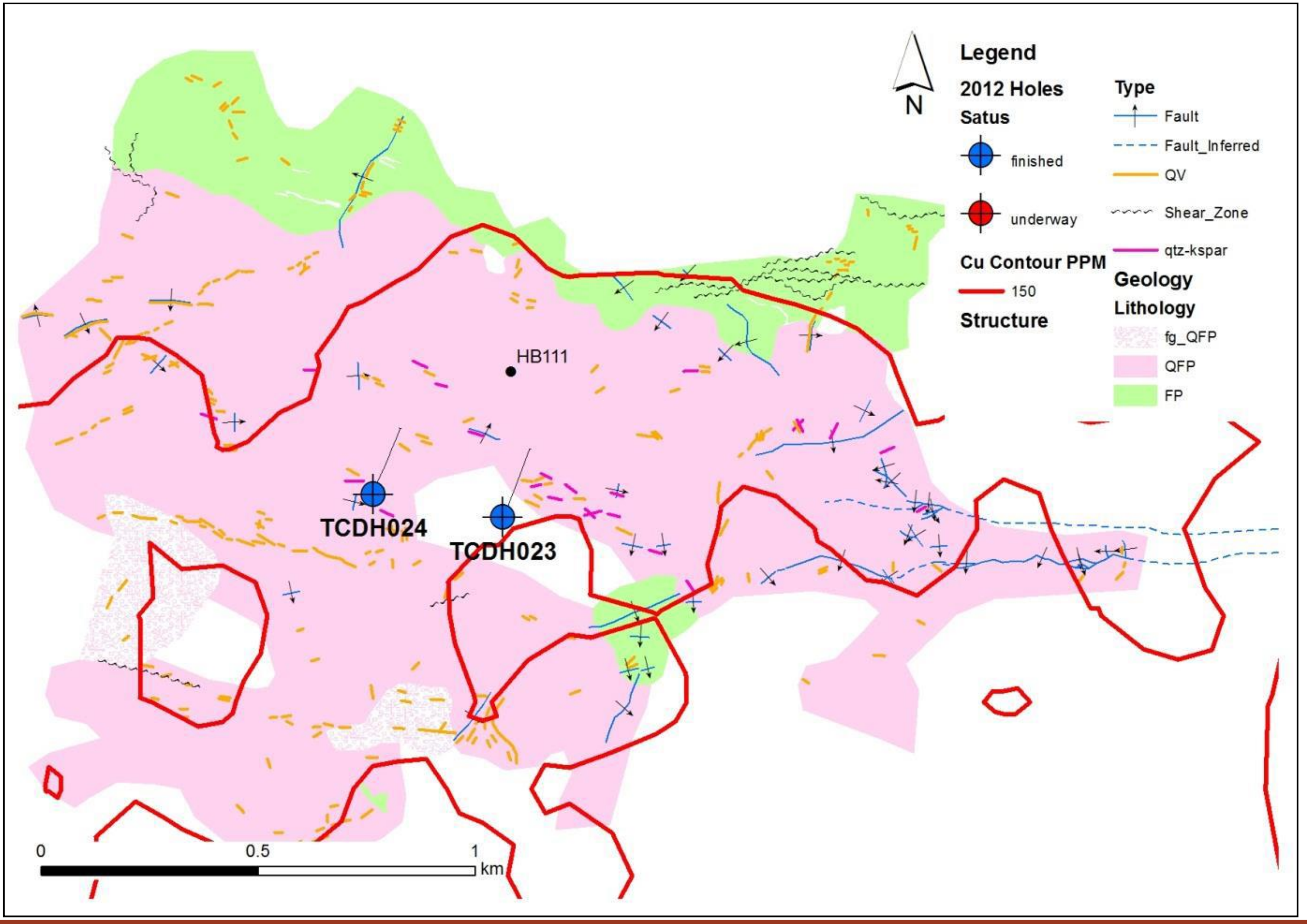


Figure 9-8: Drillhole Locations – Haib West: Plan map of Haib West showing the position of the holes drilled in 2012, targeting a zone of veining in the centre of a broad soil anomaly (Source Teck 2013)

10. DRILLING

10.1 HISTORICAL

At least five separate drilling programmes have been conducted at the Haib; for dates of these programmes see the History Section above.

The first drilling was completed by Falconbridge who drilled eleven drillholes into the deposit in three principal areas of interest. Total drilling of some 1,012 metres was completed. The average grade of the drillhole intersections was given as 0.33% Cu. Very little of this data remains other than the drill core assays and their location in the field. It is not really possible to comment on this programme.

After Falconbridge, King Resources conducted a drilling programme of 21 holes totalling 3,485 metres. Again, this programme has very little useful data surviving, although drill assays are available and the drillhole collars have been located.

Most of these earlier holes were blocked or difficult to locate.

Subsequently, RTZ completed one hundred and twenty diamond drillholes, mostly vertical, on a systematic 150 metre square grid giving a total of 45,903 metres drilled (Figure 10.1). Holes were on average 300-400 metres deep. These cores are preserved in a shed at the old RTZ campsite and are available to study although some mineralised sections are reduced to quarter-core by assay and re-assay campaigns. The information from these drillholes was verified by GFM and incorporated into their geological model. This information was therefore used by Behre Dolbear in the Haib model evaluation presented in section 6 of this report.

All drillhole assay data is based on diamond drill core, generally "N" or "B" sizes. Drillhole spacing was generally on a regional 150 metre square grid. The RTZ drillholes are mostly vertical, while the earlier Falconbridge and King Resources drillholes are inclined. One section line, 865_{00} E was partially drilled by RTZ at 25 metres spacing across the zone of high-grade mineralization where the NCJV later developed an adit for metallurgical sampling.

Sample recovery was reported to be generally good. Most of the historical drillholes were hammer-split and half core composites were sent for assay. The RTZ cores were sampled over 2 metre intervals for determination of total copper and, where appropriate, acid soluble (oxide) copper. Composite samples from each drillhole were tested metallurgically to determine recoverable copper and were assayed for molybdenum, silver and gold indicating average contents of 25 g/t Mo, 0.01 g/t Au, and 0.9 g/t Ag. The reliability of these numbers cannot be assured as assay certificates are not available.

From all of this information Venmyn Rand captured an electronic database of the available 1963-1975 drillhole data using drillhole logs as the original assay data sheets were unavailable. The database comprised 152 drillholes – 120 from RTZ, 21 from King Resources and 11 from Falconbridge.

To this database have now been added the 13 holes drilled by GFM and the 32 drillholes completed by Teck.

In 2010 and 2011, Teck quartered 3,714 metres of RTZ core from 14 drillholes (Figure 10-1 below) on a composited 3-metre sample interval and submitted them for re-assay using an *Aqua Regia* digestion method and an Inductively Coupled Plasma Emission Spectrometry (ICP-ES) technique to provide a 24 element determination; the RTZ composite samples were done on a 2-m sample interval whereas Teck composited at a 3-m interval – this means that a comparison of average elemental values can only be made at 6m intervals. The 619 x 6-m average value comparison for copper revealed that below 0.6% Cu the assay results are statistically identical but that bias (~15% positive bias in the RTZ data) creeps into the data above the 0.6% Cu level as shown graphically in the binary X-Y plot below.

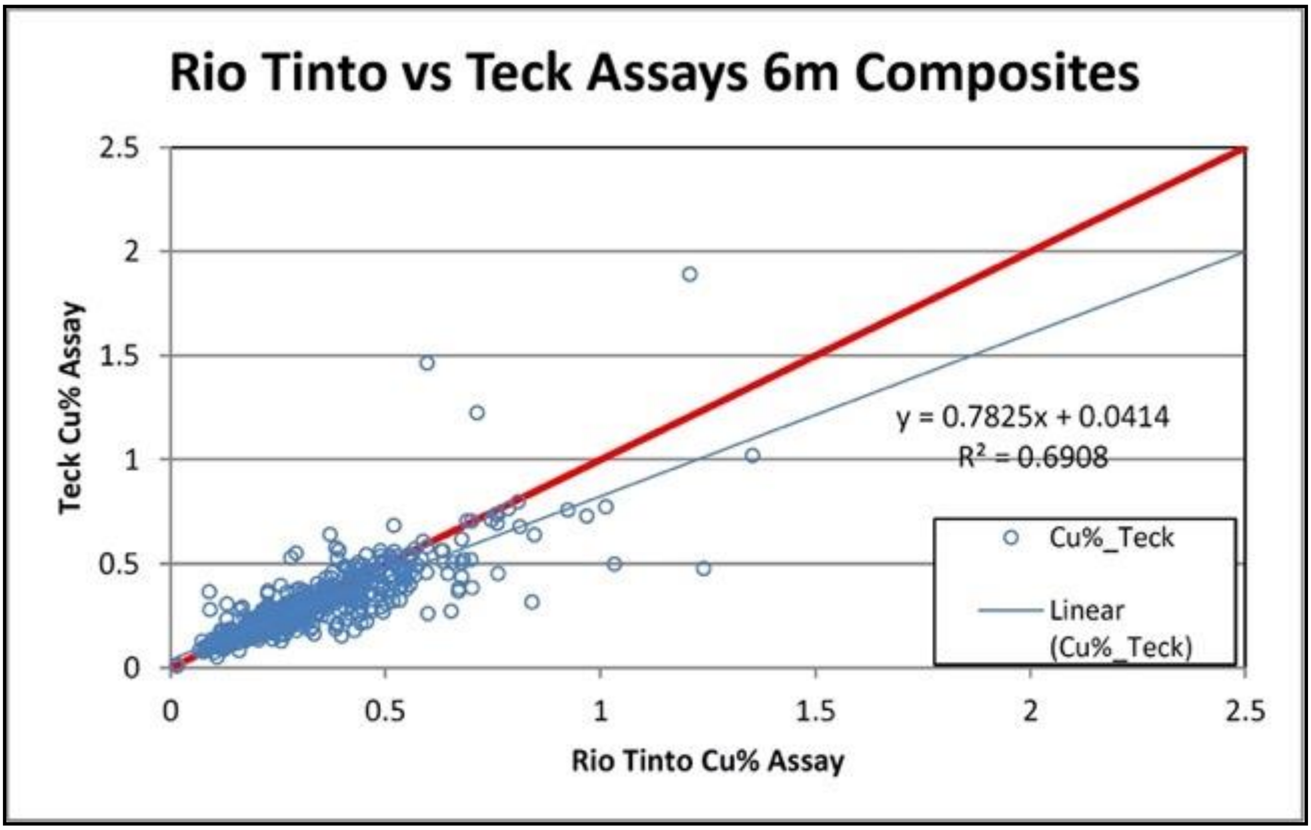


Figure 10-1: Rio Tinto vs Teck Assays 6m Composites.

It is probable that the ~15% positive bias in the RTZ >0.6% Cu results may be due to RTZ using a 4-acid digestion method which would release copper from silicate minerals, for example the copper in the biotite lattice in the high-grade zones where EDM veins are ubiquitous.

It should be noted that some of Teck's check assays of RTZ core completed in 2010 also used a fire assay in addition to the ICP-ES method, but since virtually all values returned <5ppb Au, it was decided to discontinue the fire assay as a routine assay method.

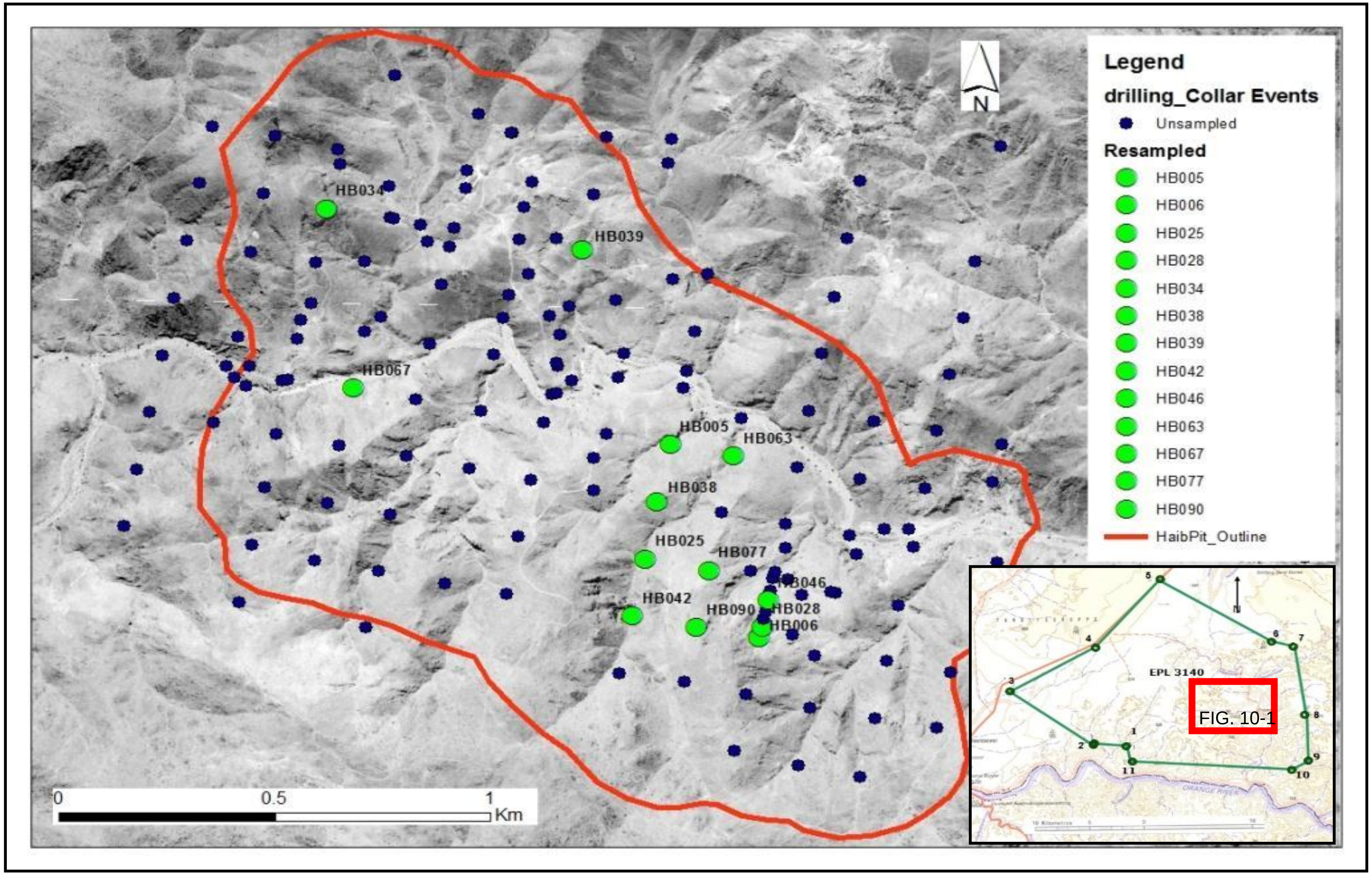


Figure 10-2: Location of RTZ Drillholes: Plan showing location of RTZ drill collars and those re-assayed by Teck (Source: Teck 2012)

An attempt was made by the NCJV to locate and resurvey all drillhole collars completed during the Falconbridge, King Resources and RTZ programmes. The data from this survey is available although not included in this report. Where existing data was available, the eastings and northings were generally found accurate but there were significant discrepancies (up to 80 metres) in the reported drillhole elevations. This factor represented a constraint on the accuracy of the data for geological modelling and on the confidence limits placed on the mineral estimates, but it was not considered that it would have a significant impact on the overall estimate figure as discussed later.

This issue was subsequently resolved by the NCJV which commissioned an Orthophoto survey of the area and generated a new surface topographic plan.

The NCJV/ GFM core drilling programme completed a further 12 infill drillholes for analytical purposes and another 5 large-diameter drillholes for geotechnical work. Technical data is available for these holes. These were reported in an October 2004 report titled “Independent Technical Review, the Haib Copper Porphyry Project, Namibia”.

10.2 Teck Drilling

The most recent drilling programme at Haib was completed by Teck between 2010 and 2014 and comprised 32 diamond drillholes totalling 14,252m. Figure 10.2 above shows the location of the Main Haib deposit drillholes (including historic drillholes).

These drillholes were used to evaluate several target zones; the first group of 22 holes totalling 10,507.92m was drilled within the existing main Haib mineralized body; the holes were drilled to test:

- the predictability of the mineralization grades in the model derived from historical assay data,
- the higher-grade portion of the mineralized body and,
- the deeper portions of the known mineralization with the deepest hole at 806m depth (some 800m below surface).

Table 10-2 below gives the basic data for all of these 32 drillholes with the Copper and Molybdenum results for significant intervals.

The second group of diamond drillholes tested for mineralization at the Eastern, Southern and Western combined soil and geophysical anomalies and consisted of 10 holes totalling 3,745.06m. The location of these anomalies is shown in Figure 7.7 above.

10.3 Teck's protocol for Drillhole Surveys

The drillhole collar locations are surveyed using a hand-held GPS at the start of the drillhole and a certified land surveyor using a differential GPS surveys all of the drill collars at the end of the programme. Down-hole surveys using a Reflex EZ-Com multi-shot tool are performed on holes in the main Haib body at 6m intervals as rods are pulled from completed holes. Down-hole surveys of the exploration holes into peripheral anomalies use a Reflex EZ-Com single shot tool at 100m intervals during the course of drilling. These instruments have a stated accuracy of 0.1 degrees of dip and azimuth.

10.4 Teck's Procedures for drill logging and sampling

All drillhole cores are collected daily and stored in a galvanized steel tray at the core yard. The cores are washed to remove all residual cuttings and drill additives. The core is then measured to determine core recovery and Rock Quality Designation ("RQD"). The average recoveries reported by RTZ were >95% and Teck have measured average recoveries of >99% in the main Haib body and averages of >98% in the more altered peripheral Anomalies. The whole cores are then photographed.

The core Is logged for lithology, alteration, structural elements, and mineralization before being marked up for core cutting and sampling, the core sample length being at the discretion of the geologist, bearing in mind the wish to constrain well mineralised intervals and lithological breaks with recommended minimum 1m and maximum 3m length; to date the sampling tends to average 2m in length. The entire hole is sampled.

The core is halved sampling one half only, although early drillhole core from 2010 and 2011 used quarter-core duplicates, subsequent drillhole sampling has used half-core duplicates. Core cutting is done on site using a water-cooled diamond saw with the cutter being assigned one hole only and prohibited from wearing any jewellery; The saw is cleaned twice daily using a concrete brick and simultaneously the coolant water settling tanks (2 sequential tanks per machine) are also emptied and cleaned. The half core sample is bagged in good quality plastic sample bags with one sample number tag inside and a duplicate number tag attached to the outside of the bag. The sample bags are batched and transported by Teck personnel to Analytical Laboratory Services, an independent commercial laboratory in Windhoek where the samples are crushed, milled, and split with representative splits shipped by Teck in batches sealed in a box using FedEx couriers to an independent commercial laboratory, Acme Analytical Laboratories, now a subsidiary of Bureau Veritas in Vancouver, Canada for assay. Teck core samples are batched with a blank, standard and duplicate sample inserted every 20 samples. The Windhoek laboratory duplicates every 20th crushed sample to check for any bias after splitting of the crushed sample and for combined preparation and analytical variation (see discussion under section 11 below).

The above protocols ensure minimal probability of sample contamination, and the chain of custody is also well defined and ensures minimal opportunity for third party tampering with samples.

10.5 Results

The details of holes drilled their location and significant intersections is summarized in Table 10.2 below.

Several of Teck's drillholes were drilled deeper than the average RTZ hole (about 400m). The deepest Teck hole was TCDH-06 drilled to 842.78m. The log of this hole is shown in Figure 10-3. The hole produced anomalously high copper results (Table 10-2) as the average grade throughout the drillhole was significantly higher than predicted from the mineralization model derived from previous RTZ drilling.

Table 10-1: Selected assay results for drillhole TCDH-06.

Hole No.	From (m)	To (m)	Copper (%)	Molybdenum (%)
TCDH-06	0	842.78	0.285	0.011
Including	349	842.78	0.36	0.018
Including	537	658	0.5	0.027

This hole also illustrates the point that historical, vertical drilling may have under-estimated the extent and tenor of the high-grade plunging EDM vein sets.

10.6 QP's Comment on Core Sample Representivity and Bias

Since both the RTZ and Teck drilling core recoveries were respectively >95% overall, QP Peter Walker's opinion is that core sampling fairly represents the values of the particular intersections reported on and core loss, broken ground or voids do not materially impact on accuracy or reliability of results.

The mineralization is to a large extent in disseminated form and there are only small differences between the sample length and the true thickness of mineralization for the majority of the drillholes. However, detailed evaluation of the higher-grade sections of the main Haib body which have additional mineralization in sheeted veins following fractures dip steeply to the south. Teck have detailed surface mapping and logging of inclined drillhole intersections (both RTZ & Teck) through this zone and are confident that their calculations of true thickness of mineralization within this zone are accurate. Since vein control of high-grade mineralization is apparent in some locations, care is exercised in sampling intervals where veins run at a low angle to the core axis, since these intervals may overestimate the grade; these occurrences are rare and in my opinion the assay results fairly represent the true grades with minimal bias.

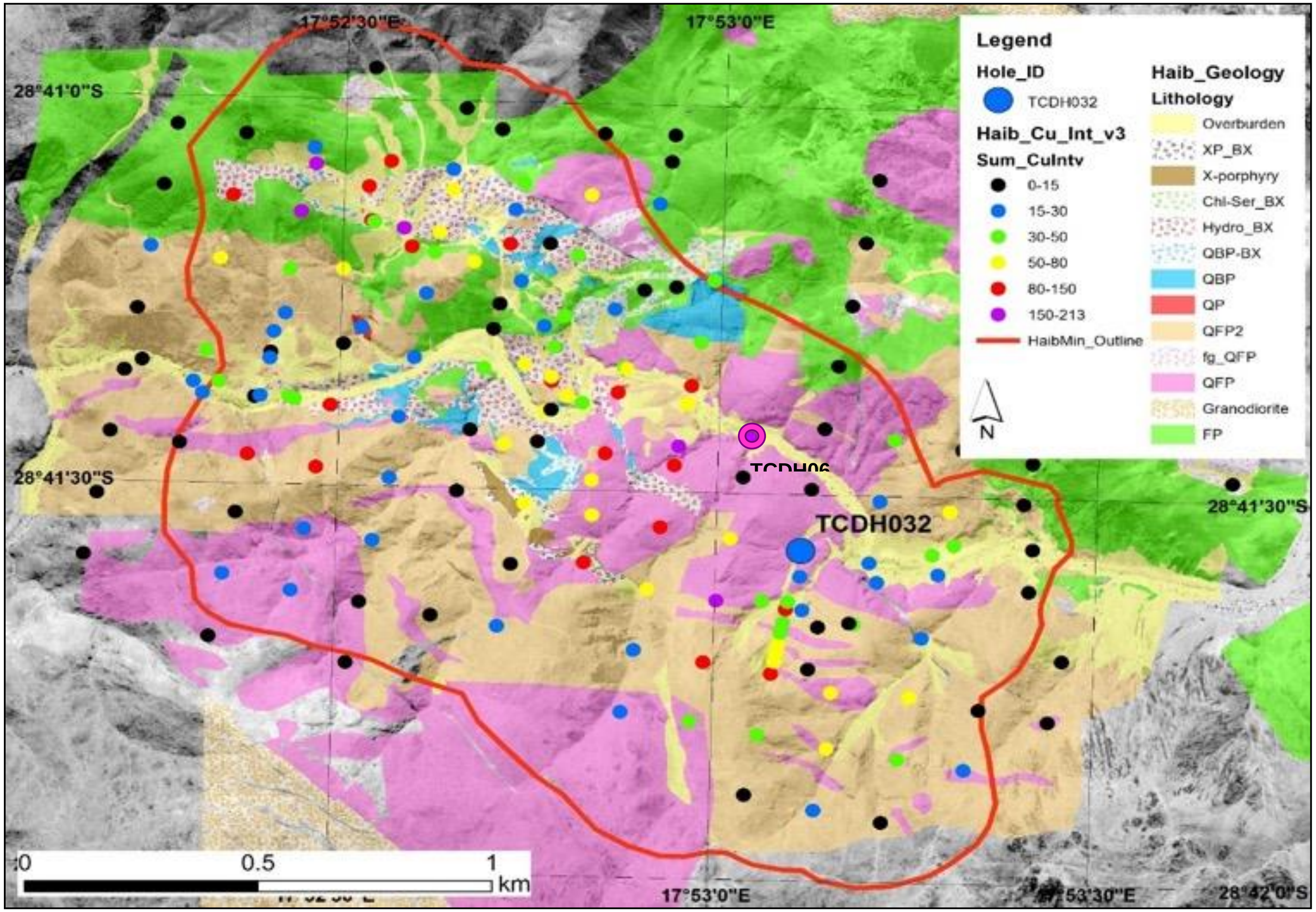


Figure 10-3: Location of All drillholes into the Main Haib Deposit: This map shows the historical drilling together with the recent Teck drilling. The location of drillhole TCDH06 is shown and its log is shown as Figure 10-3. (Source: Teck 2015)

Table 10-2: Details of the Teck Drilling with Significant Intersections

Hole ID	Target	X	Y	Z m	Length m	Azimuth	Dip	From (m)	To (m)	Interval (m)	Cu %	Mo %
TCDH-01	**Haib East**	**784102**	**6823216**	**386**	**434.17**	**360**	**-90**	**No significant Intersections**				
TCDH-02	**Haib East**	**783201**	**6823112**	**348**	**350.04**	**360**	**-90**	**No significant Intersections**				
TCDH-03	**Haib East**	**784698**	**6823388**	**309**	**383.23**	**360**	**-90**	**No significant Intersections**				
TCDH-04	**Haib East**	**784709**	**6822725**	**328**	**357.91**	**360**	**-90**	**No significant Intersections**				
TCDH-05	**Deposit**	**781662**	**6822222**	**556**	**806.52**	**14**	**-80**	0	806.52	806.52	0.16	0.005
Incl.								218	245.2	27.2	**0.22**	0.002
TCDH-06	**Deposit**	**781802**	**6822906**	**397**	**842.78**	**194**	**-50**	0	842.78	842.78	**0.28**	**0.011**
Incl.								349	842.78	493.78	**0.36**	**0.018**
Incl.								537	658	121	**0.5**	**0.027**
TCDH-07	**Deposit**	**781667**	**6823026**	**398**	**822.86**	**195.5**	**-65**	0	822.86	822.86	**0.25**	0.008
Incl.								231	405	174	**0.32**	0.006
Incl.								704	764.9	60.9	**0.38**	**0.012**
TCDH-08	**Deposit**	**781624**	**6823560**	**468**	**370**	**30**	**-60**	**No significant Intersections**				
TCDH-09	**Deposit**	**781366**	**6823047**	**428**	**602.11**	**15**	**-55**	0	602.1	602.1	0.16	0.006
Incl.								63	196	133	**0.36**	**0.010**

TCDH010	**Deposit**	**781639**	**6822881**	**415**	**799.11**	**182**	**-65**	0	799.9	799.9	**0.29**	**0.012**
Incl.								172	799.9	627.9	**0.31**	**0.014**
Incl.								227	515	288	**0.37**	**0.018**
Incl.								269	308	39	**0.53**	**0.020**
TCDH011	**Deposit**	**780763**	**6823093**	**432**	**601.06**	**7**	**-60**	0	601.06	601.06	0.10	0.003
Incl.								170	215	45	**0.53**	0.002
TCDH012	**Deposit**	**780490**	**6823091**	**431**	**156.26**	**5**	**-50**	**No significant Intersections**				
TCDH013	**Deposit**	**782228**	**6822642**	**387**	**600.77**	**186**	**-55**	0	600.77	600.77	0.19	0.003
Incl.								14	151	137	**0.28**	0.001
Incl.								86	139	53	**0.34**	0.001
Incl.								20	29	9	**0.63**	0.004
TCDH014	**Haib South**	**784364**	**6819712**	**380**	**351.33**	**360**	**-80**	**No significant Intersections**				
TCDH015	**Deposit**	**781201**	**6823323**	**519**	**464.02**	**10**	**-60**	0	464.02	464.02	**0.2**	0.002
Incl.								188	242	54	**0.26**	0.002
Incl.								50	82	32	**0.56**	0.005
TCDH016	**Haib South**	**784010**	**6819680**	**435**	**311.06**	**360**	**-70**	**No significant Intersections**				
TCDH017	**Haib South**	**784601**	**6819729**	**351**	**393.85**	**360**	**-90**	**No significant Intersections**				

(See continuation of Table 10-2 on next page)

Table 10-2 continued

Hole ID	Target	X	Y	Z m	Length m	Azimuth	Dip	From (m)	To (m)	Interval (m)	Cu %	Mo %
TCDH018	**Deposit**	**781566**	**6823254**	**494**	**460.95**	**14**	**-60**	0	455	455	0.1	0.002
Incl.								63	69	6	**0.26**	**0.023**
Incl.								269	279	10	**0.26**	0.001
TCDH019	**Haib South**	**784394**	**6819590**	**415**	**428.1**	**182**	**-60**	**No significant Intersections**				
TCDH020	**Deposit**	**781600**	**6823460**	**476**	**497.12**	**360**	**-90**	0	497.12	497.12	**0.24**	0.006
Incl.								116	472	356	**0.3**	0.008
Incl.								256	270	14	**0.39**	0.005
TCDH021	**Deposit**	**782397**	**6822631**	**404**	**314.25**	**190**	**-60**	**No significant Intersections**				
TCDH022	**Deposit**	**781265**	**6822888**	**435**	**477.48**	**12**	**-60**	0	477.48	477.48	**0.21**	**0.011**
Incl.								332	425	93	**0.44**	0.007
Incl.								383.65	415.52	31.84	**0.79**	**0.010**
TCDH023	**Haib West**	**778372**	**6823136**	**494**	**376.93**	**21**	**-60**	0	376.83	376.83	0.08	0.001
Incl.								180	204	24	**0.2**	0.001
Incl.								276	296	20	**0.24**	0.003
TCDH024	**Haib West**	**778074**	**6823190**	**653**	**358.44**	**10**	**-60**	**No significant Intersections**				

TCDH025	**Deposit**	**781435**	**6822603**	**528**	**568.7**	**360**	**-90**	0	568.7	568.7	**0.22**	0.005
Incl.								71.7	122.4	50.7	**0.21**	**0.013**
Incl.								402	480.6	78.6	**0.32**	0.005
Incl.								20	50	30	**0.36**	0.003
TCDH026	**Deposit**	**781024**	**6823563**	**495**	**475.33**	**192**	**-70**	0	475.3	475.3	**0.3**	0.007
Incl.								349	427	78	**0.31**	**0.021**
Incl.								178	327	149	**0.57**	0.004
Incl.								283	313	30	**0.81**	0.007
TCDH027	**Deposit**	**781528**	**6823066**	**409**	**446.07**	**10**	**-60**	0	446.07	446.07	**0.2**	0.006
Incl.								207	262	55	**0.27**	0.004
Incl.								0	87.5	87.5	**0.31**	**0.013**
TCDH028	**Deposit**	**780804**	**6823001**	**442**	**401.34**	**360**	**-90**	0	401.14	401.14	0.15	**0.010**
Incl.								20	182	162	**0.27**	**0.014**
Incl.								146	176	30	**0.45**	**0.023**
TCDH029	**Deposit**	**780816**	**6822996**	**458**	**200.11**	**185**	**-60**	0	200.11	200.11	**0.27**	0.005
Incl.								71.1	125.5	54.4	**0.4**	0.004
Incl.								90	99.2	9.2	**0.75**	0.007

(See continuation of Table 10-2 on next page)

Table 10-2 continued

Hole ID	Target	X	Y	Z m	Length m	Azimuth	Dip	From (m)	To (m)	Interval (m)	Cu %	Mo %
TCDH030	Deposit	781309	6823077	457	200.51	12	-65	0	200.51	200.51	0.29	0.013
Incl.								39.7	92.7	53	0.41	0.012
Incl.								103.22	200.51	97.29	0.30	0.018
Incl.								51.3	77	25.7	0.66	0.019
TCDH031	Deposit	781432	6822985	435	200.47	15	-60	0	200.47	200.51	0.27	0.010
Incl.								62.9	164.2	101.3	0.36	0.008
Incl.								81.27	121.8	15.67	0.49	0.260
Incl.								51.3	137.47	9.57	0.54	0.007
TCDH032	Deposit	781900	6822630	408	200.1	188	-60	0	200.1	200.1	0.26	0.002
Incl.								4	37.3	33.3	0.33	0.002
Incl.								77	82	5	0.45	0.004
Incl.								110	117	7	0.58	0.004

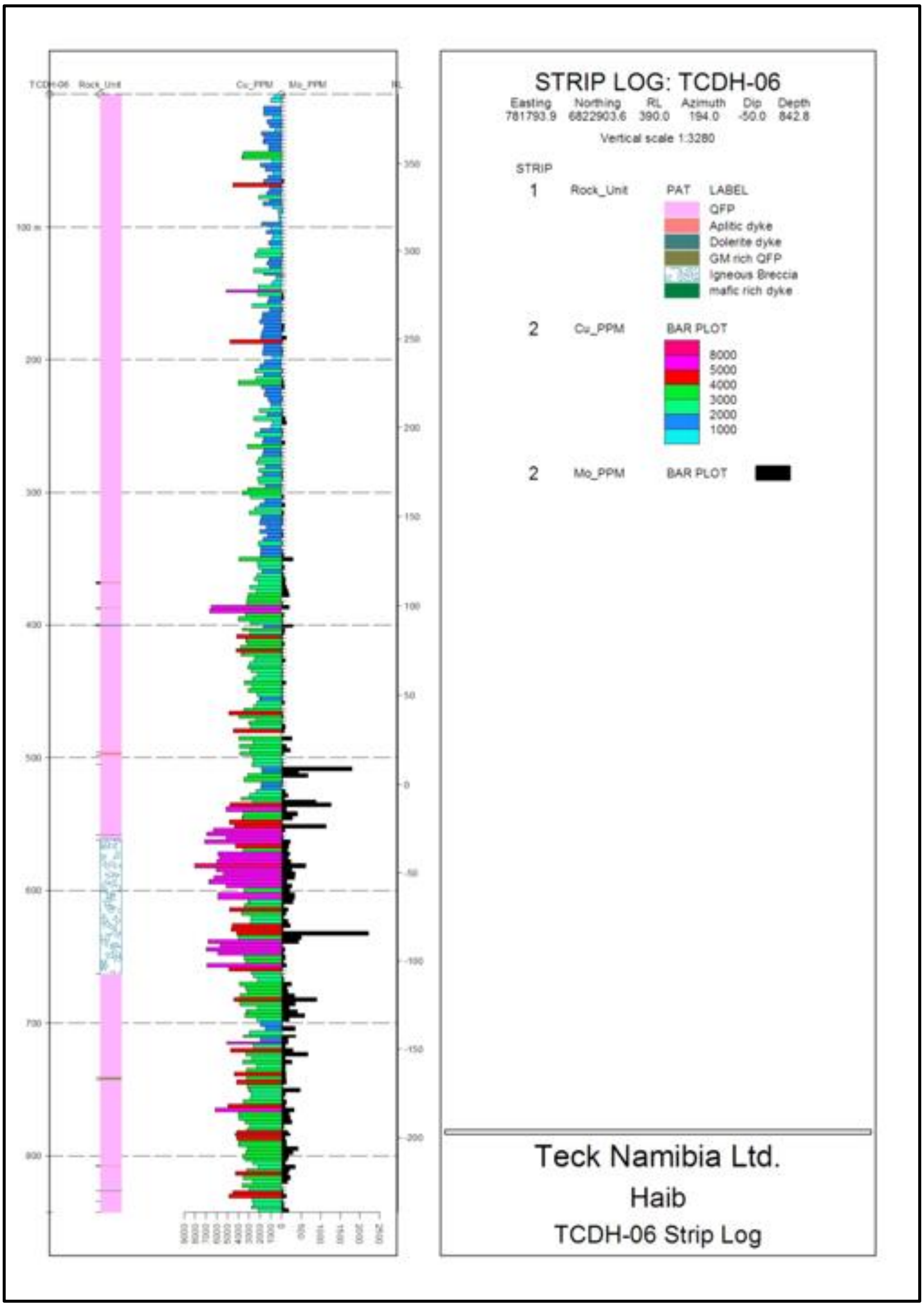


Figure 10-4: This diagram shows the strip log for drillhole

TCD-06, the deepest hole drilled at Haib by Teck. This drillhole was located just west of the centre of the main deposit at one of the lowest points (in the Volstruis riverbed). It can be seen that sections of this drillhole below 500m returned significantly high copper values and above average Molybdenum values (Source: Teck, 2012).

11. SAMPLING PREPARATION, ANALYSIS AND SECURITY

11.1 Historical Sampling

The historical drilling database comprises physical details of each hole, a drill lithological log, details of sampling intervals and assay results from approximately 25,000 samples of which the vast majority are 2 metre half-core composite samples from the Rio Tinto drilling (22,800 samples). The King Resources composite samples averaged 4.5 metres average length, while the Falconbridge samples were an average 3.0 metre length.

Of the total samples approximately 15,000 have values greater than 0.1% Cu but only 1,100 have values greater than 0.5% Cu. The acid soluble oxide-copper database comprises 1,980 samples.

Specific gravity ("SG") measurements were carried out by RTZ on 40 drillholes giving approximately 7,000 determinations; SG's ranged from 2.43 to 3.35 and averaged 2.71; GFM continued the process of SG determinations on core samples during their drilling campaign, sampling every tenth sample.

It is not possible for me to comment on the sample preparation, analysis and security of these historical drill samples as the details of quality control and assurance and copies of original assay certificates are not available. It is known that the RTZ samples (22,800) were all prepared on site, Rio Tinto having a prep-laboratory at the campsite fitted with crusher, pulveriser and splitters – the dust extractor plus parts of the other equipment are still on site. It is believed that the actual analyses were done off site at both the RTZ Rossing mine and RTZ Palaborwa mine laboratories.

11.2 Teck Sampling

No core sampling was being carried out at the time of the site visits, so I was unable to verify or personally review the Teck sampling procedures. I have been supplied with an internal Teck memorandum detailing the sample preparation protocols to be employed during both core and geochemical sampling at the Haib project and I have been assured that these protocols are strictly enforced on site and at the independent prep-laboratory in Windhoek (Analytical Laboratory Services) and the independent assay laboratory (Acme Analytical Laboratories – www.acmelab.com, now a subsidiary of Bureau Veritas) ("Acme") in Vancouver, Canada. The protocol lists the following important steps: -

- A standard sample to monitor analytical accuracy, a field blank sample to monitor carry-over contamination at the crusher and a core (or soil/stream/rock) duplicate sample to monitor geological, preparation and analysis variation are to be inserted in the core-shed every 20 samples. The appropriate standards used at the Haib are sourced from CDN Resource Laboratories in Canada who have supplied certificates certifying the material supplied. I have had sight of a selection of these certificates and am satisfied as to their veracity and appropriateness in terms of the range of expected values for copper, gold and molybdenum.

- All drillholes are sampled from the start to end of hole; the core is split using a water lubricated diamond saw blade which is cleaned frequently by using a brick to prevent carry-over contamination. Core samples are bagged in good quality plastic bags to avoid contamination or loss of fine material during transport. Sequential sample numbers are assigned and recorded on the paper drill log sheet. All of the hole's survey, logging and sampling data are captured and stored in a secure database system (Excel) on a laptop in the field and backed up by transfer to a central Access database system in Windhoek. All data is subject to routine validation during capture and storage. Drill log sheets, survey records and drill assay certificates are all securely filed in Windhoek on a regular basis.
- At the independent sample preparation laboratory in Windhoek the entire sample is dried, crushed and check screened to ensure that at least 80% of the crushed material passes through a 2mm screen; the entire crushed sample is riffle split to approximately 1Kg and this is pulverized in a disk mill as a single charge with testing of the pulp to ensure that a minimum 80% is <75 microns. Every 20 samples a duplicate sample is drawn off of the riffler to assess combined preparation and analytical variation. All of the sizing tests are recorded in a book to ensure compliance. Samples that do not pass the sizing tests are re-crushed or re-milled until a pass is obtained. The preparation laboratory cones and quarters the pulp sample to obtain a 100gm of material which is bagged in a good quality paper envelope. The entire remaining crushed and pulped sample is retained and stored by Teck so that umpire samples may be taken.
- The drill core assays routinely include copper, molybdenum, gold and 21 additional elements all determined by an ICP-ES technique.
- The Acme Vancouver facility has maintained a quality system compliant with the International Standards Organization (ISO) 9001 Model for Quality Assurance and ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories. In October 2011 the Vancouver facility received formal approval of its ISO/IEC 17025:2005 accreditation from Standards Council of Canada.
- The Analytical Laboratory Services facility in Windhoek is not certified as being ISO 17025 compliant. QA is provided by replicate analysis, the insertion of control samples, the submission of samples to independent laboratories in Namibia and the participation in independent proficiency testing schemes.

Teck have stated on public record that: -

"The design of Teck's drilling programme, quality assurance / quality control programme and the interpretation of results are under the control of Teck's geological staff. The QA/QC programme is consistent with industry best practices. Drill core is logged and cut onsite, with half-core samples prepared at Analytical Laboratory Services, Windhoek, Namibia. Prepared samples are shipped to Acme Analytical Laboratories, Vancouver, Canada for appropriate base metal assaying and gold fire assaying techniques. All analytical batches contain

appropriate blind standards, duplicates and blanks inserted at regular intervals to independently assess analytical accuracy and precision."

11.3 Sample Security

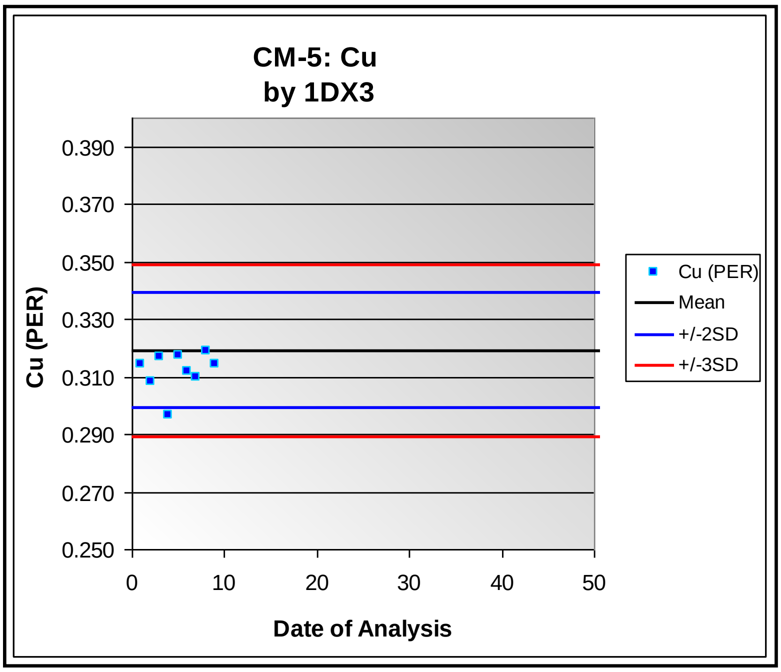
The core yard at the Haib camp is surrounded by 2m wire fencing and the metal entrance gate is secured by a padlock. I am assured by the site geologist that sampling of core is done under his supervision; the bags are secured immediately after the cutting and sampling process and the samples taken are stored within the locked RTZ laboratory building within the core yard until transported by him to Windhoek.

11.4 Data Verification

The Teck guidelines for data verification are as follows:

- The guideline for Standard failure is: Any Standard sample which falls outside of the mean +/- 3 standard deviation range or any two consecutive sample results outside of the mean +/- two standard deviations range.
- Re-analysis is at the discretion of the geologist, but the guideline is that any failure (as with CM-5 below) should trigger re-assay of all samples from the first sample after the previous passing Standard sample to the sample previous to the next passing Standard.

An example of Teck's graphical plots, this one for Standard Sample No.CM-5 is given below:



11.5 Assessment of Quality Control Data

During the QP Peter Walker site visit in 2015 to complete a 43-101 qualification technical report for the Issuer, Peter Walker performed an audit and verified the data collected by Teck against the laboratory assay certificates and can confirm that the data has been accurately transcribed from the original assay reports to the log sheets and the electronic data base and is suitable for use in resource estimation. During the site visit, Peter Walker checked the security of the sampling area on site and the QA/QC procedures used for core collection, logging, cutting and sampling and the chain of custody from site to the laboratories. Obsidian Consulting Services also reviewed the QA/QC programme implemented by Teck using the certificates of analysis received from Acme Labs and provided by Teck. This review compared the results of field duplicates, blanks as well as the various standards utilised with respect to Cu and Mo and are discussed further below:

11.5.1 Duplicates

Two types of field duplicates were utilised viz. core samples and crusher duplicates. Figure 12.1 shows scattergrams of the original core sample Cu and Mo grades versus the duplicate grades. The left-hand charts show the full data extents while the right-hand charts zoom into the lower grade areas. From Figure 12.1, it can be seen that most of the core duplicates for Cu fall within the ±10% limits from a correlation of one and that 14 of the 415 (3%) core duplicates fall outside of the ±25% limits. The R^2 (Pearson's Coefficient) of 0.94 confirms the sampling procedures for the core sampling and the reproducibility of the associated results to be of a good quality.

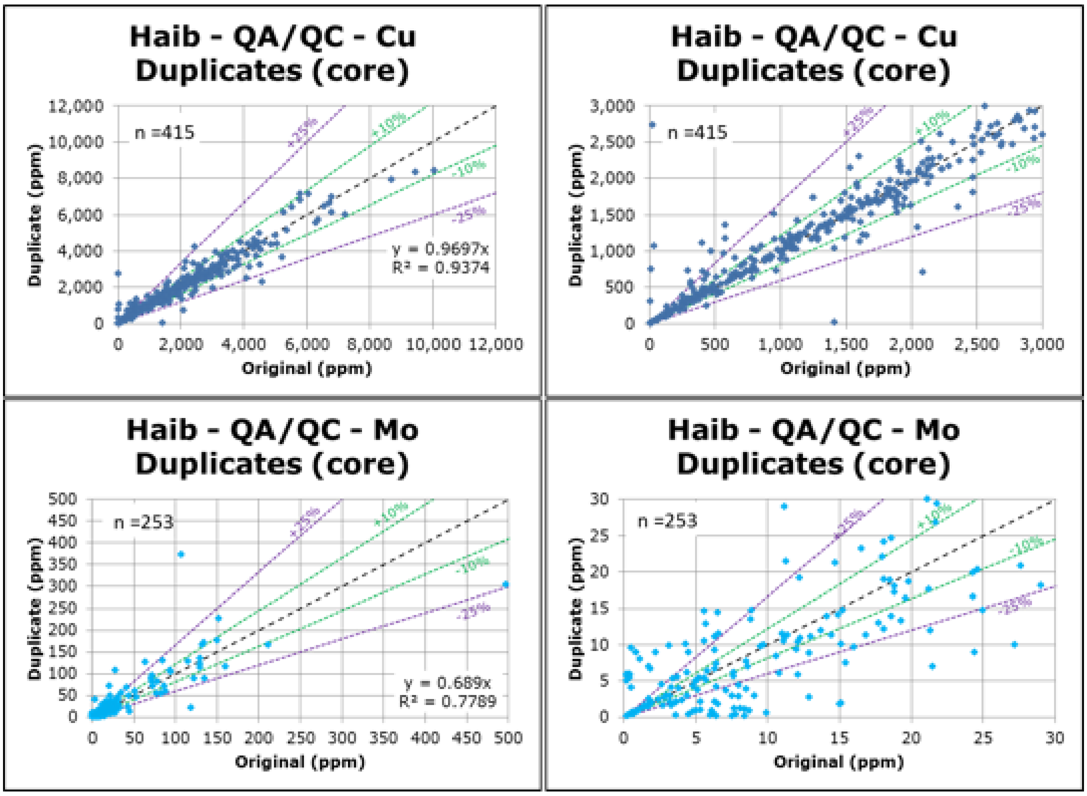


Figure 11-1: Quantile-Quantile plots comparing core original assays and core duplicates. The right-hand graphs have zoomed in near the low-grade samples as indicated by the X axes values.

The duplicates produced at the crushing stage were then analysed and are presented in Figure 12.2 below. Again, the Cu results point to good work within the crushing procedures as shown by the R^2 of 0.98 and only 5 samples (1%) falling outside the ±25% limits ±25% limits.

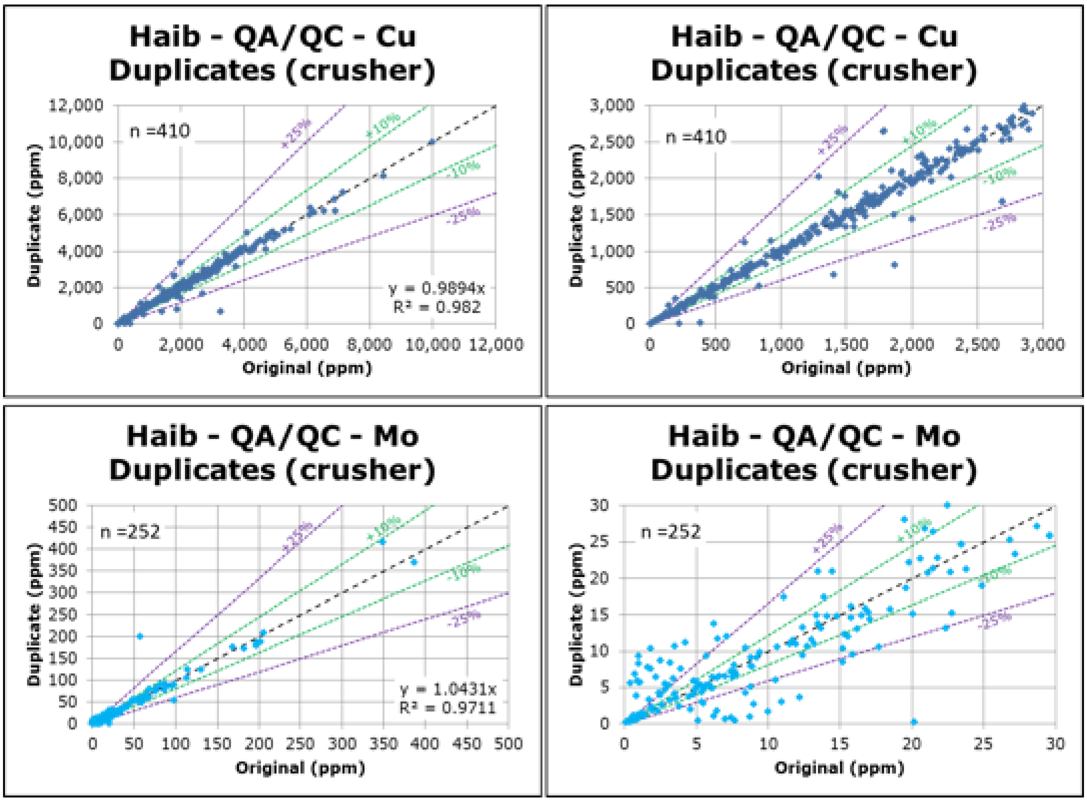


Figure 11-2: Quantile-Quantile plots comparing crusher original assays and crusher duplicates. The right-hand graphs have zoomed in near the low-grade samples as indicated by the X axes values.

11.5.2 Blanks

Figure 12.3 below shows a line graph (black) of the Cu and Mo grades received for submitted blanks along with the average grade of the batch (red shading) with which the blank was analysed. The purpose of these is to highlight erroneous results and quantify them relative to the batch results.

In the case of the Cu results, there were a couple of significant failures indicated in Figure 12.3 by labels of the respective sample numbers; there are only 13 failures from 415 blanks (3%) which is indicative of little or no contamination during sampling or during analysis. One issue though is highlighted by the blue shading where a number of sequential blanks failed. It is not known whether this is due to contamination during sampling in the field, instrument calibration or even an issue of homogeneity with the blank material but Teck's procedures would have highlighted the matter, and it is assumed the issue was examined in detail at the time and resolved.

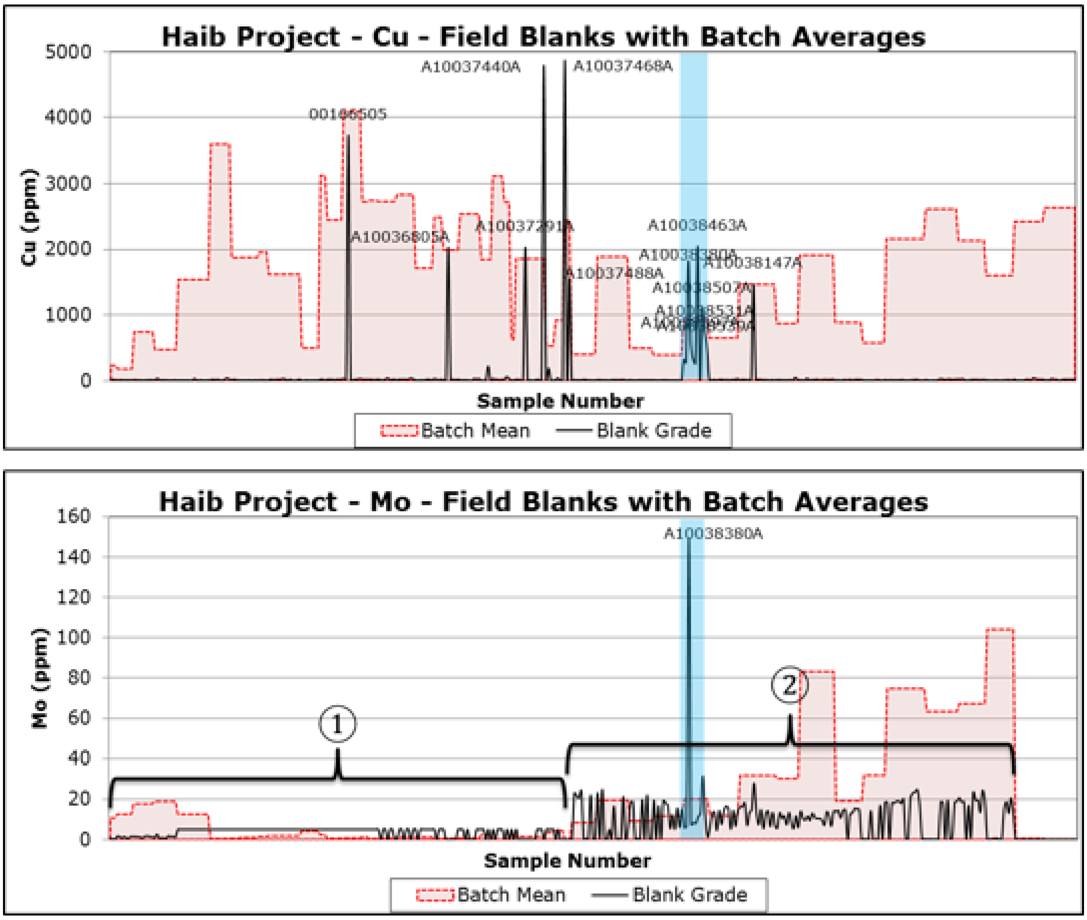


Figure 11-3: Line graphs of blank results for Cu and Mo comparing them to Batch Mean's and ordered by sample number

11.5.3 Standards

Thirteen different mineral standards were used by Teck as part of their QA/QC programme. The summary statistics of the standards are tabulated in Table 12.1 below. Note that only certified values are shown.

Regarding Cu assays, the CGS and CM standards cover a range of values from 0.112% to 0.725% which is appropriate for the grade ranges encountered at Haib. The Relincho standards comprise two very low-grade standards (ST1 and ST2) and one further standard with Cu grade approaching 1%.

Table 11-1: Summary of the certified standard materials used by Teck.

		Certifed Values Only						Results					
		Cu(%)		Au (g/t)		Mo(%)		Cu			Mo		
		Mean	2SD	Mean	2SD	Mean	2SD	No. Samples	Failures	%Pass	No. Samples	Failures	%Pass
CGS-16	*4-acid*	0.112	0.005	0.140	0.046			69	5	93%			
CGS-22	*4-acid*	0.725	0.028	0.64	0.06			14	1	93%			
CGS-23	*4-acid*	0.182	0.010					75	4	95%			
CGS-24	*4-acid*	0.486	0.034	0.487	0.05			43	3	93%			
CM-4	*4-acid*	0.508	0.025	1.18	0.12	0.032	0.004	28	2	93%	16	2	88%
CM-5	*4-acid*	0.319	0.020	0.294	0.046	0.050	0.005	41	6	85%	11	0	100%
CM-7	*4-acid*	0.445	0.027	0.427	0.042	0.027	0.002	16	0	100%			
CM-16	*4-acid*	0.184	0.014			0.016	0.002	45	1	98%	34	2	94%
	Aqua regia	0.184	0.016			0.016	0.003						
CM-20	*4-acid*	0.316	0.016			0.030	0.002	32	0	100%	28	2	93%
	Aqua regia	0.314	0.014										
CM-21	*Fire Assay*			0.467	0.052								
	4-acid	0.527	0.022			0.036	0.002	9	0	100%	7	2	71%
	Aqua regia	0.530	0.028										
Relincho ST-1	*Aqua regia*	0.018	0.002										
	3-acid	0.019	0.002										
	4-acid	0.018	0.002					13	0	100%			
Relincho ST-2	*Aqua regia*	0.076	0.006										
	3-acid	0.076	0.008			0.004	0.000						
	4-acid	0.075	0.008					21	0	100%			
Relincho ST-3	*Aqua regia*	0.835	0.046			0.016	0.002						
	3-acid	0.823	0.034			0.016	0.002						
	4-acid	0.832	0.032			0.016	0.002	4	2	50%			

Figure 11-4 below provides plots of the results of standards CGS-16, CGS-23 and CGS-24. From this Figure, it can be seen that while the reported values lie within the ±3 Standard Deviation range applied by Teck, most of the values lie below the certified mean. For CGS-16, 80% are below the mean, while 83% of CGS-23 samples and 63% of CGS-24 samples respectively are below the certified mean.

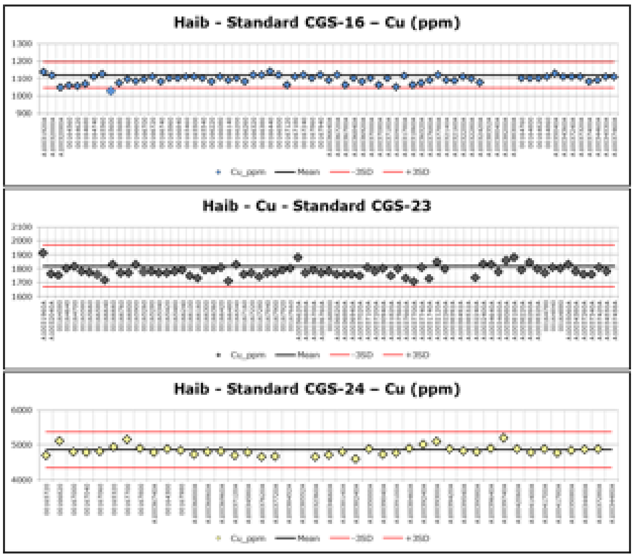


Figure 11-4: Plots of standard results for Standards CGS-16; CGS-23 and CGS-24 ordered by sample number.

This implies a potential instrument calibration error (though minor scale). Depending on the standard used, this error varies between 0.5% and 5%. As these standards account for ~46% of the total standards submitted, it can be inferred that nearly half the Cu grades are underestimated by somewhere between 0.5% and 5% i.e., percentages of their reported values and not whole numbers.

11.5.4 The QP Overall Interpretation of the QA/QC Programme

The QA/QC program implemented by Teck was aligned with international standards and has generally delivered good results. The field duplicates show that sampling practises employed by Teck have produced accurate, repeatable results especially for Cu.

The field blanks show that as a rule, contamination of Cu samples has been kept low by the sampling procedures. The selected blank was appropriate for Cu and exceptions are readily visible.

A further benefit of the QA/QC programme utilised by Teck is that it provides a basis for comparison to the historical data to determine the quality of this data. This was done as follows. Boreholes with QA/QC data (Teck and RTZ re-assayed data set) were tagged separately from those without QA/QC (Historical drilling data set) and were superimposed on the resource model. This is shown in Figure 11.5 where boreholes with QA/QC are shaded red and those without, black. From Figure 11.5, it can be seen that the two sets are relatively well interspersed particularly in the central portion of the deposit.

Within the shaded area in Figure 11.5, the two sets of drilling have sampled approximately the same sample space. The distributions of Cu samples (in ppm to provide more resolution for comparison) with QA/QC were compared to those samples without QA/QC. This was done using a QQ Plot which is shown in Figure 12.6. The reasoning behind this was that if there is no bias between the two sets of data, the curve should plot on or near the 45° dashed line depicting perfect correlation.

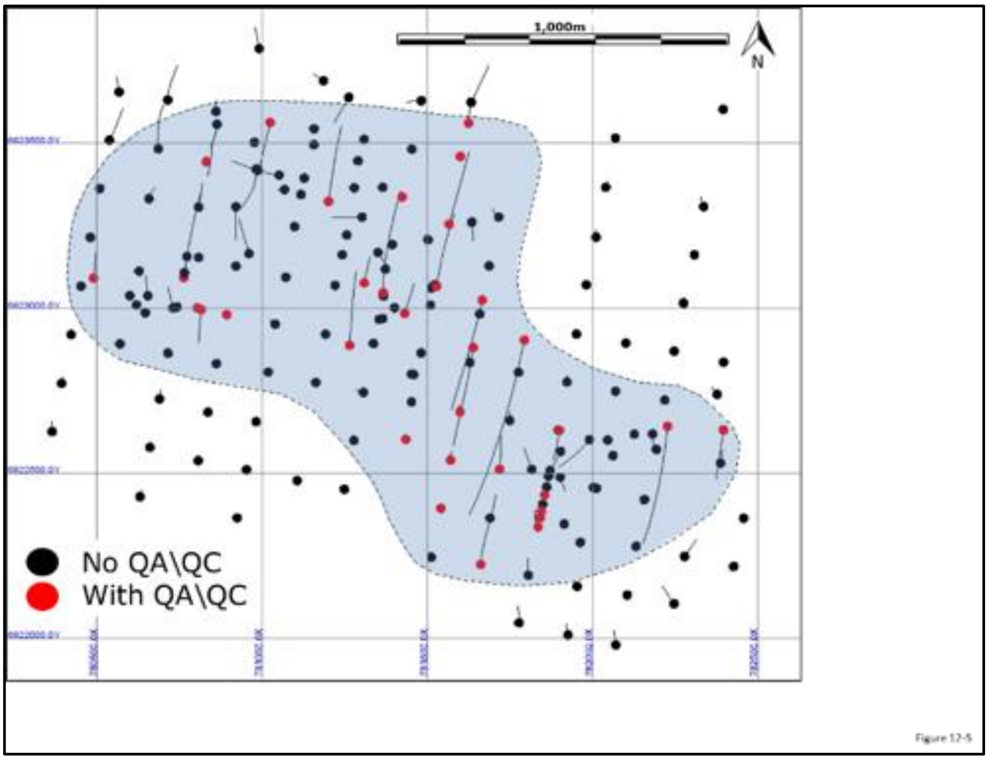


Figure 11-5: Plan showing the Haib resource 3D models and the associated drilling data coloured according to whether completed under QA/QC or not.

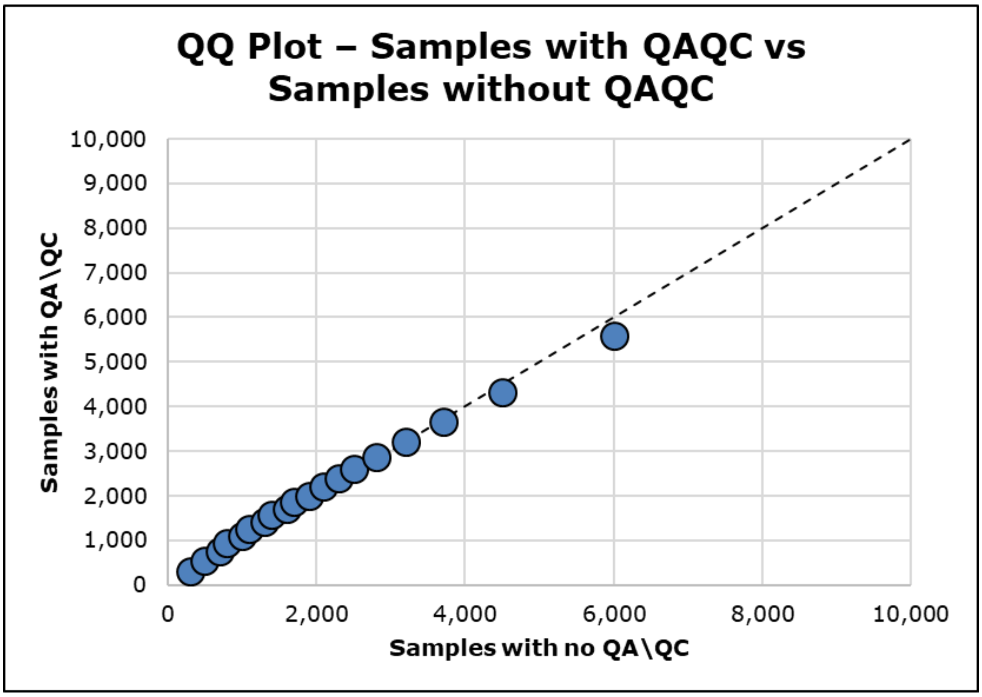


Figure 11-6: QQ Plots comparing by resource domain, the distributions of Cu results from samples taken under an appropriate QA/QC regime and those that weren't.

A look at Figure 11.6 shows that there is excellent correlation between the two. For this reason, it is the opinion of Obsidian Consulting and the QP, Peter Walker, that the historical data, despite their lack of QA/QC can be merged with the Teck dataset for use in mineral resource estimation without concerns about the introduction of any material bias.

11.6 QP's Comments on Sample Preparation, Analysis and Security

In QP Peter Walker's opinion Teck's knowledge regarding the controls on high grade zones ensures that there is no bias in their sampling. On the assumption that Teck personnel strictly adhere to their protocols regarding sample collection, transport, preparation, security and analytical procedures, then the reliability, validity and integrity of the sample assay results should be assured. Assuming that Teck personnel are adhering to their stated procedures, the chain of custody in sample collection and transport would be well controlled.

Teck used duplicates, standards and blanks to check the accuracy and precision of their assay data. The amount of QC / QA data is significant and the spreadsheet files and graphical presentation of their results have been check sampled by me and found to be adequate to ensure veracity of their results.

In the QP's opinion there is no relationship between Analytical Laboratory Services in Windhoek and/or Acme and/or Teck as operator for HM apart from a normal principal and client business relationship and both laboratories can be classified as independent applying all of the standard tests of independence.

12. DATA VERIFICATION

12.1 Historical Data

Original assay laboratory sheets or certificates were not located for the Falconbridge, KRC, or RTZ data and there are no records of any assay duplicates, field re-splits or check assays having been carried out by independent laboratories.

The RTZ drill samples were collected as composite half core samples over 2m sampling intervals and a total of some 45,865 metres had been assayed. Validating this database has been difficult because the assays were done at the RTZ Rossing laboratory with every tenth sample check assayed at the RTZ Palaborwa Mine laboratory. No original or copies of assay certificates have been located to validate the historical database. In order for HM to utilize the RTZ data in any future resource estimate, re-assaying of important intervals of RTZ core is required; this programme has been implemented – see discussion under section 10.1 above.

The NCJV drilling (completed after the Behre Dolbear historical estimates), supported the mineralization models created from previous assay results but could not verify them.

RTZ also prepared extensive metallurgical composites comprising sequential down-hole samples over approximately 20 metres. A historical estimate carried out by GFM based solely on this composite data gave comparable results to estimates using the other drill assay data.

12.2 Teck Resampling and Assay Database Verification

Due to the difficulty of validating the previous drilling, and in particular the RTZ database, in 2010 and 2011 Teck re-logged and re-assayed 619 x 6m quarter-core composites of the RTZ drillhole cores from 14 drillholes (see Figure 10.1 above) representing approximately 8% of the RTZ assay data and could potentially extend this programme of RTZ core analysis so that it can be included in a future compliant resource estimate – please see our discussion of the comparative results in Section 10.1 above. RTZ only assayed for copper on a systematic basis while all of the Teck assays routinely include copper, molybdenum, gold and 21 additional elements all determined by an ICP-ES technique.

During the two site visits of Peter Walker on the 24th of January 2012 in the company of Mr. Nuri Ceyhan, exploration manager of Teck Namibia and with Mr. Neil Grumbley, Teck's Haib Project manager and again on the June 30th 2015 with Mr. Neil Grumbley. The 2012 and 2015 visits were made on behalf of the Issuer for the completion of a technical report titled "43-101 Technical Review: The Haib Copper Project, Namibia." This was a qualification report for the reverse takeover of Jet Gold Corp., listed on the TSVX. The visits also served to collect data and verify data collection and that drill core sampling QC/QA procedures were in place and adhered to by the Teck personnel.

No core sampling was being carried out at the time of the site visits, so I was unable to verify or personally review the Teck sampling procedures. I have been supplied with an internal Teck memorandum detailing the sample preparation protocols to be employed during both core and geochemical sampling at the Haib project and I have been assured that these protocols are strictly enforced on site and at the independent prep-laboratory in Windhoek (Analytical Laboratory Services) and the independent assay laboratory (Acme Analytical Laboratories – www.acmelab.com, now a subsidiary of Bureau Veritas) ("Acme") in Vancouver, Canada.

An audit sample of assay data from assay laboratory certificates and the Teck electronic database was done to ensure that the data was accurately transcribed from the original source, which sample showed that it had been correctly recorded.

We visited the core processing facility was in a core shed building adjacent to the exploration site. When a core arrives at the facility, it is photographed in core trays with a digital camera. The core is then marked, cut, sampled, photographed again (marked-up half-core), logged, and then samples are selected from each tray for density determination using a standard Archimedes-type technique of weighing the core dry and wet. The core is stored undercover in the facility. Cores from various drillholes were examined on the logging tables and verified against the geological logs, and when available, the assay data.

The Analytical Laboratories Services which was the sample preparation facility in Windhoek was not inspected. However, the inspection of protocols with regards to the receipt of sample batches, crushing, milling, and the dispatch of sample pulps to the Acme laboratories in Canada showed that the preparation of all samples appeared to be reasonable with the necessary checks in place to identify any issues that may arise in the process.

The Acme laboratory in Canada was not inspected. However, the inspection of protocols with regards to the receipt and assay of sample batches showed that the procedure for all samples is of very high standards with the necessary checks in place to identify any issues that may arise in the process.

The QP Peter Walker has verified the data used by Teck to produce the 3-D block modelling and Cu-grade isoshells provided by Teck which were used to estimate, using Kriging, the reported resources shown in Section 14.12 and has audited a sample of the data to verify that it has been correctly transcribed and have assumed that the software has produced an accurate block model, isoshells and resource estimate.

12.3 Scientific and Technical Data Verification

The Authors have used their access to the Issuer's database of results, reports and certificates to verify the scientific and technical information used in preparation of this report by comparison with the information generated by their own studies, for example the latest resource estimates and results of metallurgical test work. Some of the data used to complete various sections of this report are obtained by reference to public domain reports, equipment and reagent vendors, Google maps and Namibian Government websites and wherever possible these have been cross-checked for consistency with a wide range of sources which are listed in the References and Bibliography Section 27 of this report.

Information obtained from the Issuer has been compared with reports to the Namibian Ministry of Mines and Energy and other statutory bodies issued by both the Issuer and Independent Contractors in order to verify the information and technical data so obtained.

12.4 QP's Opinion

The QP Mr. Peter Walker is satisfied that the necessary steps were taken to verify the data and that the data is adequate for the purpose of this report.

13. MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Metallurgical Testwork

13.1.1 Introduction

Previous testwork programmes and reviews of the Haib Project identified the two most promising options to be:

1. Beneficiation of the ore by dense media separation to reduce the amount of material to be milled for concentration by flotation; and
2. Bioleaching of the ore/rejects stream using BioHeap technology, removing the need for concentrating of the ore and subsequent roasting, leaching and electrowinning.

For either of these procedures to be successful, two key issues need to be addressed. Firstly, most of the resource is contained in disseminated, fine-grained chalcopyrite that is distributed throughout the entire mineralized body. Due to this, there are problems with the difficulty and cost associated with grinding the granite host rock to liberate the copper minerals. Processes such as beneficiation and leaching, however, are generally more efficient when working with smaller particles. Therefore, it must be determined what proportion of the mineralized material can be put through crushing, and to what particle size, and how much material of a certain grade recovered from beneficiation is to be milled for flotation for the operation to remain economical.

Secondly, the intensity of the chalcopyrite mineralization varies across the deposit. The consequence of this is that a finely tuned beneficiation or leaching procedure may not be applicable to the processing of the entire resource. If it was practical and economic to separate the areas of differing-intensity mineralization before processing each, this would not be a concern. If not, attention would need to be paid to the characteristics of the host rock for each area, and a process designed for each accordingly.

Multiple Studies and testwork have been completed on this deposit over a number of years with extensive studies into the mineralogy that dates back to 1975 when Rio Tinto explored the deposit. There have been previous reports issued by the QP Damian Connely of METS on the Haib project with the results of the report outlined below.

METS and Mintek of South Africa have undertaken a metallurgical testwork program (2019/2020) to further investigate and assess the treatment response of the Haib mineralized material to different technologies such as ore sorting and heap leaching. The testwork has showed positive results from the column bacterial leaching tests achieving a maximum copper recovery over 82.2%.

13.1.2 Mineralogy

The Haib Copper Deposit is a large sulfide mineralized body. Copper is mainly present as a sulfide in the form of chalcopyrite. Copper is also present as oxides (chrysocolla, plancheite, malachite and azurite), occurring as intrusions in shear zones. Initial testwork results showed that the Haib mineralization is a competent quartz feldspar porphyry rock. It can be seen that the main ore component is copper with only an accessory amount of molybdenum present. The chalcopyrite also occurs as occasional coarse irregular grains from 0.1 mm to 0.35 mm. It is clear that fine grinding will be required to liberate much of the chalcopyrite.

13.2 Prior Testwork

13.2.1 Comminution

Prior testwork has been conducted to determine the characteristics of the ore and its amenability to crushing. Table 13-1 shows the results from a comminution program from Minproc. The data indicates that this is a hard ore that will require large amounts of energy to crush and grind. HPGR on the other hand requires far less energy than grinding.

Table 13-1: Comminution Data

Head Grade		0.31% Cu
In-Situ Density		2.6 t/m³
Specific Gravity		2.7
Ore Density	Mass Calc	1.8 t/m³
	VolCalc	1.65 t/m³
Crushing Work Index	QFP	21.5 kWh/t
	FP	24.0 kWh/t
	Design	22.3 kWh/t
Unconfined Compressive Strength (UCS)	Design	150 Mpa
Abrasion Index (Ai)		0.485
Angle of Repose		36º
Angle of Reclaim		55º
Ball Mill Work Index (Bwi)	QFP	16.8 kWh/t
	FP	20.3 kWh/t
	Design	18.0 kWh/t
Rod Mill Work Index (Rwi)	QFP	19.8 kWh/t
	FP	25.1 kWh/t
	Design	21.6 kWh/t

13.2.2 BioHeap Leach

BioHeap™ is a heap leach technology, which it is claimed is able to treat chalcopyrite ores through careful selection of bacteria that attack chalcopyrite preferentially to pyrite. This avoids the build-up of elemental sulfur, a common problem with chemical-based leaching, as it brings about passivation of the mineral surface. Preventing this improves leach kinetics, which is a major advantage of the BioHeap™ process.

Preliminary testwork showed that the Haib ore became more susceptible to leaching as the particle size was decreased, and that the actual leaching of copper in preference to iron by the bacteria was very successful. A bacterial leach study by the University of Witwatersrand has been conducted which extrapolates short term results to infer long term. A constant diffusion coefficient is used which doesn't account for passivation layer build-up. The information suggests:

- Copper recoveries are better for smaller ore sizes and worst for larger fractions (ie. Smaller particle have better leaching kinetics)
- Iron concentration was stabilised at 6.5 to 8.5 g/L of Fe(III), periodically removing by sulfuric acid yielded copper extraction increasing by 15%
- Temperature of the column was 30ºC but rose to 40ºC over 2 weeks
- Magnesium and aluminium build-up were six times faster than copper

This study suggested that high copper extractions can be achieved in column leaching conditions; however, the method of extrapolating the data may be open to criticism.

Additionally, AMMTEC conducted testwork on bacterial oxidation; they conducted bacterial testing on a 100% passing 32 mm crush size. The testwork conducted was a single bacteria oxidation test that used a chalcopyrite specific bacteria culture. A 1% w/v milled material to bacteria culture was used and maintained at a pH of 1.8. The results concluded that the mineralized material was amenable to bacterial oxidation and gave high oxidation (95.2%) of copper.

In 2003, heap bacterial leaching testwork was performed by Mintek to establish the agglomeration requirements for different crush sizes and to assess the amenability of Haib oxide and sulfide material to heap bioleaching. Mintek's bacterial cultures were used and the columns were operated at a temperature range of 28°C to 30°C for oxide s and 20°C to 70°C for sulfides. This testwork programme showed that heap bioleaching can achieve good copper extraction for both oxide and sulfide mineralized materials. The key findings from this testwork programme are as follows:

- Oxide heap leaching
    - These tests indicated that the smaller the leached particles and the more acidic the conditions, the higher the copper extraction obtained. The highest extractions were obtained for finer crush sizes.

  - Acid requirements were in the order of 1.4 to 3.1 kg acid/kg copper.
  - The sample material was found to agglomerate relatively easily with acid concentration of around 5 g/L, and higher.
- Sulfide heap bioleaching
  - The tests on the milled samples confirmed particle size and temperature as the primary leach parameters for the Haib sulfide sample.
  - The copper leach kinetics improved with increasing temperature and reduced crush size. High redox potential was also required to maximise copper leach kinetics.
  - The sulfide material is difficult to agglomerate.
  - The best copper extraction was obtained for a crush size of 6 mm and a temperature of 65°C which yielded a copper extraction of 80% after 200 days.

13.2.3 Metallurgical Studies and Process Optimisation

A previous report issued by METS in March 2006, presented and discussed alternative processing options to the conventional roasting for extracting copper from chalcopyrite.

The processing options it was proposed be investigated and tested were:

- Heap leaching by a bacterial-assisted leach technology; and
- Production of a concentrate after beneficiation.

Options for processing a concentrate on site were also examined. A preliminary evaluation of the various processes found that the most attractive options were Intec®, Total POX, Geocoat and Activox®. It was considered that the return per tonne of material treated by any of those routes needed to be increased via beneficiation and flotation to be viable at any scale.

Process options for recovering magnesium and aluminium from leach solutions were presented, as these elements were found to leach in the biological leaching. It was determined that these metals were not able to be extracted economically.

It was recommended that metallurgical testwork be carried out to determine the applicability of bacterial leaching technology and of concentrate production using beneficiation and flotation. This was to be done in a number of phases at the laboratory scale and the pilot plant scale.

13.2.4 2019/2020 Metallurgical Testwork

METS have undertaken a metallurgical testwork programme (2019/2020), which is centred on heap bioleaching of the low-grade Haib copper sulfide mineralized material. The objectives of this testwork programme are to optimise process parameters and assess process viability especially ore sorting. Some of the key findings from the testwork results are summarised below:

- The ore sorting testwork showed that nearly half of the mass treated was ejected producing a higher-grade concentrate and achieved an overall copper grade of 1.36% which corresponds to an upgrade factor of 1.73. Although the ore sorting results showed positive results for low-grade Haib mineralized material beneficiation, the loss of copper (~30%) to the tails and additional CAPEX and OPEX of ore sorting suggest that ore sorting is not the preferred route for processing the low-grade Haib mineralized material. Crushing and heap leaching of the mineralized material will provide a higher overall copper recovery than ore sorting followed by heap leaching.
- The HPGR optimisation testwork were performed at 30 bar, 60 bar and 90 bar. The results suggested that 60 bar is the optimum pressure.
- The net acid consumption was estimated to be 11 kg/t for a pH of 1.5 and 10 kg/t for a pH of 2. The total acid consumption was calculated to be 11.5 kg/t for a pH of 1.5 and 10.5 kg/t for a pH of 2.
- The mineralised material agglomerated without any issues as opposed to the 2003 Mintek testwork indicating that the leaching solution will be able to percolate through the heap easily and hence maximise copper dissolution.
- The batch agitated leach tests showed that bacterial leaching is a viable option and achieved good copper recovery. The batch chloride leaching which showed very poor results suggested that it is not suitable for processing the Haib mineralized material.
- The geomechanical stacking test results suggested that a 6 m stacking height can be accommodated for percolation leaching for crush sizes: -2.36 mm, -3.35 mm and -4.75 mm.
- The column leach tests have shown very promising results, achieving copper recoveries ranging from 75% to 82.2% which suggest that bacterial leaching is suitable for processing the low-grade Haib mineralized material. Additional testwork will be required to confirm the results and optimise the process parameters.
- In columns, the acid generation from bacterial leaching of the pyrite resulted in a continual decrease of pH. The pH will need to be adjusted to around pH 2 for solvent extraction. Some neutralisation will be required. Column leaching with continuous recycling is required to assess the actual acid requirement which is expected to be very low.
- The iron removal tests showed that an iron removal efficiency of 99% was achieved at a pH of 4 without loss of copper to the precipitate. This suggests that the pH of 4 is the optimal condition for the iron removal process.

It is important to note that the proposed flowsheet was not possible twenty years ago when the project was discovered. Firstly, HPGR was not developed to the state where it is today allowing fine crushing. Secondly chalcopyrite could not be leached. Work over the last ten years has perfected strains that can survive at higher temperatures where the chalcopyrite will not passivate and leaches over time. Mintek has been a global leader in this area of bacterial leaching.

14. MINERAL RESOURCE ESTIMATES

14.1 Introduction

In July 2017, Mr. Dean Richards of Obsidian Consulting Services, at that time, an independent geological consultant, conducted with the co-author Peter Walker, a mineral resource estimate for the Haib Copper Project using the outputs of some 3D modelling work that had been completed by Teck using the LeapFrog GEO software package. The models were analysed with respect to their grade distributions and appropriate domains were selected on which the mineral resource estimate was then based. A mineral resource classification based principally on data density was applied to derive a mineral resource statement.

14.2 Source Data

14.2.1 Drillhole Data

All the available drill hole data for Haib was compiled in a single Geovia-GEMS project. The summary statistics of the complete compiled drill hole database are given in Table 14-1 below. The deepest intersections achieve a depth of more than 800m below topography.

Table 14-1: Summary drilling statistics by drilling programme

Series	No. Holes	Suitable for Estimation	Total (m)	Average m/hole	Max. Depth	Cu Assays	Mo Assays	
							Assayed	Visual
ADIT01	1	1	126.00	126.00	40	63	63	
GFMHB01 - GFMHB12	15	15	4,726.40	315.09	464	2,186	2,034	
H01 - H12	11	11	1,010.72	91.88	225	253	0	
HB001 - HB210A	121	121	45,795.15	378.47	653	22,838	1,530	1630
KO1 - KO4	3	3	151.49	50.50	49	34	0	
KS01 - KS21	18	18	3,324.76	184.71	288	727	0	
TCDH-01 - TCDH032	32	32	14,252.93	445.40	796	5,999	5,999	
	201	**201**	**69,387.45**	**345.21**		**32,100**	**9,626**	**1,630**

The positions of the drill holes relative to the modelled portion of Haib are given in Figure 14-1. The drill hole collars are coloured as to whether they were subjected to a QA/QC programme (red) or not (black).

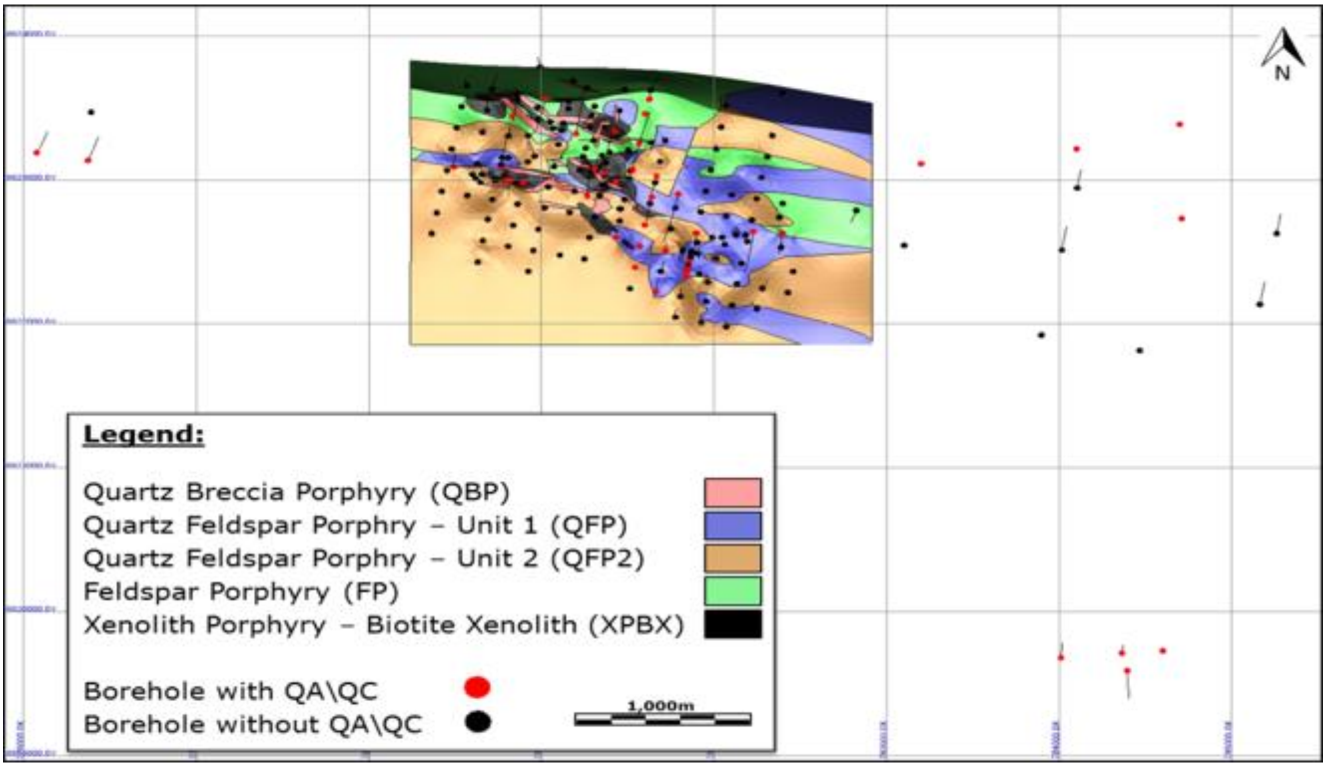


Figure 14-1: Plan showing the limits of geological modelling conducted by Teck with the available drilling overlaid (source: Teck 2015)

14.2.2 Three Dimensional Models

A summary listing of the received 3D models from Teck is given in Table 14-2 while

Figure 14-2 shows an isometric view of the data. The geological model comprises major faults as well as lithological models. The copper grade isoshells were provided, the first approximating a 0.3% grade limit, the second 0.2%. An isoshell of molybdenum grades elevated above background levels was also received.

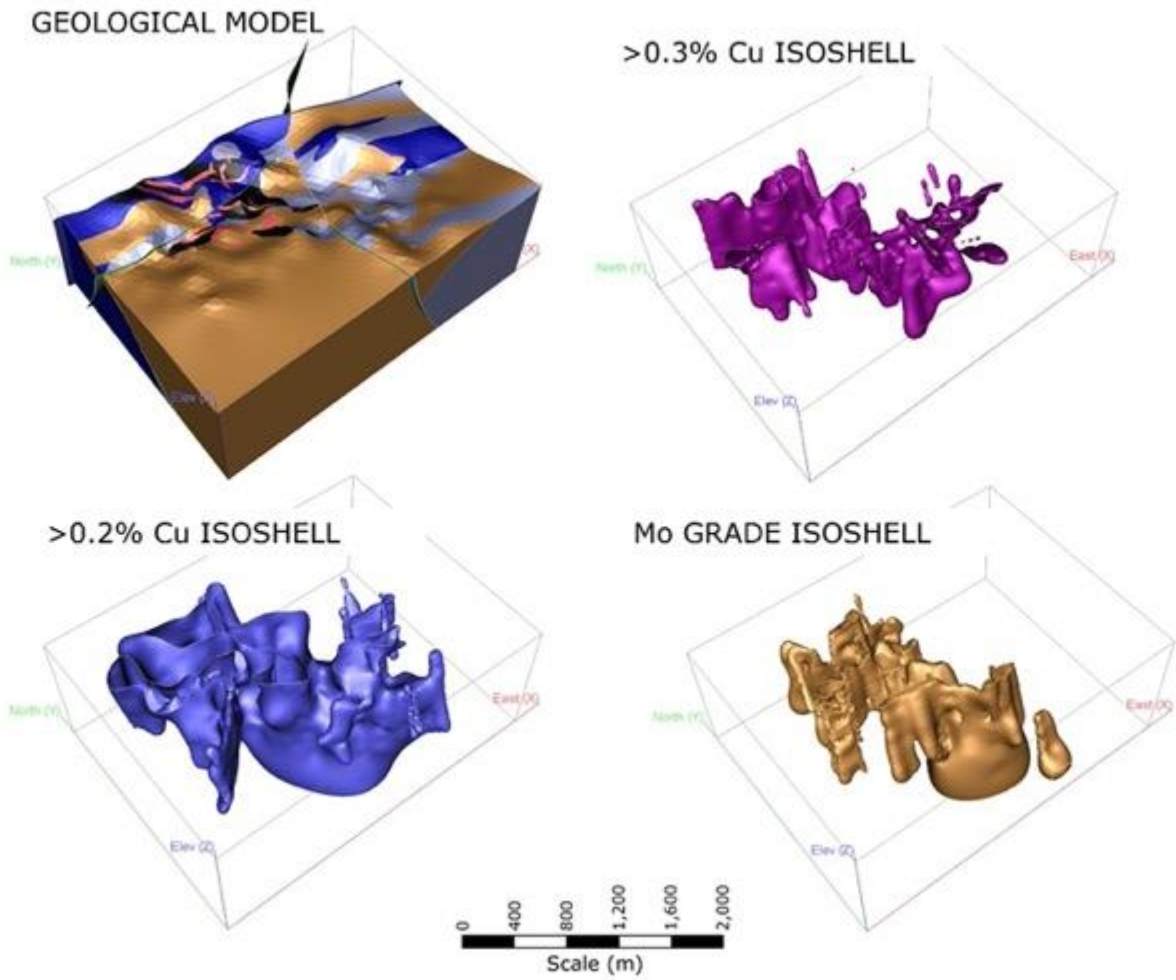


Figure 14-2: Isometric view showing the various 3D models received from Teck. (source: Teck 2015)

Table 14-2: Listing of files received from Teck

Type	LeapFrog File
Topography	Haib_Topography.dxf
Structural Model	GM_Lithology -EW FAULT.dxf GM_Lithology -NorthShear.dxf GM_Lithology -NS QV.dxf
Geology	GM_Lithology -FP.dxf GM_Lithology - QBP.dxf GM_Lithology - QFP.dxf GM_Lithology - QFP2.dxf GM_Lithology - XPBX.dxf
Grade Isoshells	GM_GradeOutlines - High Grade.dxf GM_GradeOutlines - Low Grade.dxf GM_GradeOutlines - Mo Outline.dxf

14.3 Domain Selection

Each of the solid models received represents a potential domain for resource estimation and reporting. The univariate statistics were calculated for each and are shown in Table 14-3. The molybdenum mineralization isoshell was not considered and molybdenum was viewed as secondary relative to copper. Of the lithological models, the QBP and XPBX show the highest mean and median grades, followed by the QFP's and then the FP.

Table 14-3: Summary univariate statistics by domain.

	Cu (ppm)							
	All	FP	QBP	QFP	QFP2	XPBX	>0.3 Cu	>0.2 Cu
Count	32,100	2,929	2,074	6,808	10,159	3,679	5,738	13,969
Minimum value	0.4	5.0	100.0	12.8	50.0	5.0	5.0	5.0
Maximum value	44,700	22,420	21,500	38,000	33,800	24,000	38,000	38,000
Mean	1,759	1,598	2,458	2,033	1,740	2,966	3,545	2,742
Median	1,300	800	2,000	1,600	1,400	2,300	3,000	2,200
Geometric Mean	1,071.6	828.3	1,877.1	1,484.8	1,300.8	2,116.2	2,819.2	2,136.8
Standard Deviation	1,873	2,054	1,870	2,035	1,528	2,442	2,527	2,196
Coefficient of variation	1.06	1.29	0.76	1.00	0.88	0.82	0.71	0.80
Skewness	4.15	2.99	2.17	5.50	1527.61	1.93	2.94	3.61
Kurtosis	42.53	16.86	12.51	58.53	0.88	9.37	20.16	30.44

A boundary analysis was done to examine how the Cu grades change (gradationally or rapidly) across the Haib deposit. A challenge that existed in this exercise was the fact that the majority of the boreholes are close to vertical. This is effectively parallel to the maximum direction of grade continuity as determined from the directional semi-variograms. Boreholes that intersect this trend at a high angle are preferable, nevertheless, some of the Teck drilling was inclined. From these inclined boreholes, holes representing various orientations and dips were selected and the Cu% grade was graphed against depth from collar. These are shown in Figure 14-3.

In Figure 14-3 it can be seen that in every instance there is a well-defined gradual change in grade at the large scale. Minor high-grade inflections do exist, but these are highly localised and probably represent the intersection of mineralised veins or other structure. The trend is subtler in TCDH011 primarily because the background grades in this hole are low as it has been drilled on the periphery of the deposit. Though subtle, the pattern is still there and is evident between collar and ~150m depth below collar. In summary, no evidence exists from the boundary analysis of the existence of distinct highly mineralised and less mineralised zones. Grades increase and decrease gradually, with local variations (associated with minor structures).

The above confirms the mineralisation model Ih states that the mineralisation Is spatially associated with syn-mineral dykes (QBP) as well as dark micaceous veins (XPBX). In addition, there is considerable vein development and disseminated mineralisation in the QFP and FP rocks as well. As the imprint of mineralisation clearly crosses lithological contacts and structures, stationarity (a requirement for estimation) within the lithologies is somewhat lacking.

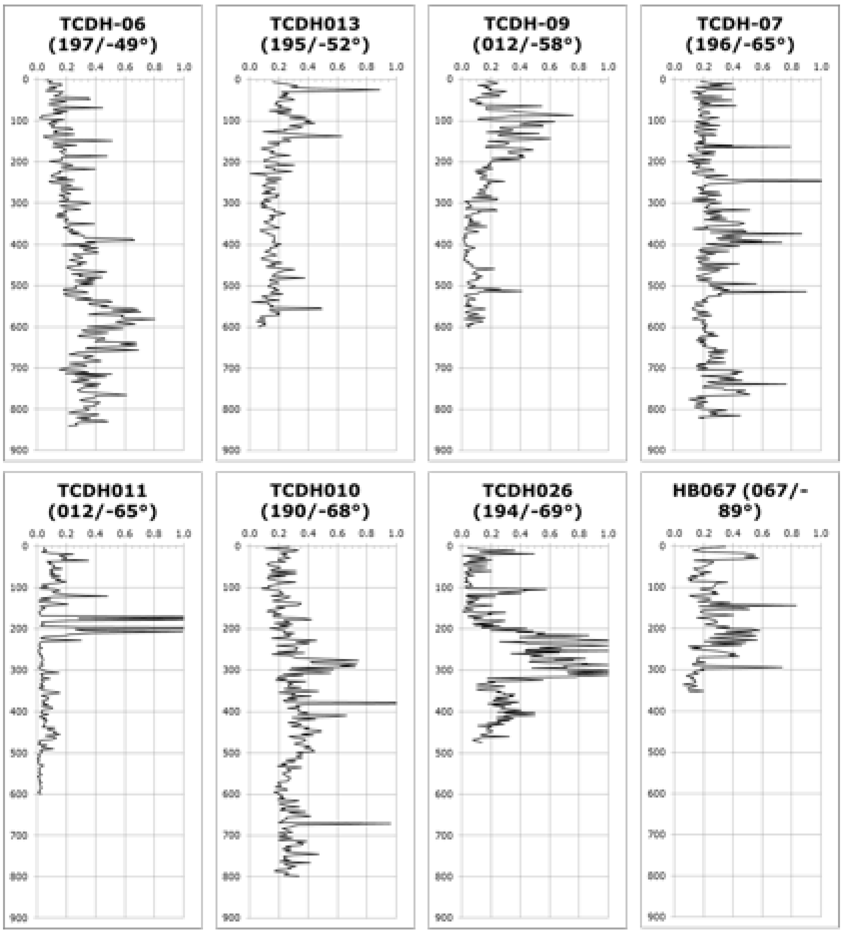


Figure 14-3: Boundary analysis of Cu grade from selected inclined boreholes drilled by Teck.

For the reasons above, the decision was taken to not apply any domaining based on lithology, structure or grade to the definition of the mineral resource for the Haib deposit. Boundaries would be managed based on proximity to data.

14.4 Statistical Analysis

14.4.1 Univariate Statistics

The univariate statistics for Cu are shown in Figure 14.4. Both populations are positively skewed, particularly the Mo grades. For Cu, the log histogram hints at two possible populations, the first around 0.008% (80ppm) and the second one at 0.18%. It is likely that this lower population represent some non-mineralised portions on the periphery of the Haib deposit.

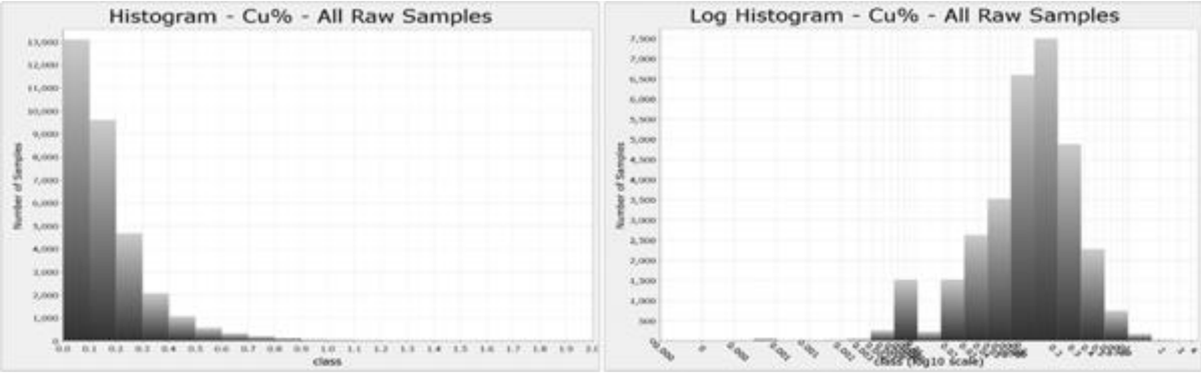


Figure 14-4: Normal and log-histograms as well as summary statistics for all raw Cu.

14.4.2 Grade versus Sample Width

Due to the fact that grade is not strictly additive; the relationship between a sample grade and the width/volume/tonnage it represents is a very important consideration. In some deposits, clear relationships (positive or negative) exist between grade and sample width and in these instances, it is more correct to work with the grade accumulation (grade x width or grade x volume etc.) than the actual grade. In this instance, the core diameter is assumed constant and a default density was to be applied so it made sense to only consider the grade and sample length relationship. A scatterplot of Cu grade versus sample length is shown in Figure 14-5.

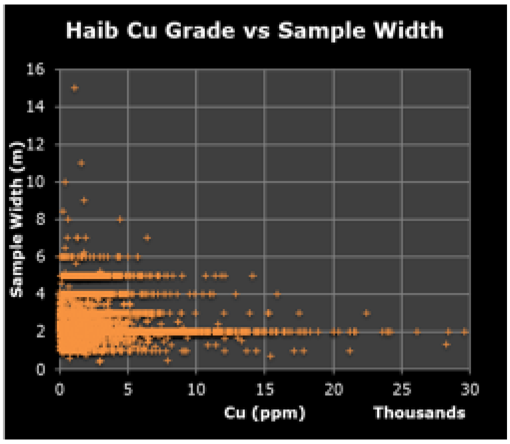


Figure 14-5: Haib Cu grade versus Sample Width

It is clear from the figure above that there is no clear relationship between Cu grade and sample width which is confirmed by a correlation co-efficient of 0.013 (calculated but not shown). As the sample size has no obvious effect on the grade, it was decided to continue with the mineral resource estimation work using the Cu grades "as-is" and not accumulations.

14.4.3 Compositing

Within the portion of the prospecting area that had been modelled by Teck, the horizontal drill hole spacing closely approximates a grid of 150 x 150m. As most of the raw samples are between 1 and 2m wide, the vertical component of the sample spacing is very small relative to the horizontal components. Compositing is typically used to regularise the sample size to produce a standardised weight for each sample. However, in this instance, as the sample lengths are already fairly consistent it was decided to composite the samples to a more global scale better suited to the scale of open cast mining. A 10m composite length was selected to correlate with a typical bench height and 10m composites were calculated starting from the collar. Residual composites were retained.

The univariate statistics were then calculated for Cu% and Mo (ppm) and are presented in Figure 14-6 while the results are tabulated in Table 14-4. From Figure 14-6, it can be seen that the composite populations remain positively skewed. The multiple populations hinted at in the raw samples have been smoothed out in the composites. The Cu composites show a clear compound log normal distribution indicating due consideration must be given to anomalously low and high grades.

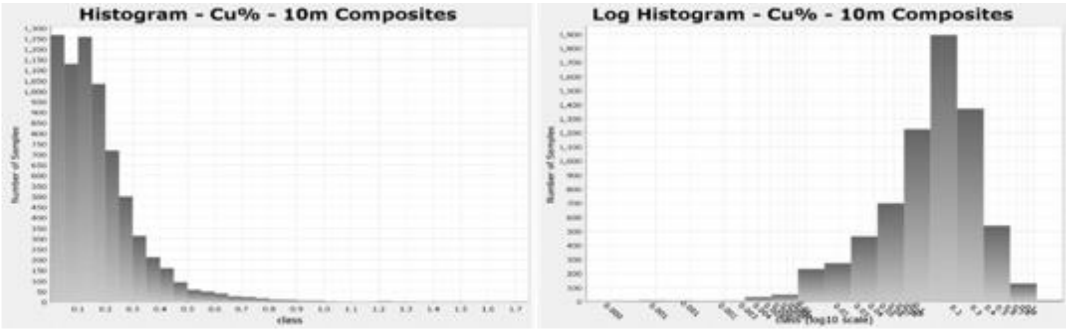


Figure 14-6: Histograms showing the distribution of the 10m composite Cu.

Table 14-4: Univariate statistics of the 10m composites

	All Samples
	Cu
Count	32,100
Minimum	0.4
Maximum	44,700
Mean	1759.2
Median	1,300
Geometric Mean	1,072
Variance	3,506,724
Std Deviation	1,872.6
CoV	1.06
Skewness	4.146
Kurtosis	42.532

Smoothing of grade is a natural consequence of compositing and care should be taken to avoid smoothing out all the natural variation of the grade. Creating 10m composites from 1 to 2m samples is quite an aggressive approach so the impact of the compositing was assessed.

This was done using Quantile-Quantile (QQ) Plots to compare the percentile distributions of the raw and composited data. These are given in Figure 14-7.

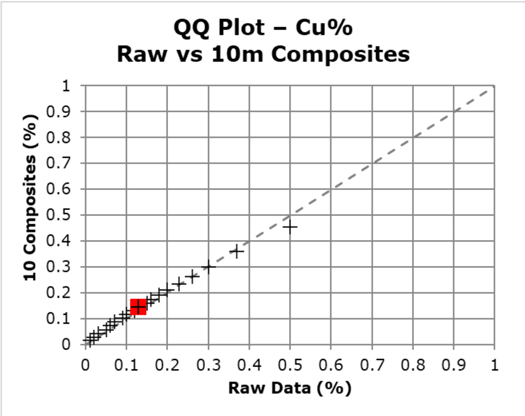


Figure 14-7: QQ Plots comparing the Cu grade distributions of the raw data against the derived 10m composites.

On a QQ Plot, one expects to see the curve cross the dashed 45° line at the median (red shaded point) or mean value (indication of bias) while the amount of rotation from the 45° line provides an assessment of the amount of smoothing that has occurred. From Figure 14-7, it can be seen that the effect of compositing on the Cu distribution is negligible and the composites reflect a similar variation to the original data.

14.4.4 Grade Capping

Grade capping analysis was done on the %Cu grades of the raw data as well as the 10m composites. The former in order to test the extent to which capping was required for the compositing while the latter was done to evaluate the risk of extreme assay values during estimation and whether it was necessary to limit their influence during the estimation process. Figure 14-8 shows a Top Cut Analysis for the raw Cu grades as well as the 10m composites. These were derived by applying an upper cap to the data and calculating the mean of the samples below the cap value (blue lines in Figure 14-8). The Lost Metal% effectively quantifies the amount of "metal" lost due to the exclusion of the grades above the cap (red lines in Figure 14-8). The graph provides a means to determine how sensitive the data are to the inclusion or the exclusion of the values above each cap value with the sensitivity being reflected in the gradient of the curve. For instance, between 0.1% and 0.4%, the application of each subsequent cap has a material influence on the resultant "metal". Above 0.4% this is more subdued.

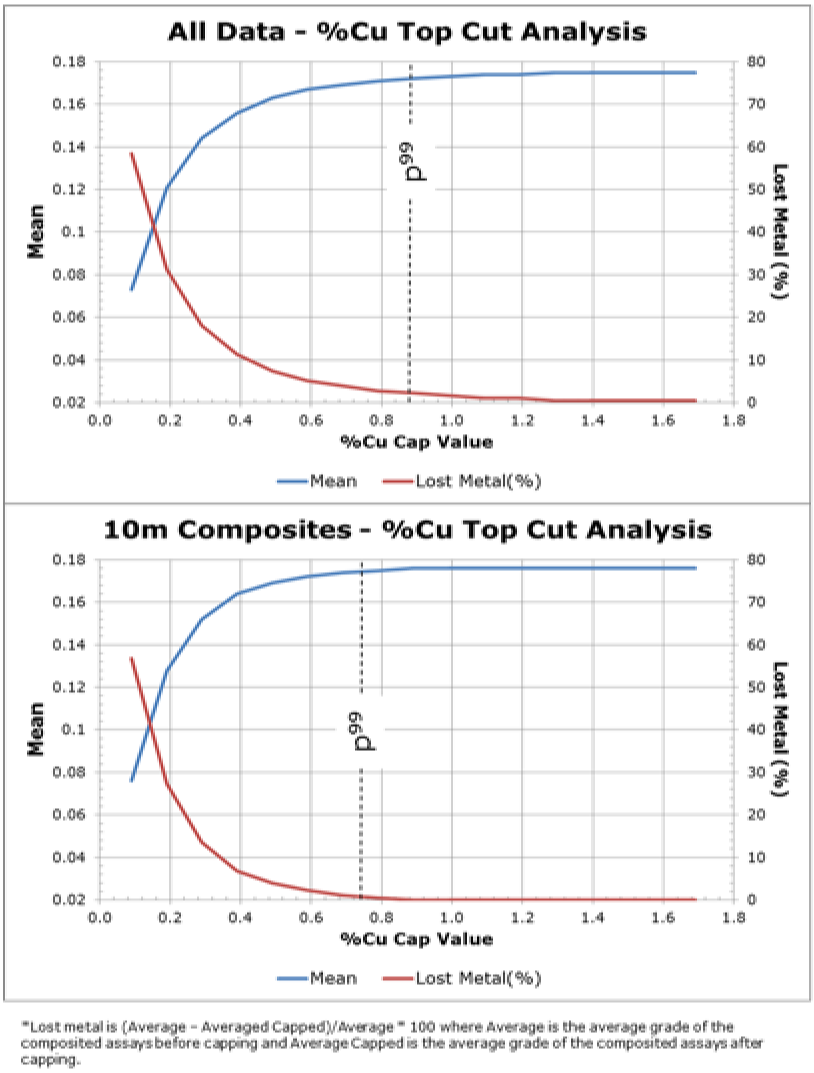


Figure 14-8: %Cu Top Cut Analysis for raw data and 10m composites

From Figure 14-8 it can be seen that;

- The respective curves for each of the raw data and composites are practically identical.
- For the raw data, beyond the 0.4% Cu cap value, there is very little change in the sample subset mean while the Lost Metal% effectively remains constant.
- The same is true for the 10m composites.
- For these reasons it was decided not to apply capping to the calculation of the 10m composites to be used in estimation.
- For the 10m composites, it is clear that the inclusion or exclusion of samples >0.7% will not have a material effect on the resultant contained "metal". However, it must be remembered that these are 10m composites and therefore they represent a significant volume, i.e., to get a high-grade composite requires multiple high-grade samples. As it was felt that these high-grade composites actually carry the requisite support the

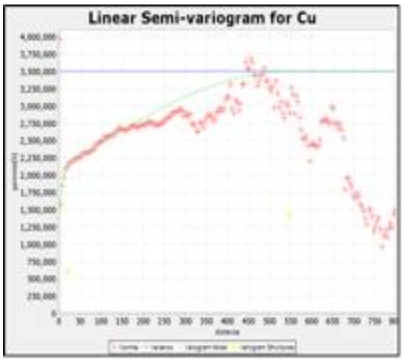
decision was taken not to cap or cut these values during estimation. However, to avoid spurious smearing of the grades, their range of influence during estimation was significantly reduced as described further in this text.

14.5 Variography

In order to detect any preferred directions of grade continuity, variography was conducted for Cu and Mo. This comprised linear semi-variograms to examine the Nugget Effect as well as omni-directional and directional experimental semi-variograms. Anisotropy was determined and variogram models fitted for use in estimation by Ordinary Kriging.

14.5.1 Linear Semi-variograms

Experimental linear semi-variograms were generated down the hole using the raw data. As linear semi-variograms use the closest spaced samples they can provide a good indication of the degree of randomness (Nugget Effect) of a deposit. The experimental linear semi variograms and the derived variogram models are shown in Figure 14-9.



	Linear Semi-Variogram	
	Cu	Mo
Model Type	*Spherical*	*Spherical*
C_0	1,481,721	11,309
% of Var	42%	76%
$Sill_1$	604,313	1,143
Cum% of Var	60%	84%
$Range_1$	20	16
$Sill_2$	1,417,440	2,381
$Range_2$	548	104

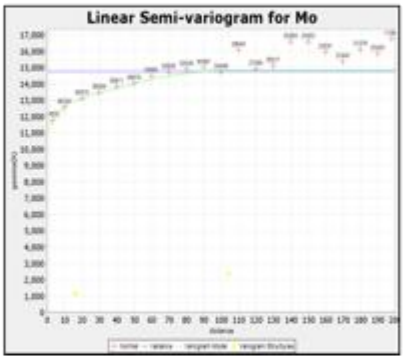
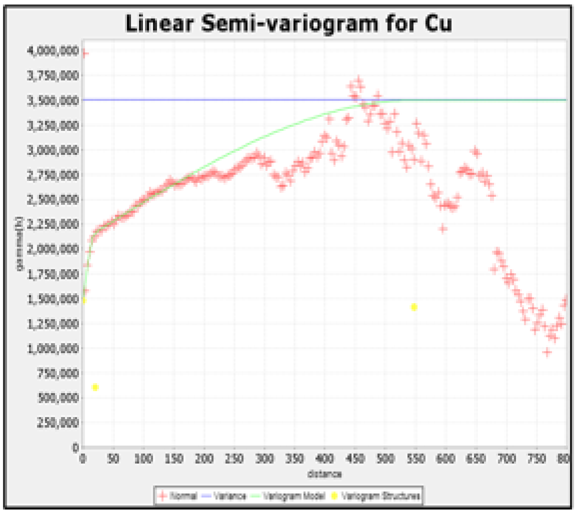


Figure 14-9: Experimental linear semi-variograms for Cu and the derived spherical models.

14.5.2 Omni-directional Semi-variograms

These quantify the rate of change of grade continuity only on the basis of distance without any considerations of anisotropy. A robust spherical variogram models was obtained for Cu and are shown in Figure 14-10. In some instances, outliers were filtered out of the experimental variograms to reduce noise. The model was fitted in this space then back transformed to the original population space. The variogram model is summarised in Table 14-5.



	Linear Semi-Variogram
	Cu
Model Type	*Spherical*
C_0	1,481,721
% of Var	42%
$Sill_1$	604,313
Cum% of Var	60%
$Range_1$	20
$Sill_2$	1,417,440
$Range_2$	548

Figure 14-10: Omni-directional semi-variograms for Cu and the derived spherical models.

Both elements considered could be modelled using a double spherical structure. The largest ranges were obtained for Cu at 1,215m and 560m for Mo. The Nugget for Cu is at ~30% of the population variance.

Table 14-5: Derived omni-directional variogram models for Cu and Mo by domain

	Cu
Model Type	*Spherical*
C_0	657,477
% of Var	29%
$Sill_1$	1,126,183
Cum% of Var	79%
$Range_1$	263
$Sill_2$	477,570
$Range_2$	1,215

14.5.3 Directional Semi-variograms

Although well supported omni-directional variogram models were obtained, one of the drawbacks of omni-directional variograms is that they can often obscure finer scaled details. Additionally, in this instance the mineralisation has a component of structural control with an association with veins and fractures. For these reasons, the presence of any existing potential preferred orientation of grade continuity was tested using directional semi-variograms.

The derived directional semi variogram model is shown in Figure 14-11. The maximum continuity is shown by the red lines while the subordinate anisotropy axes are indicated by the magenta and cyan lines. These show a general anisotropy where the semi-major axis has a Range of ~50% of the major axis and the minor about 25%.

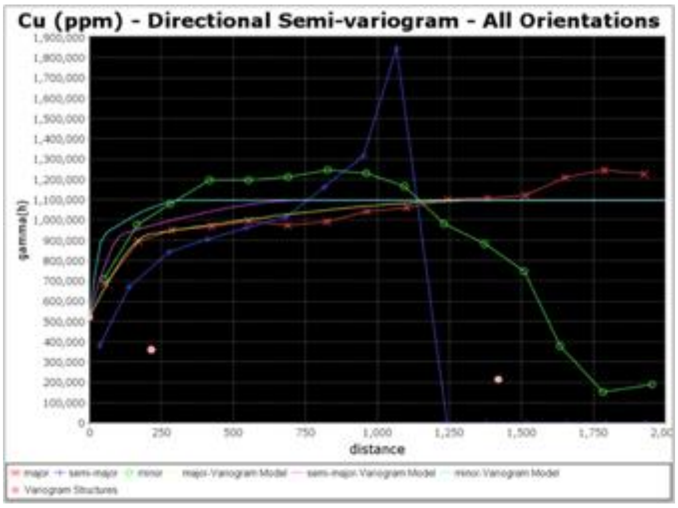


Figure 14-11: Directional semi-variograms showing the "All Orientations" variogram models for 10m composites of Cu.

The variogram model is summarised in Table 14-6. The model shows a double spherical structure with a maximum Range of just over 1,400m. The Nugget Effect, shown here as "% of Var." is just less than 50% of the total population variance.

Table 14-6: Derived variogram models and their associated anisotropy components for Cu and Mo

	Cu
Model Type	*Spherical*
o	1,073,898
% of Var	47%
Sill1	744,247
Cum% of Var	80%
Range1	215
Sill2	443,085
Range2	1,420
Plunge	0.0
Bearing	134.7
Dip	67.2
Major:semi-major	1.87
Major:minor	4.15

At this stage, the decision was made to use the directional variogram models for Cu in Table 14-6 further because they show a larger maximum Range than the omni-directional variograms and the associated anisotropy was felt to be more representative of the Cu mineralisation.

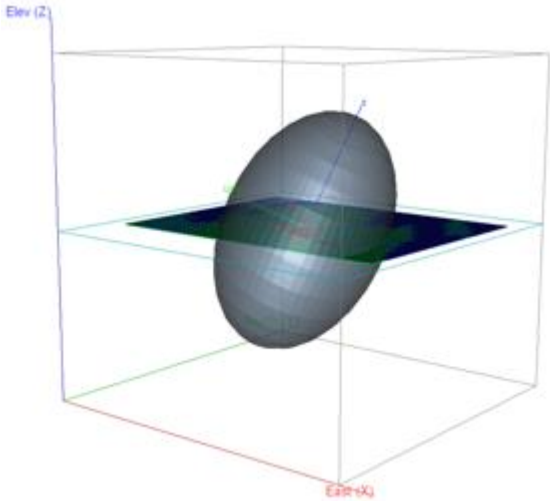


Figure 14-12: Isometric view looking northwest showing the semi-variogram anisotropy for Cu.

The anisotropy ellipsoid for Cu is shown in Figure 14-12. Maximum grade continuity is oriented approximately horizontally along 135°. The semi-major dips towards 225° at about 67°.

14.6 Block Modelling

The general mine planning software, Geovia-GEMS from Dassault Systems was used for this work. GEMS make use of a Percent block model attribute and not sub-celling to manage and report volume accurately. The cell size used in the estimation in GEMS is therefore purely a function of the data spacing. For this work, it was felt that a full Quantitative Kriging Neighbourhood Analysis (QKNA) was un-warranted due to the fact that the drilling is relatively evenly spaced and the derived variogram models are robust and supported by a large number of sample pairs. Any gains from the QKNA are likely to be minor and wouldn't be substantiated by the amount of work required.

Instead, a horizontal cell size of 75m x 75m was used as the drill holes are spaced on a grid with a general spacing of 150m x 150m. A cell height of 10m was selected.

The block model project was positioned over the main target area on which the 150m x 150m pattern had been drilled and sized appropriately to cover the full extent of the drilling with depth. This is called the “Mineralized Zone” or MZ. The geometrical definitions are given in Table 14-7.

Table 14-7: Block model geometrical definitions

Origin	X	780,140
	Y	6,821,810
	Z	650
Cell Size	Column	75
	Row	75
	Level	10
No. of Cells	Columns	39
	Rows	31
	Level	115
Length	X Direction	2,925
	Y Direction	2,325
	Z Direction	1,150

14.7 Specific Gravity

Limited specific gravity (SG) determinations were done by Teck on core from boreholes TCDH014 up to and including TCDH027 (excluding TCDH025). A total of 99 SG determinations were available for this work. Figure 14-13 shows a normal histogram of these along with the summary statistics. The distribution is quite normal with the mean and median values being identical at 2.76 T/m^3. Values range between a low of 2.23 and a high of 3.01 T/m^3.

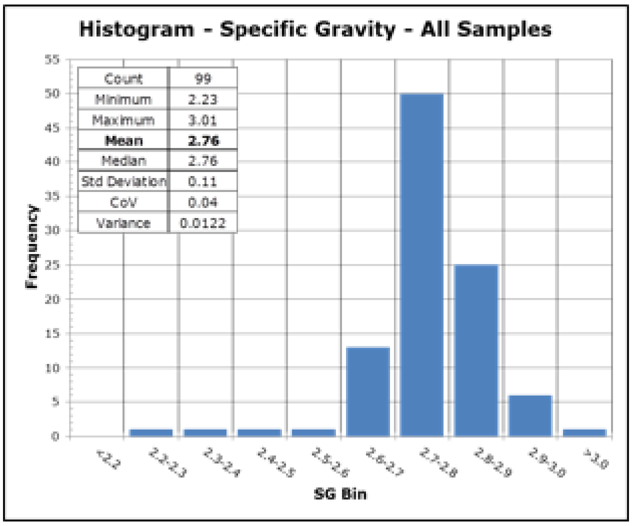


Figure 14-13: Normal histogram of available specific gravity determinations

As there were not enough determinations to allow for interpolation of the SG for the Haib deposit, it was decided to apply a default SG of 2.8 tonnes/m^3 to the Haib mineral resources. This figure was derived by rounding the mean SG of 2.76 to one decimal place. It is the co-author's opinion that this is a perfectly reasonable approach considering the low variability of the SG's determined for the Haib deposit.

14.8 Estimation

Ordinary kriging was used to estimate Cu in a stepwise fashion as follows:

- A first pass kriging run was done using a search ellipse matched to the Ranges of the semi-variogram models. Cells estimated during the first pass were tagged with an integer value of 1.
- The search ellipsoid Ranges were then doubled, the minimum and maximum number of samples adjusted, and a 2^{nd} kriging run was done. Cells populated were tagged with the value 2. In both instances, all cells were estimated within a search of 2x the Range.
- An ellipsoidal search was used.
- No high-grade limits were used. Instead, a high-grade transition (HGT) value for Cu was defined at 1%. Cu grades above this value were used "as-is" but the range of influence for these was reduced significantly.

A summary of the kriging run inputs is given in Table 14-8.

Table 14-8: Summary of the kriging inputs for each of the runs completed for Cu.

		Cu
Run 1	Search	RANGE
	Minimum Samples	10
	Maximum Samples	18
	Discretisation	10x10x5
	Search Type	Ellipsoidal
	High Grade Transition (HGT)	1%
	Range for >HGT	700; 380; 170
	No. of Cells Estimated	108,758
	Estimates Cells as %	>99%
Run 2	Search	RANGEx2
	Minimum Samples	12
	Maximum Samples	24
	Discretisation	10x10x5
	Search Type	Ellipsoidal
	High Grade Transition (HGT)	1%
	Range for >HGT	700; 380; 170
	No. of Cells Estimated	108,758
	Estimates Cells as %	<1%

During kriging, various outputs such as kriging variance, kriging efficiency, slope of regression, number of samples, number of negative weights and others were tracked and used as a guide in the estimation process.

14.9 Estimate Validation

During kriging, various parameters were tracked, and trace blocks were used in regions of high, medium and low data support. Post-estimation, visual inspection was used along with more quantitative methods such as;

- Non-spatial comparison of source data and estimates using QQ Plots
- Swath plots were generated to compare trends in the data with estimates
- Comparison of estimates and average grades of informed cells as well as estimation methodologies.

14.9.1 QQ Plots

The Quantile-Quantile Plots comparing the percentile distributions of the 10m composite source data to the estimates are shown in Figure 14-14. Smoothing is a consequence of estimation and as expected is reflected by the rotation of the curves from the dashed 45° line. For Cu the estimate distribution is lower grade than that of the source data. This is probably due to the fact that the domain extends beyond the data limits (particularly with depth). In these areas, grades are lower but also a lot of cells will be populated by only a portion of the source data. As the QQ Plot is non-spatial, it cannot really account for this. Nevertheless, the fact that the estimates are slightly lower grade does imply a more conservative result and it is the opinion of the author that these results are a reasonable representation of the source data.

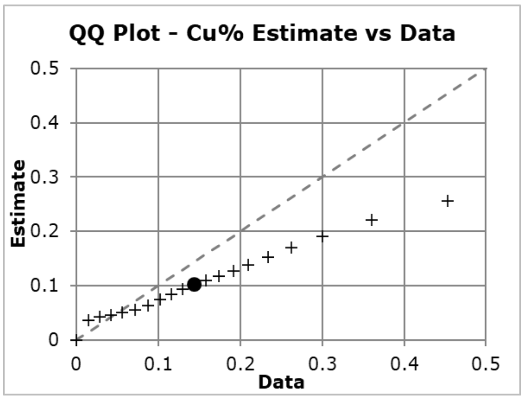


Figure 14-14: QQ Plots comparing the grade distributions of the source composite data and the estimates

14.9.2 Swath Plots

Swath plots involve the aggregation and calculation of average grades of samples and estimates along pre-defined corridors orientated along the X, Y and Z axes of the block model. As they are aggregations, they are used to test whether data trends are reflected in the estimates e.g., Areas with high grade samples are associated with high grade estimate values. The generated swath plots for Cu are shown in Figure 14-15 where it can be clearly seen that the estimate and data trends show good correlation.

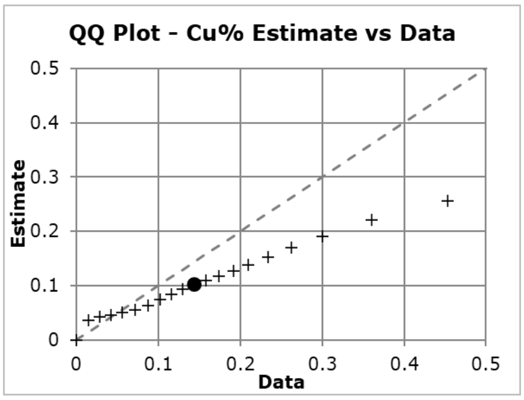


Figure 14-15: Swath plots showing trends in source 10m composites and the estimates of Cu.

14.9.3 Comparison of Estimates and Informed Cells and Methodology

An inverse distance squared estimate (“ID^2”) was prepared for the blocks using the same search criteria used for ordinary kriging (“OK”) and the results were compared to the OK estimate. In addition, the average composite sample grades for all blocks containing composite samples (informed blocks) were compared to the OK and ID^2 estimates using scatter plots, which are shown in Figures 14-16.

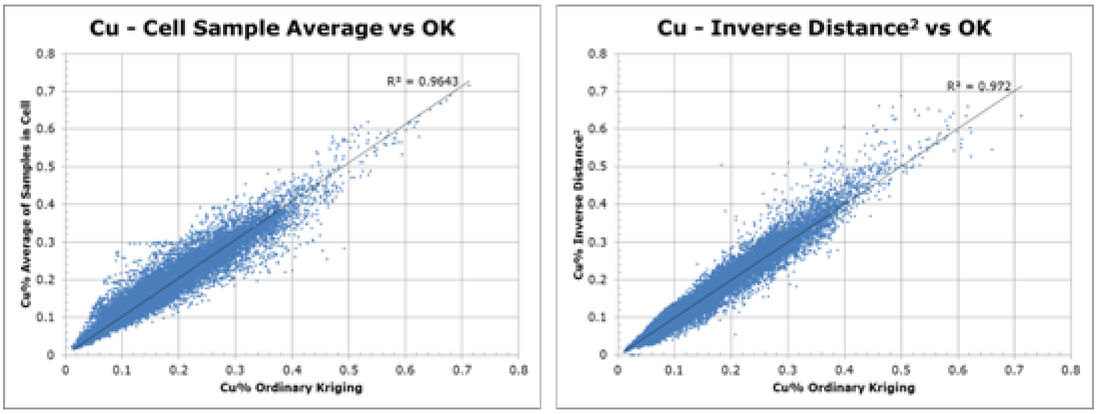


Figure 14-16: Scatterplots comparing Ordinary Kriging estimates to Inverse Distance^2 and Ordinary Kriging estimates to informed cell averages

In Figure 14-16 it can be seen that for Cu there is good correlation between the OK estimates and average grades of informed cells (R^2 = 0.964). The same is true for the OK and ID^2 estimates as reflected in the R^2 of 0.972.

14.10 Mineral Resource Classification

The mineral resource estimates presented here have been classified according to the Definition Standards of the Canadian Institute of Mining, Metallurgy and Petroleum ("CIM") adopted by CIM Council as amended. by co-authors Peter Walker and Dean Richards of Obsidian consulting Services who was an independent QP in January 2018 when the first version of the PEA was presented and filed on SEDAR. as a compliant report entitled "Independent Technical Review and Resource Estimate – The Haib Copper Porphyry Project, Namibia", with a report date of December 22nd 2017. This estimate compares well to all the historical estimates. Peter Walker was co-author of the "Independent Technical Review and Resource Estimate – The Haib Copper Porphyry Project, Namibia" dated December 22nd 2017 and has reviewed the resource estimate and the related data provided in order to ensure that the resource remains current in this report with an effective date of February 1st 2021. Peter Walker is the independent Qualified Person responsible for the resource estimate in this report.

The QP Peter Walker considers that the resource estimate filed on Sedar in January 2018 remains current because there was no drilling or field work between the resource estimation of January 2018 and this updated PEA with an effective date of February 1st 2021. Apart from the metallurgical test work that was carried out in the Mintek laboratories, no new scientific data was acquired on the Haib Copper deposit during this period.

The definitions applied from the code were as follows:

14.10.1 Mineral Resource

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

14.10.2 Inferred Mineral Resource

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

14.10.3 Indicated Mineral Resource

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

14.10.4 Measured Mineral Resource

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve.

The types of data, data density and the distribution for Haib are such that they provide a good basis for the confident interpretation of the geology and mineralization constraints of the Haib deposit. The drillhole spacing and the quantity of data has allowed the grade continuity to be well defined at distances much smaller than the Ranges expressed by the variography. While a significant portion of the data was not subjected to an international standard Quality Assurance and Quality Control programme, the most recent work completed by Teck was significant and as it sampled largely the same domain as the historical work, it provides a means of establishing the quality of the historic data. These show that for the MZ, the two distributions of the historic and the Teck data are practically identical for copper. For the WR, a slight bias is indicated with the Teck grade distribution being slightly lower than the historic data, but it is the QP's opinion that this difference is not material.

Under the considerations above, the following classification has been applied. No Measured Mineral Resources can be declared for Haib at this stage. From topography to an elevation of 75m above mean sea level (amsl), the data density across most of the estimated resource is high being associated with a drill grid approximating 150m x 150m. This spacing is substantially smaller than Ranges obtained for Cu both from linear and directional semi-variograms and thus the portion of the mineral resource supported by this data density to an elevation of 75m amsl is classified as Indicated Mineral Resources.

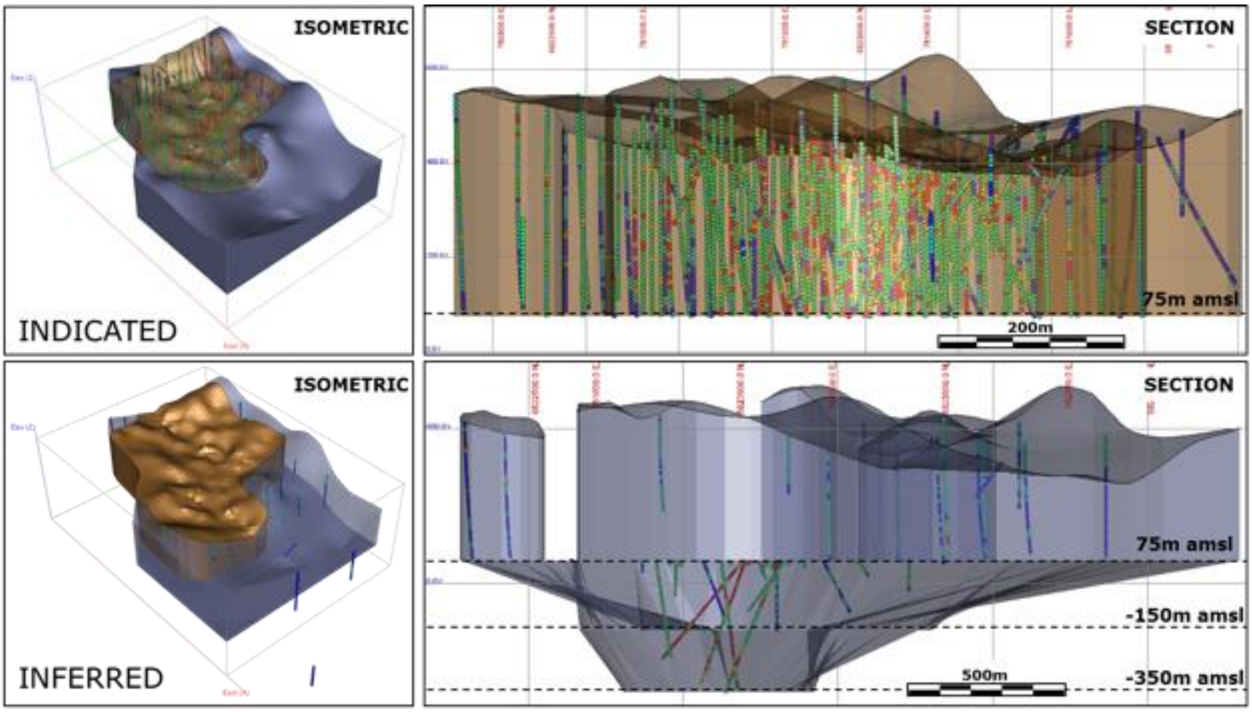


Figure 14-17: Isometric and sectional views showing the distribution of drill hole data and the applied mineral resource classification

On the periphery of the 150m x 150m grid, along the northern and eastern edge of the deposit, the data density increases to a grid approximating 300m x 150m with holes drilled to 75m amsl. This portion has been classified as an Inferred Mineral Resource and extends eastwards to the edge of the estimated volume. This extension is supported by the fact that there is a line of boreholes in this area (Inferred isometric view in Figure 14-18) that are spaced within the maximum variogram Range Cu.

Below 75m amsl, the number of holes drilled deeper decreases rapidly. 11 boreholes are drilled to an elevation of -150m amsl while 6 of these are drilled even deeper to -350m amsl (Figure 14-18). Using an area of influence of 250m approximating the short-Range spherical structure seen in the Cu variogram, areas of influence were created around these data points at -150m amsl and -350m amsl. The resulting volume is classified as Inferred Mineral Resources.

The fact that data density has been used primarily as the basis for the mineral resource classification is clearly illustrated in Figure 14-18 above. As a supplementary exercise, the Slope of Regression and Kriging Efficiency parameters generated for Cu during the ordinary kriging were cross referenced to the mineral resource classification.

This showed that within the Indicated Mineral Resources, the average Slope of Regression is 0.85 (target 1) while the Kriging Efficiencies are positive and average 76% (target +100%). For the Inferred Mineral Resources, the average Slope of Regression is 0.56 (target 1) while the Kriging Efficiencies are positive and average 46% (target +100%). Although not the basis for the Mineral Resource Classification, they do confirm that the classification applied is reasonable. Furthermore, it is the QP's opinion that the Indicated Mineral Resources are suitable for use in a Pre-Feasibility level study.

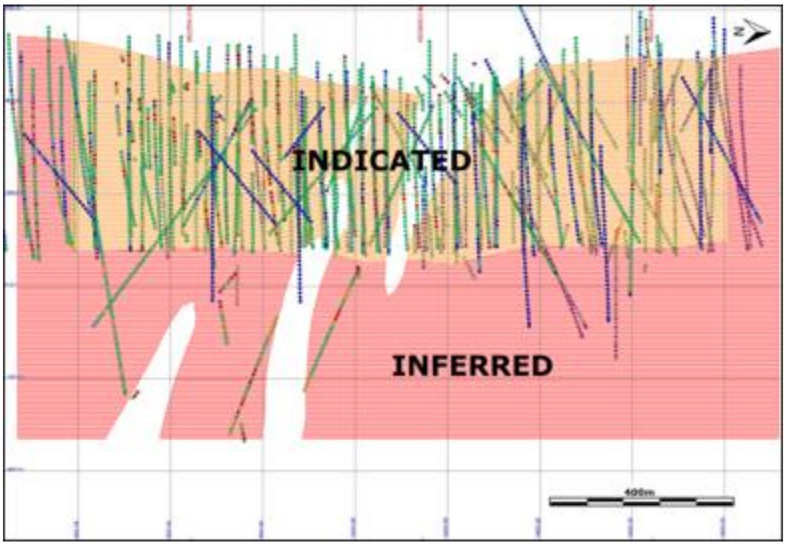


Figure 14-18: Vertical section looking westwards showing the mineral resource classification and sample positions.

14.11 CUT-OFF GRADE SELECTION AND PIT CONSTRAINTS

For the selection of a meaningful cut-off grade to be applied in the mineral resource statement for Haib, a desktop study was completed identifying comparable, analogous Cu porphyry projects. Projects were selected on the basis of:

- Mineralisation style (Cu porphyry),
- Size of mineral resource,
- Average grade of mineral resource,
- Deposits mineable by open pit methods,
- Cu as the main source of revenue,
- Listed company of comparable size to Deep South Resources,
- Project development state (PEA or earlier),
- No operating mines were included.

Table 14-9 provides a summary of the results of the desktop study. In all, seven Cu porphyry projects are presented, all located in South America and at a similar development stage to the Haib Project. %Cu cut-offs applied vary from 0.15% Cu for Cadente Copper Corporations' Canariaco Norte Project up to 0.25% Cu for the Vizcachitas Project (Los Andes Copper Ltd.). Despite different %Cu cut-offs both projects deliver a resource grade of 0.36% Cu. Two projects, Tandayama-America (Solgold) and the JoseMaria Project (JoseMaria Resources) used equivalent Cu grades, the former 0.16% CuEq (including an Au equivalent) and the latter 0.10% Cu Eq (including Au and Ag equivalents

Table 14-9: Summary of applied %Cu cut-off grades used by comparable Cu porphyry projects.

Company	Project	Year	Deposit Type	Cut-off (%)	Element	Reported Mineral Resources					
						Measured		Indicated		Inferred	
						Tonnage (Mt)*	%Cu	Tonnage (Mt)*	%Cu	Tonnage (Mt)*	%Cu
McEwen Mining	Los Azules Project	2023	Cu porphyry	0.20%	Cu	-	-	962	0.48	2,666	0.33
Los Andes Copper Ltd	Vizcachitas Project	2022	Cu porphyry	0.25%	Cu	273	0.43	1,268	0.37	1,823	0.34
Solgold	Alpala Project	2022	Cu porphyry	0.21%	Cu	1,192	0.48	1,470	0.37	544	0.31
	Tandayama-America	2022	Cu porphyry	0.16%	CuEq	18	0.20	511	0.24	105	0.24
Atlas Mining	Carmen & Lutopan Projects	2015	Cu porphyry	0.20%	Cu	732	0.34	84	0.34	48	0.34
JoseMaria Resources	JoseMaria Project	2020	Cu porphyry	0.10%	CuEq	197	0.43	962	0.26	704	0.19
Cadente Copper Corp.	Canariaco Norte Project	2022	Cu porphyry	0.15%	Cu	424	0.43	671	0.36	411	0.32

Based on the results of Table 14-9 a 0.25% Cu cut-off was considered appropriate and reasonable for the definition of the mineral resources at Haib producing an average %Cu resource grade of just over 0.3% Cu. The estimated >= 0.25% Cu cells define a remarkably contiguous envelope of above cut-off grade material that outcrops across the project area lending itself to extraction by open pit mining methods (Figure 14-20).

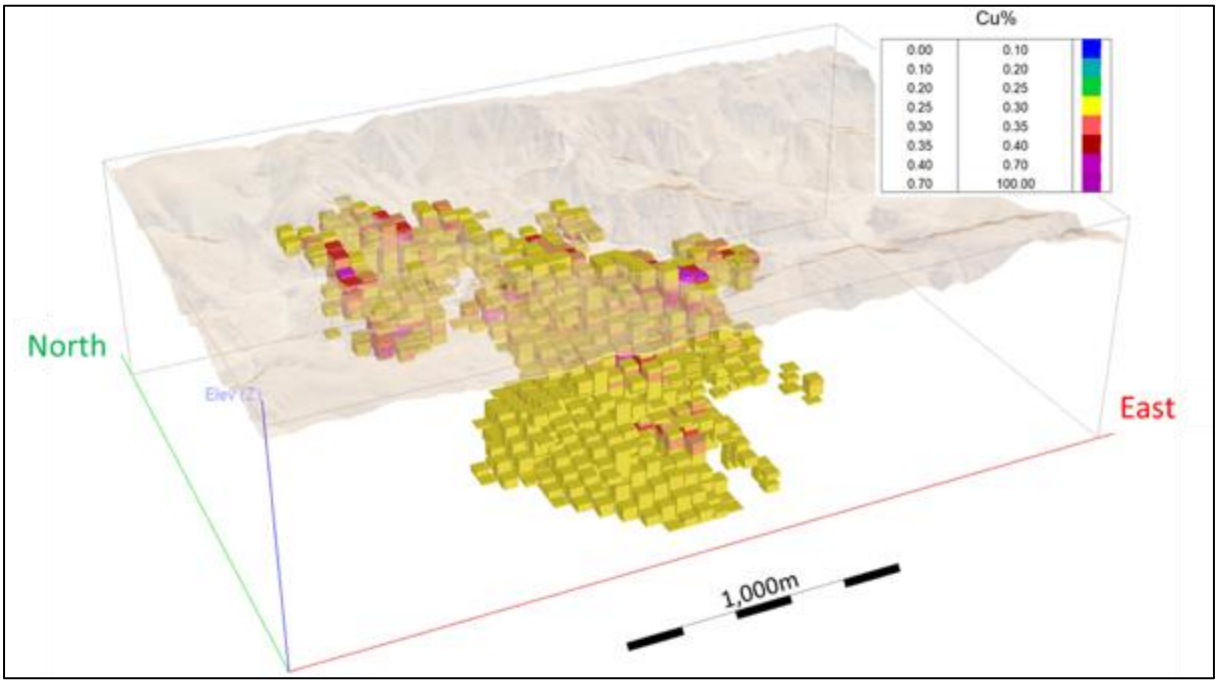


Figure 14-19: Isometric view showing the continuity and extent of estimated block models >= to 0.25% Cu

In the absence of a pit optimisation exercise, a 3D pit constraint was generated as follows and applied to the compilation of the mineral resource statement.

- Section 14.11 above outlines the mineral resource classification and in particular the basal limit of Inferred mineral resources. Here a vertical maximum depth of -350m above mean sea (amsl) had been applied, this being the depth of the deepest holes drilled at Haib.
- Using the 0.25% Cu limit at -350m amsl, a pit shell was extrapolated upwards using an average slope angle of 62°. No allowance was made for ramps or safety berms.
- Where other lobes of >= 0.25% Cu appeared closer to surface, the outline of the cells above the cut-off was extrapolated upwards at 62°, producing a couple of bulges in the pit shell, particularly in the northwest and west.

The resultant pit constraint produced is shown below in Figure 14-20. When compiling the mineral resource statement, only the volumes above 0.25% Cu contained within the pit have been reported.

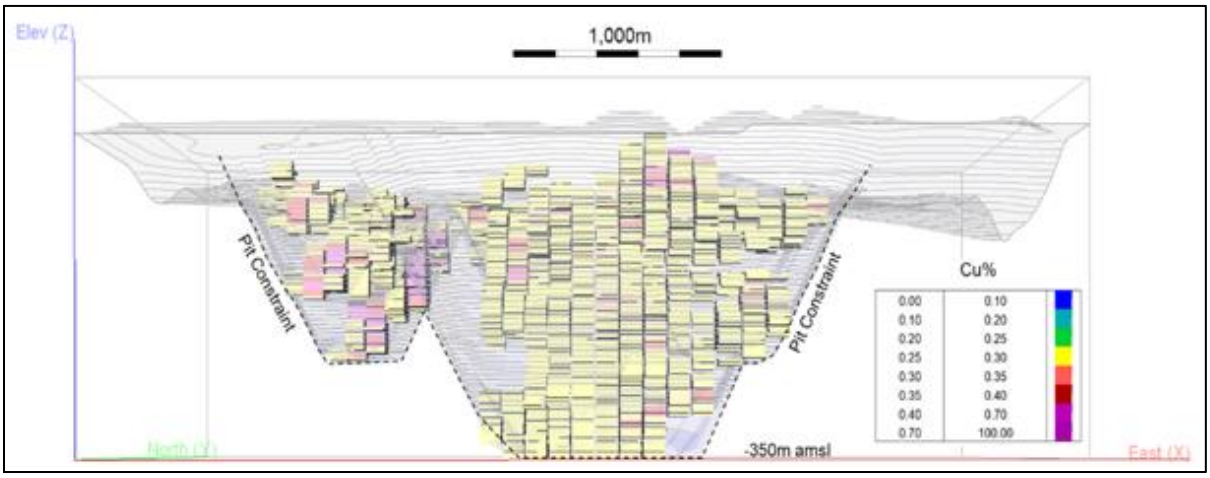


Figure 14-20: View northwards showing the limit of the pit constraint applied to the Haib mineral resources.

14.12 Mineral Resource Statement

CIM Definition Standards for Mineral Resources and Mineral Reserves (adopted by CIM council May 19, 2014) defines a mineral resource as:

"*A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.*"

Subsequent financial modelling (see Section 22.11 below) using a target feed grade of ≥0.3%

Table 14-10: In situ classified mineral resources of the Haib Project at a 0.25% Cu cut-off grade.

Resource Class	Volume (xMillion m^3)	Density	xMillion Tonnes	Cu(%)
Measured	-	-	-	-
Indicated	163.2	2.8	456.9	0.31
M+I	**163.2**	**2.8**	**456.9**	**0.31**
Inferred	122.3	2.8	342.4	0.29
Rounding has been applied as appropriate to reflect limits of precision and accuracy				

Cu confirms that "Based on the findings of the economic analysis, the Haib project has significant potential to be a profitable project." In Section 16.11.1 and 16.11.2 below, the proposed mining of the Haib mineral resources at a 0.25% Cu cut-off shows that at a 20 Mtpa production rate, the average stripping ratio is 1.41 over 20 years.

Please note that: Mineral Resources are not Mineral Reserves and do not have <u>demonstrated</u> economic viability as may be obtained once a pre-feasibility or feasibility studies have been completed and all modifying factors have been taken into account. The estimates do not account fully for mineability, selectivity, mining loss and dilution. These estimates contain inferred Mineral Resources that are considered too speculative geologically in terms of grade continuity between drillholes to have the economic considerations applied to them to be categorized as mineral reserves. There is no certainty that the preliminary economic assessment will be realized.

14.13 QP'S COMMENTS

The Resource Estimates reported here for the Haib mineralization were made in December 2017 by Dean Richards of Obsidian Consultancy and Peter Walker of P&E Walker Consultancy cc. It was again reviewed in detail by Peter Walker, who is the current QP responsible for this section of the amended report. These resource estimates can be viewed as the best estimates available with the currently available data from exploration completed at the Haib up to December 2017. No additional exploration data has been acquired between December 2017 and the effective date of this report, being 1st February 2021. On February 1st 2018 the copper price was quoted as US$3.23 per lb. and on January 1st 2021 it was US$3.56 per lb. which is approximately a 10% increase and it is not sufficiently significant to influence the estimate when using a 0,25% Cu cut-off.

14.14 AREAS OF UNCERTAINTY THAT MAY IMPACT THE ESTIMATES

Areas of uncertainty that may materially impact the Mineral Resource estimates include:

- A change in Cut-off grades due to changes in Cu pricing and other economic factors.
- Drill spacing – The drill spacing and depth of drillholes at the Haib deposit is insufficient to determine the full extent of the mineralization. The drill spacing proves to be too large to accurately represent grade variations at the smaller scales required for short term planning and scheduling of mining operations.
- If the SG's of the deposit display significantly greater variation than indicated by the limited data set of SG determinations, there is a risk that the conversion of Volume to Tonnage may be inaccurate.
- Commodity prices and exchange rates may materially affect project feasibility.
- Assumptions used in the PEA to generate the data for consideration of feasibility of mining the Haib deposit, such as mining costs, both Capital and Operating, extraction and recovery of Cu and Mo, infrastructure development costs, availability of water, electric power and rail transport.
- Unusual weather phenomena, government regulation changes, governmental failure to provide adequate infrastructure may have material effects on the feasibility of the project.

- The project will require additional approvals, permits and licences in order to begin mining operations and these may be delayed or not granted.
- Any revocation, dispute or challenge to HM's mineral title may have a severe effect on project feasibility.
- Labour disruptions and increased labour costs could have a material effect on feasibility of the project.
- Namibia is a democratic, capitalist country. However, there is a political risk factor which could affect the feasibility of the project and the enforceability of HM's rights. The Fraser Institute Survey of Mining Jurisdictions in 2016 reported Namibia's score and their rank deteriorated for the second straight year. In 2014, Namibia was ranked as the 19th most attractive jurisdiction in the world when only policies were considered. The country fell to 29th in 2015 and dropped again to rank 38th in 2016. After this decline, Namibia no longer ranks as the second most attractive jurisdiction in Africa based on policy. In 2016 miners expressed increased concern over uncertainty regarding the administration, interpretation, or enforcement of existing regulations (+28 points), the taxation regime (+21 points), and trade barriers (+19 points). Namibia now ranks 9th out of 18 African mining jurisdictions.

15. MINERAL RESERVE ESTIMATES

In applying the Definition Standards of the CIM as adopted by the CIM Council as of May 19th, 2014 there are no mineral reserve estimates for the Haib deposit.

16. MINING METHODS

16.1 Introduction

The characteristics and geometry of the Haib deposit as well as its proximity to surface mean that the deposit lends itself to extraction by open pit mining methods. The deposit is basically composed of hard rock material and the mining operations will involve drill and blast of all excavated material, which will be designated as either mineralized material or waste on the basis of samples taken from blast hole drilling and application of the cut-off grade.

The mining fleet considered suitable for the Haib project would comprise hydraulic excavators (80 t and 120 t), off highway dump trucks with a capacity of between 65 t to 90 t, supported by standard open pit drilling & blasting along with auxiliary equipment.

16.1 Geotechnical Review

16.1.1 Pit Slope Assessment

A detailed geotechnical study is required for the Haib copper deposit to determine key parameters for the design of a practical and safe pit such as bench height, batter angle, safety berm width and the overall pit slope angle. Parameters established by geotechnical study are fundamental for strategic mine planning and effective technical guidance of the mining operations.

16.1.2 Excavation Characteristics

In terms of the excavation characteristics, even though there is no geotechnical study of the deposit, the current information indicates that drilling and blasting is needed for all excavated material.

16.2 Groundwater Investigation

There is no detailed ground water study of the Haib copper deposit area. The Orange River flows about 15 kilometres south of the main deposit, located in the extreme south of Namibia, where the average annual rainfall is 25-50 mm.

16.3 Proposed Mining Operation

16.3.1 Introduction

Initial analysis involved mining approximately 20 Mtpa of mineralized material for a period of 20 years. In achieving this, some 405 Mt of mineralized material is mined along with some 570 Mt of waste over the 20-year life-of-mine.

16.3.2 Open Pit Work Roster

It is suggested that the mining operations would work 365 days in a year, less unscheduled delays such as high rainfall events which may cause mining operations to be temporarily suspended.

There are numerous types of rosters, but one in which the mine workforce will operate on a 2 shifts a day, 7 days a week is likely. This will involve two 11 hour working shifts with the equipment services scheduled as required.

It is assumed that the crushing plant will operate continuously except for planned maintenance periods.

16.3.3 Bench Design

The height of the mining benches is usually determined according to physical characteristics of the mineralization, its impact on selectivity and dilution control as well as geotechnical parameters.

Both mineralised material and waste could be drilled and blasted on standard 5 m benches for primary crusher feed and possibly 10 m benches for waste, and then mined by hydraulic excavators; nominally ranging from two 3 m high faces to three 4m high faces, taking into account blast induced swell, into rear dump off highway haul trucks. The number of flitches to mine a bench will be dependent on the selectivity required and the size of the excavator used.

16.3.4 Drill and Blast

Rock fragmentation will be undertaken by drilling and blasting, and its parameters will be based on the rock characteristics obtained during the geotechnical investigation, which will provide information of weathered and fresh material.

The blast pattern is dictated by the powder factor required to ensure appropriate fragmentation and heave. The selection of the powder factor will be based on the UCS (Unconfined Compressive Strength) measurement results obtained from the preliminary excavation characterisation work.

16.3.5 Load and Haul

Considering the amount of ROM to be processed in the 20 Mtpa schedule, it is most likely that the mineralized material will be directly tipped into the ROM feed bin using a combination of 220 t and 360 t off-highway dump trucks.

The high-grade mineralized material will be transported by trucks to the run-of-mine (ROM) stockpile, which will be located near the primary crusher. The distance between the pit and the plant will be established considering further topographic studies and the final mine pit design.

16.3.6 Stockpiling and Reclaiming

It is suggested that the material which does not match with the quality standard grade and cannot be directly dumped into the crushing circuit, be placed in an appropriate stockpile for processing at a later time if and when it may become profitable to do so.

16.3.7 Pit Dewatering and Drainage

In the extreme south of Namibia, the summer rainfall is associated with occasional thunderstorms of short duration but potentially of high intensity. Due to this, engineered surface water management structures are suggested to minimize effects of storm water run-on to critical mine facilities and to control the release of mine-impacted water to the environment.

16.4 Contract Mining

It is generally not economic for a mine operator to undertake all the functions required in the development and operation of a mine. Contractors are usually engaged when funds are not available for equipment purchase, the duration of the task is short, specialist skills are required and/or specialised equipment is involved.

Contractors can be effectively utilised to overcome unavoidable peaks in production required to maintain the mining schedule. For example, an open pit which feeds a gyratory cone crusher may have a large volume of pre-strip required which can be effectively moved by scrapers before the commencement of a hard rock mining.

Therefore, it is suggested that contract mining instead of owner mining operation is adopted. The infrastructure necessary to the mining contractor, such as administration facilities and workshop may be contemplated in the contract as contractor's responsibility, which will decrease the project's CAPEX although is also likely to result in higher operating costs.

16.5 Contract Drilling and Blasting

Considering the same arguments from mining contracts and also for security and quality service reasons, it is suggested to adopt drill and blast contract instead of owner operation.

All explosives and accessories must be stored at the planned magazine site and explosive storage facility site. The amount of explosive consumed per week will be defined basing on powder factor (kg/m^3 or kg/tonne) and the amount of material mined (ore + waste). As the Haib deposit is situated in a remote area, it is suggested to have enough explosives stored to operate for a reasonable time.

The explosive storage facility may be contemplated in the contract as contractor's responsibility, which will decrease the project's CAPEX but is likely to result in an increase of operating costs.

16.6 Pit Optimisation

16.6.1 Optimisation Methodology

To do a pit optimisation study requires suitable mining software. For a given resource model, costs, recovery, metal selling price and slope data, the software calculates a series of incremental pit shells in which each shell is an optimum for a slightly higher commodity price factor.

The sequence of the pit shell increments is sorted from the economically best (the inner smallest shell viable for the lowest commodity price) to the economically worst (the outer largest pit shell viable for the highest commodity price).

In pit optimisation, the software provides indicative discounted cashflows for two mining sequences called “best case” and “worst case” scenarios, both using time discounting of cash flows. In the best case, the optimum pit shells are mined bench by bench in increments from inner to the outer shell, resulting in a higher discounted cash flow (DCF) due to lower stripping ratios and/or higher grades in the early years of mine life. The worst-case scenario is based on mining the whole pit outline bench by bench as a single pit, hence resulting in a lower DCF as a result of usually high stripping requirements in the early years of the operation.

Ordinarily, after the selection of the ultimate pit, several practical mining stages are designed and sequenced when developing a final production schedule. This sequence would provide a discounted cash flow somewhere between worst- and best-case scenarios. For this reason, the average discounted cash flows are calculated for each pit shell (mean of the worst and best cases) in order to emulate a practical mining sequence.

The cash flows, as described above, are exclusive of any capital expenditure or Project start-up costs and should be used for pit optimisation comparison purposes only. No project Net Present Value (NPV) can be derived from these cash flows.

16.6.2 Overall Pit Slopes

The overall pit wall slope angle, which is essential for the pit optimisation study, must be based on the geotechnical parameters established by further geotechnical study. In early stages of the project, such as this, in the absence of geotechnical data, slope angles from similar open pits in surrounding area could be used.

16.7 Mine Design

The mine–design will be determined considering economics, engineering, and geological structure aspects, guided by the pit shells produced in a pit optimisation study utilising the mineral resource block model. This is recommended for the next study phase where once the model & geotechnical criteria have been provided, an open pit optimisation will be run to determine the economic pit shell of the resource model and from this, detailed designs will be developed.

16.8 Tailing Disposal

16.8.1 Introduction

There will be no tailings. The spent heaps will be rehabilitated and left in place. Due to environmental reasons and water resources, the tailings from the pH adjustment process and the iron removal process will be disposed onto the spent heaps via the method of filtered dry stacked tailings.

16.8.2 Environmental

In terms of environmental aspects, dry stack facilities offer several advantages to other surface tailings storage options – some of these include:

- Reduced water requirements, principally achieved by recycling process water and near elimination of water losses through seepage and/or evaporation.
- Groundwater contamination through seepage is virtually eliminated.
- Significant safety improvement with the risk of catastrophic dam failure and tailings runoff being eliminated.
- Easier to close and rehabilitate.

16.9 Waste Rock Storage

16.9.1 Introduction

It is suggested considering stockpiling the low-grade mineralized material to process it at the end of mine life in case the copper price increases considerably by the end of the mine life and/or a new mineral processing technology/strategy is created or developed.

16.9.2 Waste Rock Storage Design

The overall rock storage design is dependent on a number of factors, such as:

1. Topography of the dump site.
2. Method of construction.
3. Geo-technical parameters of mine waste.
4. Geo-technical parameters of the foundation materials.

All of these factors combine in various ways during the life of a mine waste dump to aid in the stability of the dump or to contribute to its instability.

16.10 Mining Sequence

A mining sequence has been developed for the Haib deposit for a plant throughput of 20 Mtpa to provide insights of what the resource can deliver through the proposed life of mine. The 20 Mtpa throughput has been chosen to be the base case. The following inputs were used for the development of the proposed mining sequence:

- A life of mine (LOM) of twenty years was used while considering the different grades of the mineralized material that can be delivered for processing and the anticipated stripping ratios.
- An overall slope angle of between 55° to 60° was used to define the pushback limits of mining pits.
- Using the resource block model as a guide:
  - Polygons were digitised to define the mineralized packets
  - Average grades of those packets were calculated
- Mining plan of the mineralized material was centred on 5 areas (Figure 16-1) named:
  - Pit 1 – southeast pit includes the adit area.
  - Pit 2 – central pit.
  - Pit 3 – northwest pit
  - Pit 4 – just south of Pit 3 and a possible westward extension of the Pit 2 higher grade mineralization
  - Pit 5 – a small pit to the northeast of Pit 1

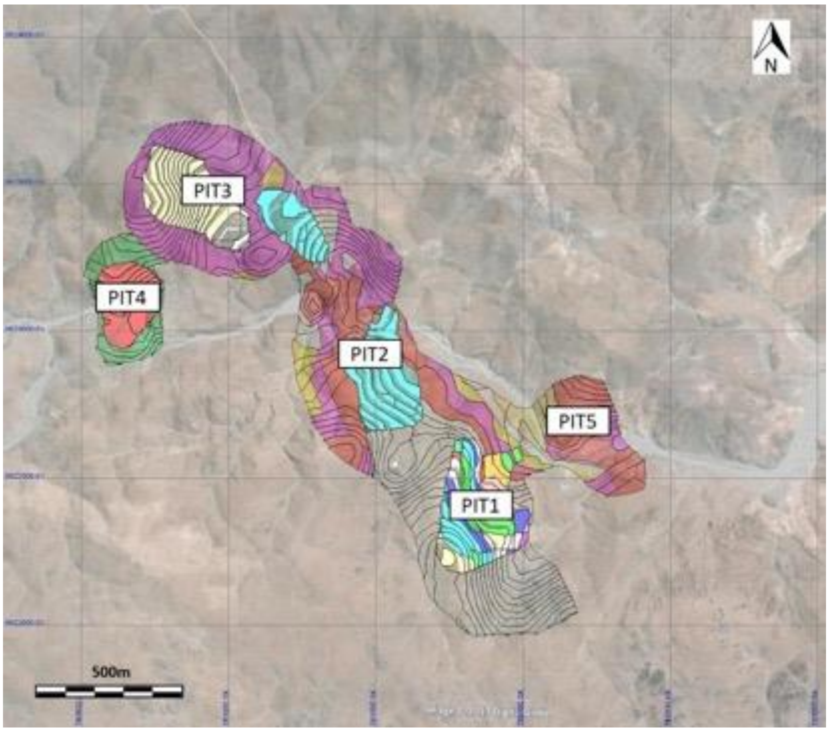


Figure 16-1: Plan showing the polygons used to compile the mining schedule

16.10.1 20 Mtpa Mining Sequence

The 20 Mtpa mining sequence was developed using a relaxed cut-off grade with stretched polygons to include material between 0.25% and 0.30% Cu with the proviso that the resultant grade was still ≥0.3% Cu. While producing a lower Cu grade for the polygon, it does result in a significant reduction of the stripping ratio as less material is being classified as waste.

The mineralized and waste polygons of the mining sequence are shown in Figure 16-3. Initially (Years 1 to 5) the schedule focuses on near surface higher grade material but during this time waste stripping is undertaken in Pit 1 and Pit 5. During Years 4, 5 and 6 mineralized material is taken exclusively from Pit 3 while waste stripping is undertaken in Pits 1 and 2 as well as 3. In Year 7 the remaining exposed mineralization in Pits 3 and 4 is mined while waste stripping continues in Pits 1 and 2. From Year 8 to 17, all mineralized material is taken from the deeper parts of Pit 1 and Pit 2. In Year 18 mineralized material is still mined from Pit 1 while stripping starts again in Pit 3. In Year 19, exposed mineralized material in Pit 1 is finally depleted and production moves to Pit 3 for the remainder of the 20-year period.

The mining sequence is shown in Table 16-1 and 16-2 Over the 20-year period, the average LOM stripping ratio is 1.41. At 80% Cu recovery, 2.19 billion pounds of Cu are recoverable while at 85% this number is 2.33 billion pounds of Cu will be recovered. The lower cut-off grade and lower stripping ratios could improve the project economics.

16.11 QP's COMMENT

It is the opinion of Mark Gallagher QP for section 16 that although the optimal pit, depletion plans and associated schedules contained in section 16 are high level, they have been derived using proven engineering methods and fall within the range of accuracy required for a PEA. These components of the study will be updated with improved information during the next study phase.

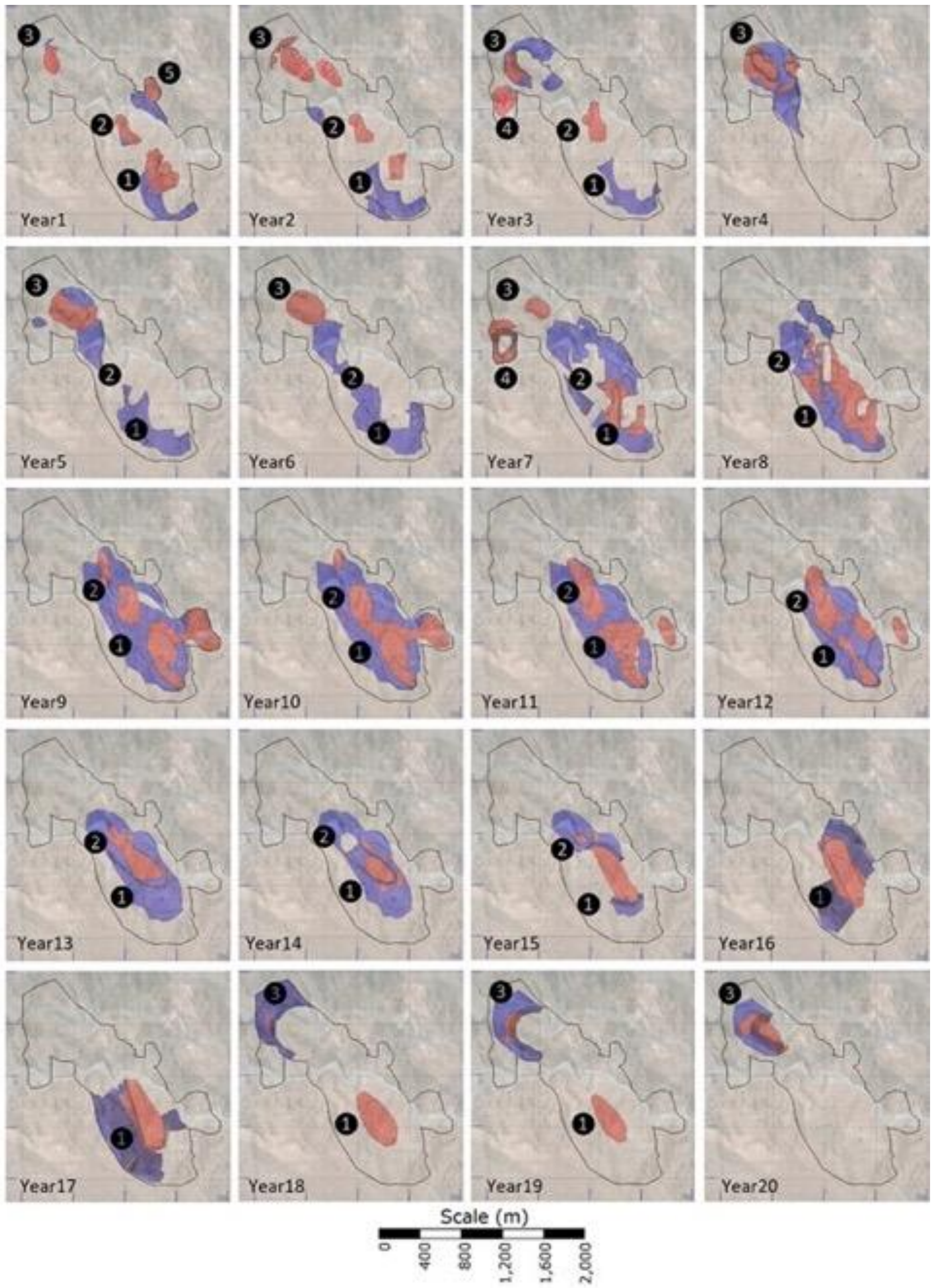
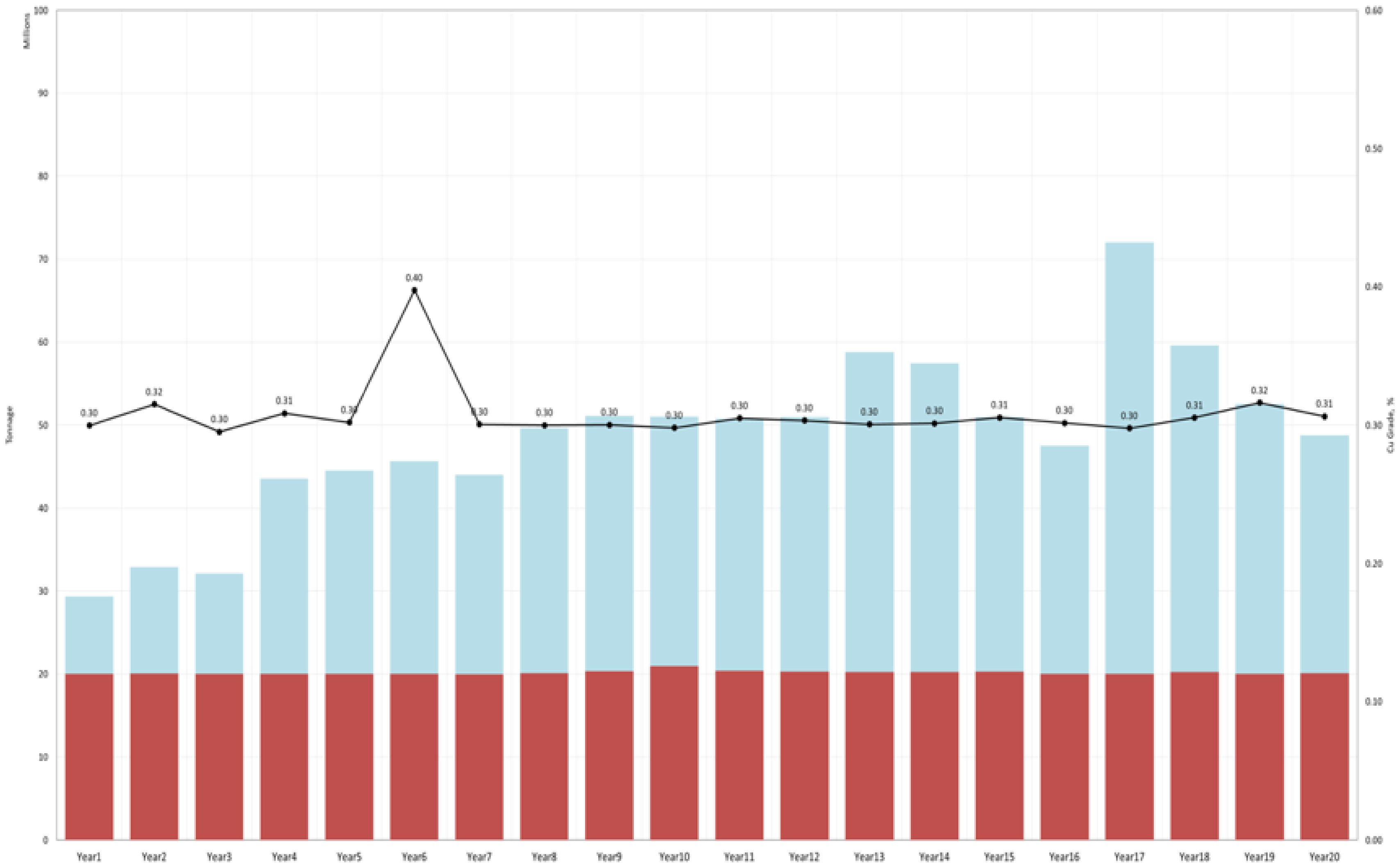


Figure 16-2: Ore (red) and waste (blue) mining by period – 20 Mtpa. For location and orientation see Fig.16-1 above

Table 16-1: Summary incremental schedule for the lower cut-off, waste balancing – 20 Mtpa

	Unit	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10	Year11	Year12	Year13	Year14	Year15	Year16	Year17	Year18	Year19	Year20	Total
Mineralized material Tonnage	T	20,027,002	20,067,071	20,000,177	20,002,593	20,029,691	20,036,384	19,993,087	20,126,543	20,328,544	20,947,037	20,409,485	20,311,583	20,250,309	20,259,953	20,293,441	20,033,713	20,018,519	20,258,081	20,023,378	20,096,557	**403,513,147**
Grade																						
Cu	%	0.30	0.32	0.30	0.31	0.30	0.40	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.31	0.30	0.30	0.31	0.32	0.31	**0.31**
Mo	ppm	39.15	38.31	34.96	37.57	40.34	56.82	37.48	39.37	39.61	39.61	47.39	53.70	56.36	52.29	59.16	60.54	64.11	82.33	77.49	60.33	**50.84**
Pyrite	%	0.47	0.60	0.33	0.53	0.55	0.59	0.45	0.55	0.49	0.45	0.47	0.46	0.85	0.38	0.49	0.53	0.52	0.33	0.49	0.63	**0.51**
Chalcopyrite	%	0.30	0.40	0.23	0.39	0.42	0.65	0.34	0.41	0.38	0.41	0.45	0.42	0.44	0.48	0.48	0.67	0.65	0.66	0.65	0.44	**0.46**
Contained Metal																						
Cu	lb	132,330,203	139,377,758	130,126,377	136,051,057	133,328,748	175,568,017	132,495,821	133,036,873	134,514,647	137,653,645	137,200,959	135,804,945	134,183,305	134,554,333	136,663,217	133,197,345	131,399,811	136,373,918	139,567,666	135,688,468	**2,739,117,113**
Mo (T)	T	784	769	699	752	808	1,139	749	792	805	830	967	1,091	1,141	1,059	1,201	1,213	1,283	1,668	1,552	1,212	**20,514**
Pyrite (T)	T	94,123	120,236	65,425	106,379	109,860	117,963	89,865	109,888	98,660	93,760	95,797	93,912	172,725	77,479	98,478	105,785	103,191	66,619	98,061	127,471	**2,045,679**
80% Cu Recovery	lb	105,864,162	111,502,206	104,101,101	108,840,845	106,662,999	140,454,413	105,996,657	106,429,498	107,611,718	110,122,916	109,760,767	108,643,956	107,346,644	107,643,466	109,330,574	106,557,876	105,119,849	109,099,135	111,654,133	108,550,775	**2,191,293,690**
85% Cu Recovery	lb	112,480,672	118,471,094	110,607,420	115,643,398	113,329,436	149,232,814	112,621,448	113,081,342	114,337,450	117,005,598	116,620,815	115,434,203	114,055,809	114,371,183	116,163,734	113,217,743	111,689,839	115,917,831	118,632,516	115,335,198	**2,328,249,546**
Waste Tonnage	T	9,327,981	12,863,675	12,148,644	23,517,417	24,481,866	25,600,600	24,019,996	29,507,486	30,782,332	30,064,356	30,361,672	30,644,724	38,558,269	37,199,246	30,662,596	27,488,113	51,983,203	39,319,262	32,535,158	28,667,111	**569,733,708**
Grade																						
Cu	%	0.16	0.16	0.16	0.18	0.18	0.18	0.20	0.19	0.20	0.21	0.21	0.21	0.22	0.22	0.20	0.17	0.18	0.13	0.17	0.19	**0.19**
Mo	ppm	29.56	31.68	28.26	31.65	31.96	32.68	34.03	44.97	41.31	36.86	43.82	40.50	46.31	47.70	54.66	33.88	47.82	30.29	32.95	46.52	**39.91**
Pyrite	%	0.27	0.23	0.47	0.56	0.38	0.36	0.43	0.48	0.47	0.47	0.47	0.45	0.47	0.40	0.42	0.29	0.38	0.48	0.52	0.40	**0.43**
Chalcopyrite	%	0.17	0.17	0.20	0.27	0.28	0.31	0.32	0.34	0.35	0.35	0.37	0.39	0.37	0.36	0.38	0.39	0.35	0.22	0.34	0.33	**0.33**
Contained Metal																						
Cu	lb	15,053	20,585	18,988	95,307,520	95,585,076	103,692,386	104,444,130	125,553,672	138,245,899	137,102,763	139,105,532	144,609,348	187,148,761	560,198,422	135,869,167	103,902,308	206,365,722	114,061,225	122,686,341	118,234,430	**2,632,167,326**
Mo	T	276	408	343	744	782	837	817	1,327	1,272	1,108	1,331	1,241	1,786	6,284	1,676	931	2,486	1,191	1,072	1,334	**27,245**
Pyrite	T	25,351	29,122	57,319	132,199	94,178	92,205	104,276	142,272	144,410	140,068	142,323	137,648	183,004	595,551	128,333	79,791	197,621	189,806	167,903	113,291	**2,896,670**
Total Tonnes Mined	T	29,354,983	32,930,747	32,148,821	43,520,010	44,511,557	45,636,983	44,013,083	49,634,030	51,110,876	51,011,393	50,771,158	50,956,306	58,808,578	230,056,927	50,956,037	47,521,826	72,001,721	59,577,343	52,558,536	48,763,668	**1,145,844,583**
Stripping Ratio		0.47	0.64	0.61	1.18	1.22	1.28	1.20	1.47	1.51	1.44	1.49	1.51	1.90	1.84	1.51	1.37	2.60	1.94	1.62	1.43	**1.41**

Haib Cu Project – 20Mtpa Sequence – Annual Mineralized Material and Waste Tonnages with Materialized Mineral Grade



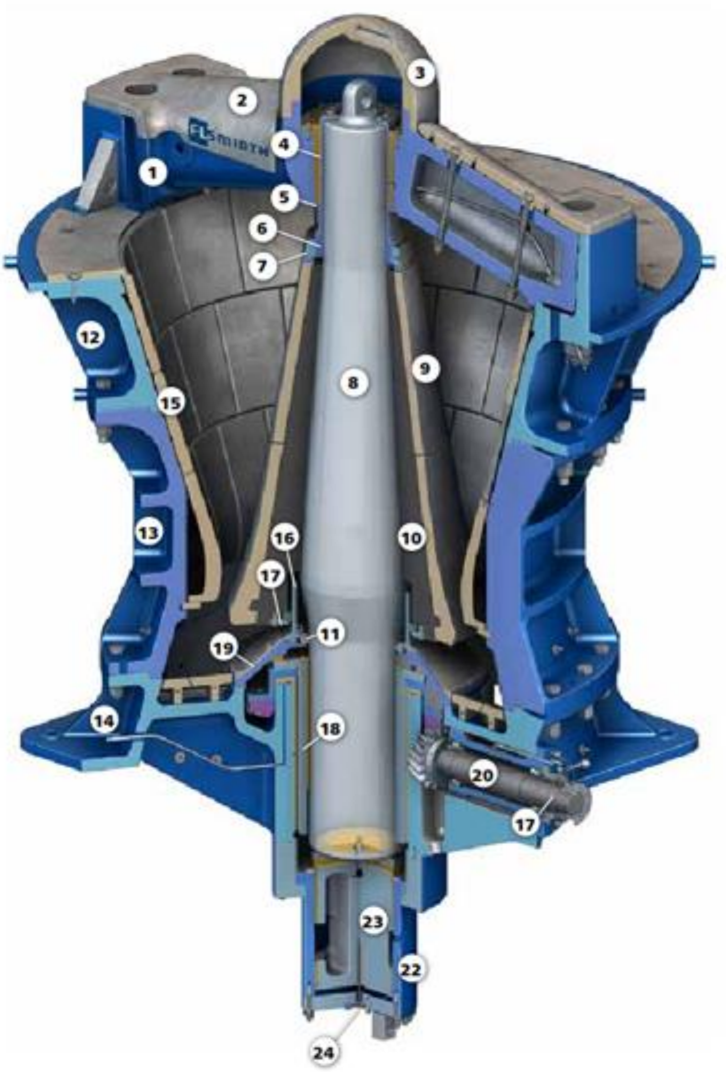
Red: Mineralized Material tonnage – Blue: Waste Tonnage – Black line: Cu

Figure 16-3: Mining sequence – 20 Mtpa

17. RECOVERY METHODS

17.1 Introduction – Heap leaching background information

17.1.1 Primary Crushing



Available TS Crusher Sizes (mm)
900 x 1400
1100 x 1800
1300 x 1800
1400 x 2100
1600 x 2400
1600 x 2900
1600 x 3000

Figure 17-1: Primary crusher schematic

The primary crusher is a gyratory crusher as seen above in Figure 17-1. Primary crushing is the first stage of crushing and the initial size reduction of ore from run of mine ore (ROM) stockpile. The ore is crushed to a suitable size for conveyor transport to a coarse ore stockpile. The mine trucks tip ore directly into the primary crusher. The crusher is in an excavated area usually on three levels and has lubricating oil and dust collection systems incorporated. The feed size is less than 750 mm and they produce a product size passing 200mm for further processing. Copper prices of $2.00/lb, $2.25/lb, $2.50/lb, $2.85/lb, $3.00/lb, $3.25/lb, $3.50/lb, $3.75/lb and $4.00/lb were incorporated in this economic analysis.

17.1.2 Secondary Crushing

The purpose of the secondary crusher is to crush ore from the primary crusher to a size passing 50mm which can be fed to the High Pressure Grinding Rolls (HPGR) circuit.

The secondary cone crusher is similar to a gyratory crusher in that it has a mantle and bowl with replaceable manganese alloy wear liners. It reduces the ore size from 200 mm to a size suitable to feed the HPGR. These are heavy large pieces of equipment mounted on substantial concrete foundations (Figure 17-2).

The cone crusher mantle sits in an eccentric so as the drive pulley rotates the mantle opens and closes around the periphery. The ore feed is passing 200 mm and produces a product passing 50 mm. Product produced is proportional to power drawn. The secondary crusher has nitrogen tramp relief, and the gap is adjusted as the liners wear.

Figure 17-2: Secondary crusher schematic

17.1.3 Coarse Screening

The purpose of the coarse screens is to classify product that meets a certain size and return the oversize back to crushing. Capacity and efficiency are conflicting requirements of vibrating screens. The vibrating screen uses screen media (woven mesh in this case) to effect the separation of undersize and oversize.

The screens consist of side plates and a screen frame the screen mesh sits on. They have an exciter which causes the screen to vibrate and separate ore smaller than the screen size and allow the oversize to pass over the top of the screen (Figure 17-3).

Capacity is defined as: Quantity of material fed to the screen per unit time

Efficiency is defined as: The measure of the effectiveness of the screen to separate different sized material.

$$\text{Screen Efficiency} = U / F * 100\%$$

Where:

U = mass fraction in undersize product i.e. less than the screen size

F = mass fraction of true undersize in feed

The screen cloths wear and are replaceable items on a regular basis.

Figure 17-3: Typical secondary screen

Typically, screens have a life of 8 to 12 years. After this period of time due to cyclic vibration the metal fatigues and cracks appear. At this point in time the main frame and side plates must be replaced. The exciter mechanism can continue to be used.

17.1.4 Tertiary Crushing (HPGR)

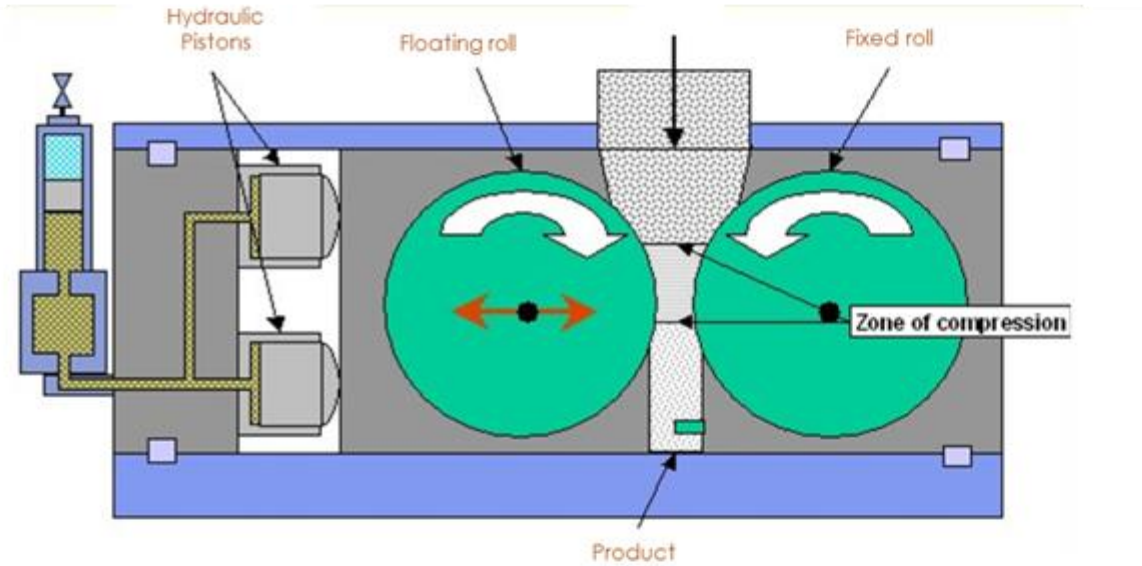


Figure 17-4: Typical HPGR schematic

The tertiary crushing is achieved using HPGR's which are similar to roll crushers but have high pressure hydraulic cylinders keeping the rolls together (Figure 17-4). The rolls have studs, and the tyres are replaced after a period when they become worn. The feed size is 50 mm, and the product size is less than 3 mm. The HPGR is very suitable for very hard high wear rock such as Haib mineralized material.

The purpose of the HPGR is to crush hard ore to a very fine size not possible using conventional crushers. The roll facings wear and must be replaced every say 8,000 hours depending on the abrasiveness of the ore.

17.1.5 Agglomeration

Figure 17-5: Agglomeration drum

Agglomeration is a process where wet ore is added with binder, water and acid in order for the drum to roll the ore and stabilise the clay content in the ore (Figure 17-5, Figure 17-6). It is necessary to agglomerate fine ore particles to achieve satisfactory percolation rates when irrigating the heap.

Figure 17-6: Agglomeration drum

17.1.6 Percolation

Agglomeration improves percolation by binding up the fines component of the ore to be stacked (Figure 17-7). Cement, commonly used as a binder in gold heap leach operations is unsuitable due to the acidic environment and a polymeric binder such as anionic polyacrylamides should be used. Typical polyacrylamide binder consumption rates 100 to 200 g/t are common for acidic heap leach operations. Agglomeration is necessary to maintain percolation rates and avoid the formation of 'dead zones' within the heap where the migration of clays results in uneven leachate flow distribution.

Maintaining high percolation rates and preventing the migration of clays is key to high metal recovery rates. Metal recovery rates can be improved by using leach liquor in the binding process. Reactions commence in the agglomeration drum a long time before the ore would normally be irrigated.

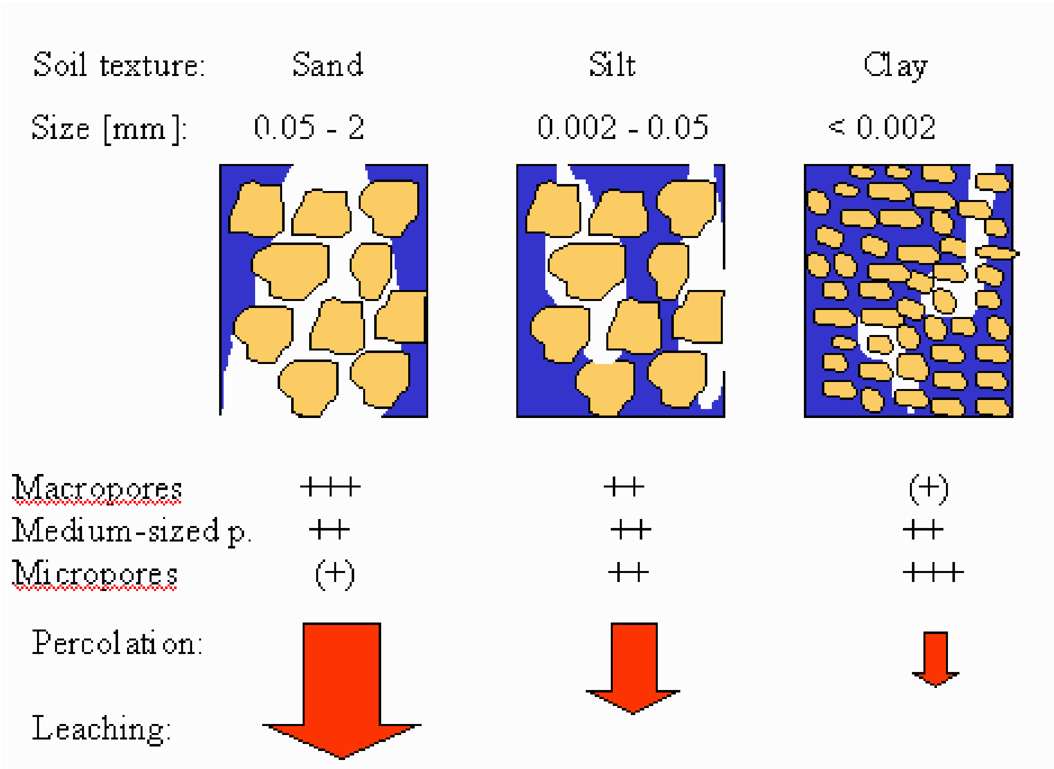


Figure 17-7: Un-agglomerated ore with clay

17.1.7 Stacking

Figure 17-8: Grasshopper conveyors and stacker

Figure 17-8 shows ore being conveyed by grasshopper conveyors onto a stacker which places ore on the heap.

The stackers slew in an arc spreading the ore on the heap and can move back as the heap builds up (Figure 17-9). Grasshopper conveyors are used to adjust the stacker as it retreats from the heap.

Figure 17-9: Grasshopper conveyors and stacker

17.1.8 Bacterial Leaching

The high content of chalcopyrite in primary copper sulfide ores has made it difficult to be leached in acid sulfate media, as mineral surface passivation will result in a lower leaching rate when leaching is conducted at ambient pressures and temperatures. In this case, bioleaching at 50-85°C has been shown to overcome the effects of surface passivation of chalcopyrite, which will lead to a faster leaching rate and higher copper recovery.

Bioleaching of sulfide minerals relies on the use of microbial cultures that catalyse the oxidation reaction of sulfide minerals with oxygen through the generation of iron (III) from the oxidation of iron (II) and direct oxidation of sulfur, where additional heat will be generated, and the leaching rate of minerals can be further enhanced. Heap bioleaching at elevated temperatures is mainly autothermal, relying on heat generated from the microbial oxidation of the sulfide minerals. Although the operating principle of heap bioleaching is relatively simple, the process design of this operation requires a thorough understanding of heap hydrology, chemical and physical properties of the ore, leaching kinetics of sulfide minerals, culture conditions of selected microorganisms, and fluid dynamics and process heat transfer of the process to properly manage the heat loss and operating temperature of the process.

The predominant metal sulfide dissolving microorganisms are acidophiles (microorganisms that thrive under highly acidic conditions, usually at pH 2.0 or below), and they have the capability to oxidise sulfur compounds and iron (II) ions. The most common acidophilic iron/sulfur oxidising bacteria are the mesophilic Acidithiobacillus thiooxidans (A. thiooxidans) and Acidithiobacillus ferooxidans (A. ferooxidans). In most circumstances, the endogenous bacteria (bacteria that naturally resides within a closed system) within the ore are not excluded and those being acclimatised to high level may contribute as an effective bioleaching catalyst. Acclimatisation of bacteria generally refers to the process where continuous exposure of microbial population to a chemical result in a more rapid biodegradation of the chemical than initially observed. Due to the unique characteristics of each ore, the microbial consortium (two or more microbial groups living symbiotically) varies according to the specific type of mineral and its environmental conditions. This is the reason why the microbiological industry continues to invest in a variety of research to find new strains to obtain optimised bacterial bioleaching results.

Bioleaching of chalcopyrite can be represented by the equations below, where the leaching of $CuFeS_2$ follows two stages of dissolution and then further oxidation, with Cu^{2+} ions being left in the solution.

Initial Oxidation by Iron (III):

$$CuFeS_2+4Fe^{3+} \rightarrow Cu^{2+}+5Fe^{2+}+2S$$

Iron oxidation:

$$4Fe^{2+}+O_2+4H^+ \rightarrow 4Fe^{3+}+2H_2O$$

Sulfur oxidation:

$$2S+3O_2+2H_2O \rightarrow 2SO_4^{2-}+4H^+$$

Net reaction:

$$CuFeS_2+4O_2 \rightarrow Cu^{2+}+Fe^{2+}+2SO_4^{2-}$$

17.1.9 Aeration

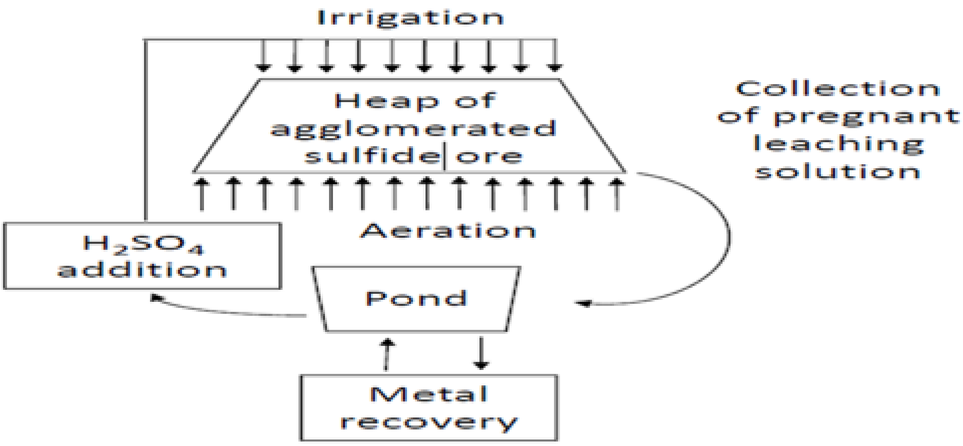


Figure 17-10: Requirement for aeration of heap leaching

For bacterial leaching of sulfides we must have:

- Elevated temperatures → increased kinetics.
- Aeration necessary for sulfides
- Sulfide source for bacteria

17.1.10 Heap Leaching

Advantages:

- Relatively low CAPEX and OPEX compared to milling and tank leaching.
- Quick installation and setup.
- Simple process; requiring low levels of training for routine operations.

Disadvantages:

- Reduced metal recovery compared to milling and tank leaching.
- Cash flow delays at start-up.
- High inventory of valuable metals.
- Leach kinetics – slow to change and difficult to analyse potential problems that may develop.
- High risk – especially for lower-grade ores with little 'margin for error'.
- Management of exhausted heaps and closure.

Heap leaching often offers a viable alternative to milling/leaching. The use of heap leaching as a secondary operation to existing mill sites processing lower-grade ores is sometimes disregarded or overlooked.

Heap leaching is a mineral processing technology whereby large piles of crushed or run-of-mine rock (or occasionally mill tailings) are leached with various chemical solutions that extract valuable minerals. The largest installations in terms of both land area and annual tonnage are associated with gold leaching with cyanide and copper mines, where copper-containing minerals are irrigated with a weak sulfuric acid solution.

This solution dissolves the copper from the mineral and the "pregnant leach solution" (PLS) passes down through the ore pile and is recovered at the bottom on the "leach pad," which usually consists of a geomembrane liner, sometimes clay (either to create a true composite liner or more commonly as a good quality bedding layer for the geomembrane), and a permeable crushed rock drainage system called an "overliner", with a drainage pipe network. In some applications (principally oxide copper ores) thin liners are installed between layers or "lifts" of ore to intercept the PLS earlier. Copper is extracted from the PLS using solvent extraction and the acidic solution is recycled back onto the leach pile (Figure 17-11). Gold heap leaching is similar, except that the solvent is cyanide.

Leach pads can be divided into four categories: conventional or "flat" pads, dump leach pads, valley fills and on/off pads. Conventional leach pads are relatively flat, either graded smooth or terrain contouring on gentle alluvial fans such as in the Chilean Atacama Desert, Nevada and Arizona, and the ore is stacked in relatively thin lifts (5 to 15 m typically). Dump leach systems are similar or can include rolling terrain; the term "dump" usually means that the lifts are much thicker (up to 50 m). Valley fill systems are just that – leach "pads" designed in natural valleys using either a buttress dam at the bottom of the valley, or a levelling fill within the valley.

The success of a heap leach operation, or otherwise, is dependent upon a number of factors, notably:

- The type of ore to be treated
- The extent of testwork completed to define the process
- The interpretation of the testwork results
- Ore preparation prior to stacking
- Agglomeration and curing requirements

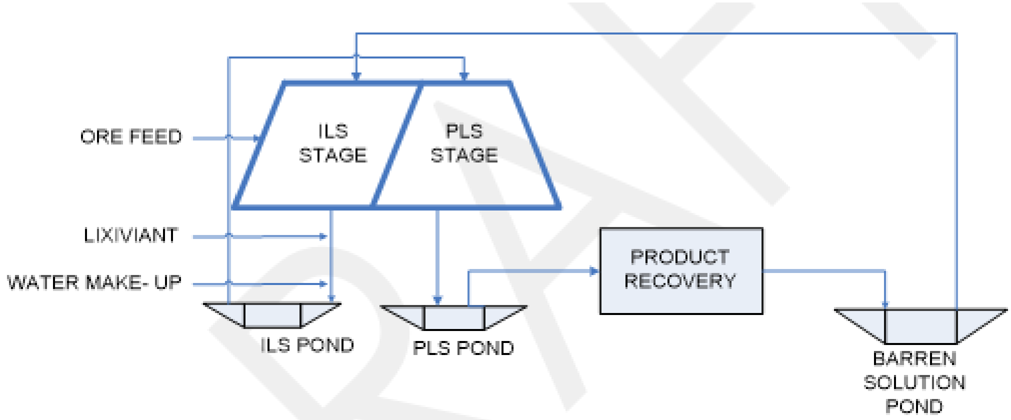


Figure 17-11: Heap leach flowsheet

Typical heap leach arrangements are also shown in Figure 17-12 and Figure 17-13.

Figure 17-12: Ore on pad with solution flowing to toe drain

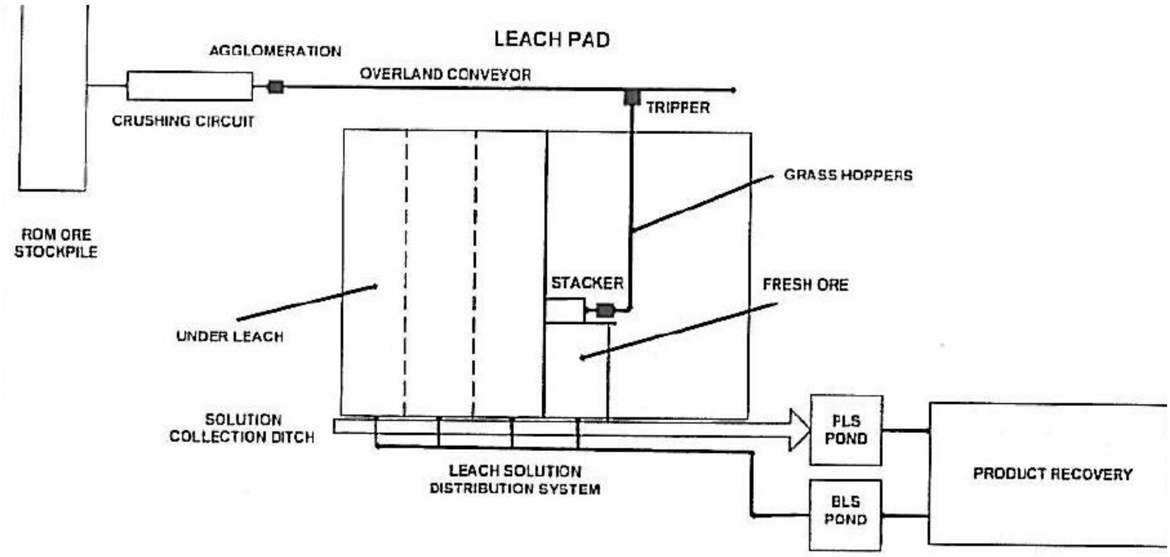


Figure 17-13: Typical leach pad general arrangement

17.1.11 Heap Leach Testwork

Heap leaching is a low OPEX and CAPEX route but a high-risk option. Only 50% of heap leaches can be classed as successful.

Design considerations:

- Size of ore reserve
- Grade of ore
- Crush size sensitivity
- Percolation
- Leach kinetics
- Geological location of ore
- Local weather conditions
- Economics

Factors affecting testwork:

- Ore mineralogy
- Ore grade
- Acid consumption
- Size of deposit
- Commitment of company

Ore characteristics:

- UCS, CWI, SG, bulk density, moisture, Ai.
- Bottle roll tests
- Crush size sensitivity
- Initial column testing
- Water analysis
- Agglomeration
- Percolation
- Leach kinetics
- Soak test - slumping
- Large scale columns

17.1.12 Pond Interconnections

Figure 17-14 indicates the pipe interconnection between the heaps and ponds. The environmental pond is for rain events. The ability to water wash and recycle each heap is important.

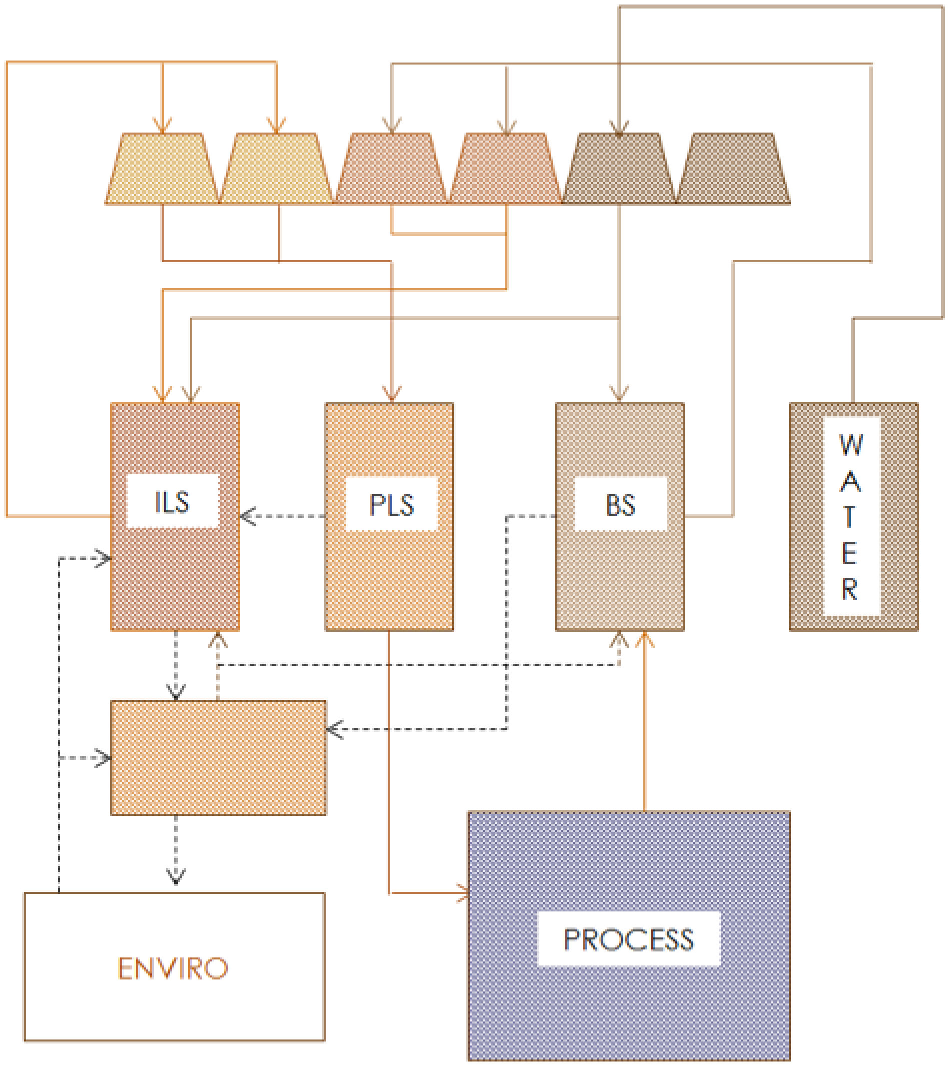


Figure 17-14: Pond Interconnection

- ILS= intermediate liquor solution
- PLS=pregnant liquor solution
- BS= barren liquor solution
- PROCESS= solvent extraction and electrowinning (SX/EW)

17.1.13 Solvent Extraction

Solvent extraction (SX), also called liquid-liquid extraction (LLE) and partitioning, is a method to separate metal compounds based on their relative solubilities in two different immiscible liquids. Immiscible liquids do not mix and separate into layers when shaken together and allowed to settle. Aqueous copper solution is mixed with kerosene containing a copper selective organic (e.g. LIX) and after mixing, the copper is extracted into the organic phase (extraction). A schematic of the process steps is shown in Figure 17-15.

The organic is then stripped in acid to reverse the process to produce a rich pure copper liquor which can be electrowon to produce metallic copper.

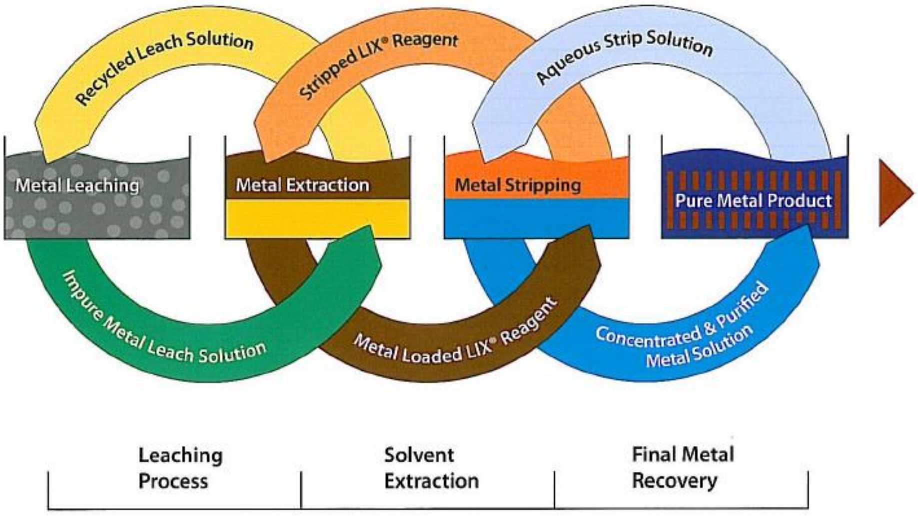


Figure 17-15: Solvent extraction process

17.1.14 Electrowinning

Figure 17-16: Electrowinning process

Electrowinning is an electrolytic technology using two electrodes – an anode and cathode (Figure 17-16). It is basically electroplating on a large scale.

Anodes are rolled lead-alloy sheets, which are virtually inert but still subject to corrosion over long periods of time. Cathode is a copper starter sheet made of copper plating onto titanium or stainless steel.

Electrowinning involves applying an electrical potential to the electrodes in the copper electrolyte then plating pure metallic copper onto the cathodes. The pregnant solution (electrolyte) normally contains 25-60 g/L copper sulfate ($CuSO_4$) and 50-180 g/L sulfuric acid (H_2SO_4). The temperature of the electrowinning process is maintained at 50-60°C and the current density is maintained at about 300 A/m^2. The power consumption rate of a electrowinning cell is typically at 2 kWh/kg of metal cathode produced.

17.1.15 PLC and SCADA Control

Supervisory control and data acquisition (SCADA) is a control system architecture comprising computers, networked data communications and graphical user interfaces for high-level process supervisory management. Plant drives and automatic valves are operated from the control room via the SCADA system. The SCADA system operates the control loops utilised to control specific operating units/processes of the plant. The plant is controlled by Programmable Logic Controllers (PLC's) that are housed in the various motor control centres (MCC's). Each drive, with the exception of spillage pumps, has a run command output from the PLC. The Control Room Operation (CRO), situated in the Central Control Room (CCR), uses the SCADA system to observe and operate the plant.

The distinct plant areas are presented in graphic form on individual screens which displays the status of selected drives and instrumentation in that area. Alarms are generated and displayed in a dedicated portion of the screen for the operator to action.

Drives can be individually started from the SCADA system and all interlocking between drives are carried out in the PLC. The drive interlocks can be disabled from SCADA system and run in "maintenance mode" or manual from the field stop/start station. Once the drive is placed back in automatic mode, the interlocks are re-enabled for sequence start-ups and shutdowns. The operators have to walk through the plant before start-up to make sure that it is safe to start any drive.

17.2 Proposed Recovery Methods

In this updated PEA report, only whole ore heap leaching was considered for the recovery of copper from the Haib deposit. The primary reason for the selection of heap leaching is the low-grade nature of the deposit and the vast scale of the mineralized body.

Previous work conducted on the Haib project suggests that a conventional crush-grind-float and sale of copper concentrate is not economically feasible due to the low grade and hardness of the mineralized material, requiring a significant amount of energy for grinding. The low costs associated with heap leaching compared to a whole ore flotation circuit is believed to improve the viability of the project.

Heap leaching is traditionally performed on oxide material, although there has been increasing development in the application to acid insoluble sulfides. Previous sighter amenability testwork suggests the Haib material can extract high amounts of copper, up to 95.2% via a bacterial assisted leaching. The current testwork programme has also confirmed that bacterial assisted heap leaching can achieve copper recoveries over 90%. Given these results there is no reason to suggest the chalcopyrite in the Haib deposit will not be amenable to bacterial assisted heap leaching.

The flowsheet development was based on the estimate of indicated and inferred resources of 456.9 Mt at 0.31% copper. The throughputs of the project are based on 8.5 Mtpa and 20 Mtpa, which corresponded to a project life of 55 years and 24 years respectively. Each throughput scenario has considered two copper recoveries: 80% copper recovery and 85% copper recovery. The flowsheet and subsequent mass balance, equipment sizing, and capital estimate calculations were performed based on the following case:

Base case: 20 Mtpa with 80% copper recovery with $CuSO_4$

The recovery of the six options is based on limited testwork. There is the possibility to increase the copper recovery and hence improve the project economics. This could be done by further laboratory testwork or during the pilot plant operation at later stage. There are a number of areas where the recovery could be improved, specifically optimising the bacterial column leach conditions.

Due to the unrealistically long project life, it was suggested to start at 8.5 Mtpa and operate at this throughput for approximately 3 years and then execute staged expansions to eventually ramp up to 20 Mtpa, ultimately shortening the project life. As the resource expands and the inferred data progresses towards measured, then additional expansion to possibly 40+ Mtpa should be assessed.

17.3 Mineralized material Transport

The Haib copper deposit it situated in highly undulating terrain. Heap leaching using a valley heap method would be suitable considering the topography, although the cost associated with earthworks to provide a flat surface for the process plant and the cost associated with transportation of raw material in, and products out, warrant the placement of the process plant on flatter grounds. A long-distance conveyor (4.5-5 km) has been proposed, which would transport crushed ore from the mine site to the process plant for subsequent grinding.

17.4 Process Description

17.4.1 Crushing and Ore Handling - 8.5 Mtpa

Run of Mine (ROM) mineralized material is transported by truck from the mine to the ROM stockpile area near the crushing plant. The material is transferred to a ROM bin, which feeds to a primary crusher. The primary crusher is a gyratory crusher suited to higher crushing capacities. The closed side setting (CSS) of the gyratory crusher is expected to be set at 160 mm with an assumed P_{80} of 137 mm to be produced. The output of the gyratory crusher is discharged into a surge vault where it will be directed to a primary crusher discharge conveyor via an apron feeder. The gyratory crusher product is then transferred to a diverter chute which will distribute the material into two streams that feed two cone crushers feed bins in parallel.

The cone crusher feed bins discharge will be withdrawn using cone crusher vibrating feeders (100-FE-02/03) into the cone crushers. The cone crushers have a CSS of 32 mm, with an expected product P80 of 40 mm. The cone crusher product will be fed to a screen in which the oversize is directed to the primary crusher discharge conveyor and recycled to cone crusher feed bins whilst the undersize is conveyed to a crushed ore stockpile via a screen undersize discharge conveyor.

The crushed ore stockpile is reclaimed and conveyed to a HPGR feed stockpile locating at the processing plant by a long-distance conveyor.

The HPGR feed stockpile ore is reclaimed via apron feeders and stockpile discharge conveyors. The ore is then transferred via the HPGR feed conveyor and is discharged onto a diverter chute to feed the grinding circuit. The tertiary crushing circuit consists of two high pressure grinding rolls (HGPR) in parallel. The diverter chute will distribute the ore into two HPGR feed bins. The HPGRs will then be fed via vibrating feeders via a conveyor belt with a metal detection system to protect the roll surface from tramp metal damage.

The HPGR target crush size is 5 mm. The product is in closed circuit with two double deck banana screens and produces two size fractions. The oversize material is recycled back to the HPGR feed conveyors and the undersize fraction stream reports to agglomeration through the screen undersize discharge conveyor.

HPGR introduces micro-cracking that improves leach kinetics, allowing for maximum metal extraction during the heap leach process.

17.4.2 Crushing and Ore Handling - 20 Mtpa

Run of Mine (ROM) ore is transported by truck from the mine and is discharged into a ROM bin, which feeds to a primary crusher. The primary crusher is a gyratory crusher suited to higher crushing capacities. The closed side setting (CSS) of the gyratory crusher is expected to be set at 177 mm with an assumed P_{80} of 150 mm to be produced. The output of the gyratory crusher is discharged into a surge vault where it will be directed to a primary crusher discharge conveyor via an apron feeder. The gyratory crusher product is then transferred to a tripper feed conveyor which will distribute the material into five secondary crusher feed bins in parallel.

The cone crusher feed bins discharge will be withdrawn using the cone crusher vibrating feeders feeding into the cone crushers. The cone crushers have a CSS of 25 mm, with an expected product P_{80} of 31 mm. The cone crusher product will be fed to three screens in which the oversize is directed to the primary crusher discharge conveyor and recycled to cone crusher feed bins whilst the undersize is conveyed to a crushed ore stockpile via a screen undersize discharge conveyor.

The crushed ore stockpile is conveyed to a HPGR feed stockpile locating at the processing plant by a long-distance conveyor.

The HPGR feed stockpile ore is reclaimed via apron feeders and stockpile discharge conveyors. The ore is then transferred via the HPGR feed conveyor and is discharged onto a diverter chute to feed the grinding circuit. The grinding circuit is consisted of two HGPRs in parallel. The diverter chute will distribute the ore into two HPGR feed bins. The HPGRs will then be fed via vibrating feeders.

The HPGR target crush size is 5 mm. The product is in closed circuit with four double deck banana screens and produces two size fractions. The oversize material is recycled back to the HPGR feed conveyors and the undersize fraction stream reports to agglomeration through the screen undersize discharge conveyor.

HPGR introduces micro-cracking that improves leach kinetics, allowing for maximum metal extraction during the heap leach process.

17.4.3 Agglomeration Drum

Agglomeration improves the permeability of the heap and facilitates even acid flow without pooling and increasing the amount of oxygen available for reaction. Additionally, pre-wetting will reduce the losses of fines from the wind and increase the leaching kinetics of the ore. Heap leaching requires good percolation throughout the heap to ensure maximum metal recovery is realised. Clays and fine particles can hinder solution flow through the heap, and the ore is often agglomerated to overcome this issue. It is considered essential to undergo agglomeration prior to heap leaching to ensure good metal recovery.

The undersize particles from the HPGR are combined with binder, sulfuric acid and water to agglomerate the ore into clumps. The binder is added to the agglomeration drum in solution form.

17.4.4 Heap Leach

The ore will be stacked by grasshopper conveyors and inclined conveyor stackers, producing a heap pile. This is a preferred stacking method due to conveyor stacking being able to reduce ore segregation which allows for increased permeability. Due to the use of sulfuric acid the conveyor edges must be moulded, open edge belts will severely corrode. Additionally, it is preferable to splice the conveyor belt instead of using clips as it reduces spillage and belt stress.

Drippers are used primarily in arid environments due to the substantially reduced evaporation in comparison to heap sprays. The drip lines are buried 10 cm to 50 cm beneath the surface of the heap to minimise evaporation. The irrigation rate will be approximately 10 $L/h/m^2$. The primary heap pad will be irrigated with solution from the intermediate leach solution (ILS) pond. The secondary and the wash heap pad will be irrigated with solution from the barren pond.

The pad will require a double liner (HDPE) to minimise any possible loss of liquid from liner punctures. Due to the high evaporation rate in the area and close proximity of a river, a compacted impermeable clay layer in conjunction with necessary leakage detection systems will be used to minimise risk of the heap solution entering the environment.

Pipe heat exchangers utilising solar energy are used to ensure that the irrigation solutions are maintained at the desired temperature. A forced aeration system is also used in the heap design to ensure that sufficient oxygen/air is supplied to the heap for bacterial activities.

17.4.4.1 Primary Heap

The primary heap will consist of fresh ore from the agglomeration drum that is stacked using conveyors and irrigated from the intermediate leaching solution (ILS) pond. The ILS Pond will contain a low concentration leached solution from the secondary pad. The primary heap is leached for 120 days and the pregnant leach solution (PLS) from the primary heap is collected in the pregnant solution pond. The leached ore then becomes the secondary heap by re-routing the flow of the particular piping.

17.4.4.2 Secondary Heap

The secondary heap will be irrigated from the barren solution pond. The barren pond solution contains leftover metal sulfates from the solvent extraction raffinate. The ILS from the secondary heap is collected in the ILS pond after the ore is spent. The spent ore becomes the washing heap by re-routing the flow of particular piping.

17.4.4.3 Washing Heap

The washing heap will be irrigated with solution from the barren pond. This ore is washed with solution through drip irrigation periodically (can be conducted over several years). The solution from the heap is collected in the barren pond and used for leaching of the secondary heap.

17.4.5 PLS Clarification

Several operations have installed pinned-bed filters on the PLS streams and have been effective. There are examples where the total suspended solids are consistently reduced to <20 mg/L. This is effective, as the uncontrolled separation of solids from the process liquor is usually a significant contributor to crud formation.

17.4.6 Crud Treatment

Crud formation at the interface of the aqueous and organic phases is a common issue for solvent extraction which will lead to loss of organic and lower metal extraction efficiency. Crud treatment using clay and diatomaceous earth has been included in the process to optimise organic recovery and quality. The recovered organic is recycled back to the solvent extraction process and the spent clay is transferred to a storage drum which will be sent to disposal.

17.4.7 Copper Solvent Extraction/Electrowinning

The copper solvent extraction (SX) circuit will consist of two extraction cells and two stripping cells. Two extraction cells are used due to the high concentration of copper in the solution to extract as much copper into the organic phase as possible.

Solvent extraction works by combining an organic extractant with an aqueous acid leaching solution at a favourable pH to transfer metal ions of interest into the organic phase. The copper depleted aqueous phase, referred to as the raffinate, is sent back to the leach circuit. The extraction of copper from dilute sulfuric acid is pH dependent with most copper SX being performed at a pH of 2. Due to the similarities in acid dissociation constants, the iron in solution will have to be monitored and subsequently removed to improve the copper grade in the end product.

17.4.7.1 Extraction

In the extraction stages the PLS solution is mixed with an organic diluent (usually a kerosene type organic solvent) containing an organic compound called an “extractant”. The extractant releases its protons and coordinates with copper, transferring the copper from the aqueous phase to the organic phase as an extractant complex. The protons released increase the acid level.

$$Cu^{2+}(aq) + 2RH(org) \rightarrow R_2Cu(org) + 2H^{+}(aq)$$

Where,

$Cu^{2+}(aq)$ - is copper ions in solution

$RH(org)$ - is the extractant, i.e. fresh or recycled stripped organic

$R_2Cu(org)$ - is the copper/extractant, i.e. loaded organic

$2H^{+}(aq)$ - is acid in the raffinate solution

17.4.7.2 Stripping

Stripping is accomplished by contacting the copper containing (loaded) organic with relatively strong sulfuric acid. In most cases, an excess acid concentration of approximately 150 g/L H_2SO_4 is required to maintain adequate stripping. Spent electrolyte from electrowinning (containing copper) may be used as the stripping agent, and the copper content can be increased to any desired level up to about 100 g/L Cu for use as a strong electrolyte. Stripping of copper occurs only when strongly acidic solution is mixed with the organic copper complex. The complex releases its copper and takes on acid, according to the following reaction.

$$R_2Cu(org) + 2H^{+}(aq) \rightarrow Cu^{2+}(aq) + 2RH(org)$$

17.4.7.3 Product

The stripped copper sulfate solution will be converted to copper metal via electrowinning. The copper electrolysis process involves electroplating of copper from copper sulfate onto a cathode. This is carried out by passing a current from an inert anode through the solution which causes the copper to plate out on the cathode. The spent solution from copper electrowinning is sent to the stripping liquor tank and then to the strip liquor makeup tank. The cathodes loaded with metallic copper will then be washed in a cathode washing tank. The washed cathodes are sent to a flexing station and a stripping station to release the metallic copper from the cathodes while the washing water will be directed to the barren pond. The metallic copper is transferred to a strapping station and a weighing station where it will be palletised and weighed prior to transport.

The copper sulfate solution can alternately be sent to an evaporative crystalliser where the water is drawn off to leave behind a saturated copper sulfate solution with copper sulfate crystallising as a pentahydrate ($CuSO_4.5H_2O$). This is continuously done and refluxed to obtain a high level of saturation which is sent to a centrifuge to collect the copper sulfate solids product. The solution is recycled back into the strong electrolyte tank for recycle and subsequent recovery of the contained copper. The solid product is sent to a flash dryer where water is evaporated, and the product is then collected into the product bin. The dried copper sulfate pentahydrate will then be bagged into 1 tonne bulka bags on pallets.

17.4.8 Iron and Aluminium Precipitation

Iron and aluminium in the ore is approximately 1.8% and 7% respectively which will build up as the process continues. The iron and aluminium build up in the solution needs to be treated before recycling the SX raffinate for heap leaching. The process involves pumping the bleed stream of the solution from the copper raffinate return line into the iron precipitation tank where limestone and lime is added to adjust the pH. Iron will be present primarily as iron sulfate ($FeSO_4$) which when reacted with lime will produce iron hydroxide ($Fe(OH)_2$). Additionally, aluminium will also be present as a sulfate ($Al_2(SO_4)_3$) and will produce an oxide when precipitated. At an elevated pH (5.8-6.0) the hydroxide will precipitate out of solution as a red insoluble oxide. This will be transferred to the iron tailings thickener where the oxide is collected, filtered, and disposed of by dry stacking. The thickener overflow will be sent to the raffinate recycle tank and then will be pumped into the barren solution pond where it can be recycled to the heap leach pad.

17.4.9 Water Distribution

Water distribution covers the raw water dams and process water tanks. These will supply general plant water as well as a feed for potable water, fire water, gland seal water, reagents makeup, dust suppression as well as cooling and heating water.

17.4.10 Reagents

Reagents are mixed in an open area in covered tanks to prevent rain from damaging or reacting with the dry chemicals. The design incorporates accepted methods for mixing, holding, solution distribution and ventilation for each chemical according to their individual SDS and common industry practice. Reagents are kept in a warehouse until they are required. Containment bunds and sump pumps are required for individual reagent handling areas. The sump pumps feed any spilled reagents into the respective tank depending on reagent area. The reagents area will provide storage and distribution for quicklime, limestone/calcrete, sulfuric acid, solvent extraction reagents, electrowinning reagents, crud treatment clays, flocculant, and binder.

17.4.11 Services

A services area will include air distribution (both instrumentation and process air), potable water production using a reverse osmosis package and heavy fuel oil distribution.

A detailed process description outlining each area for whole ore heap leaching and all related equipment is available from METS on request.

18. PROJECT INFRASTRUCTURE

18.1 Mine Area Power Requirements

The current Project site power requirement estimates are shown in Table 18-1:

Table 18-1: Power requirement for each scenario

Plant Option	kWh/t	Installed Power (kW)	Power Draw (kW)
Base case	11.04	33,227	28,788

18.2 Mine Area Buildings

The pit mine site itself is located in a very rugged and steep area. Therefore, the cost of construction of the processing plant and heap leach pad nearby to the pit mine might be high. However, the mine area buildings required will depend on the processing option chosen.

The crushing plant will be constructed near to the pit mine site. ROM will be transported from the mine to the ROM stockpile area near the crushing plant. The material from the stockpile will feed the crushing plant. The crushed ore is transferred to the processing plant.

The processing area consists of the agglomeration plant, heap leach area, pond area, recovery plant, workshop and offices as shown in Figure 18-1. It will be located in a flat area, approximately 4.5 km northwest of the mine. Thus, a 4.5 km conveyor will be necessary to transfer the material to the processing area. It is foreseen that this will be a pipe conveyor to minimise dust losses.

The heap leach area will accommodate the primary, secondary, and washing heaps. The design of the heap leach pad is determined by various factors such as slope stability, seismic stability, amount of space available and climate. In the pond area are the pregnant leaching solution pond (PLS), the intermediate leaching solution pond (ILS), barren leaching solution pond (BLS) and the process water pond. The metal recovery plant consists of the solvent extraction, electrowinning, and crystallisation facilities.

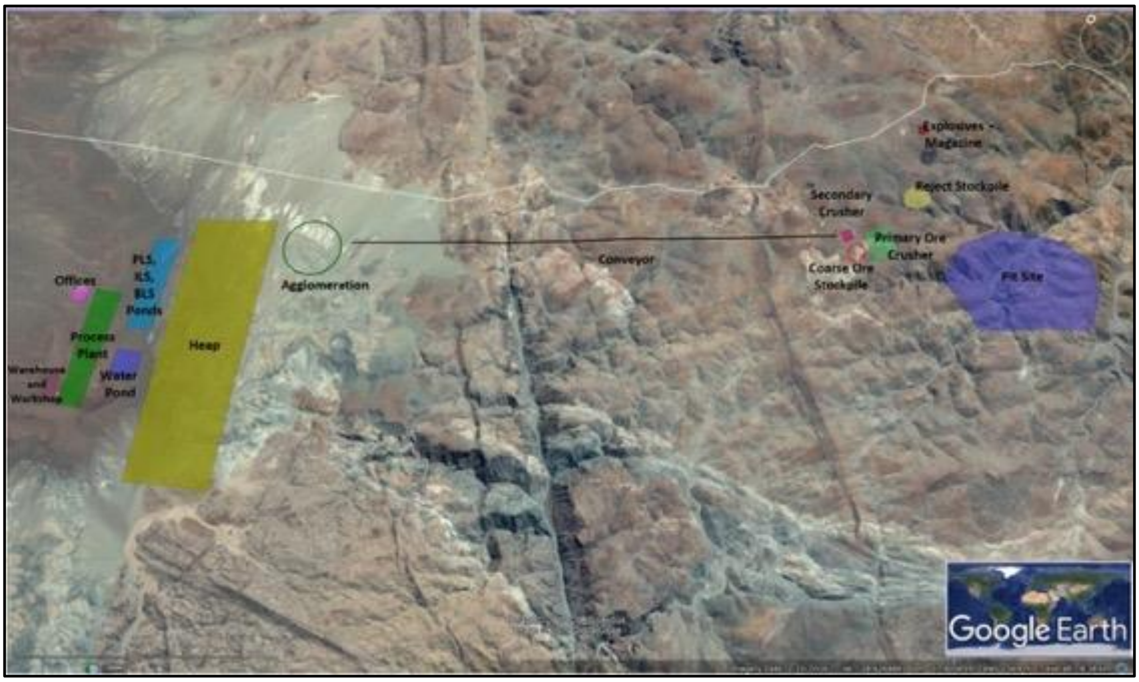


Figure 18-1: Mine site layout

18.3 Explosives Storage

In Namibia, criteria apply to the possession and storage of explosives to ensure storing explosives without creating an unacceptable risk to the community and to the employees. Thus, a licence is required to possess and store explosives as prescribed by the Explosives Act 1956 and Regulations (GNR 1604 of 8 September 1972). Application for a licence shall be made to the chief inspector of explosives, who may issue such a licence subject to the observance of the regulations and after consultation with the local authority.

Design and location of a magazine for the storage of explosives will depend on the explosive category, quantity, and distance to buildings such as railways, roads, dwelling-houses navigable water.

Table 18-2 specifies distances that shall form the basis on which applications for magazine for storage of explosives licences must follow.

Table 18-2: Distance requirements (all in metres) to build a magazine for storage of explosives

Net explosives	25- kilogram cartons	To other magazines			To railways, roads, open sports- ground, navigable water, or dwelling-house in same ownership as magazine and occupied by the owner or an employee			To other dwelling-houses or public buildings*		
Quantity kilograms	Number	Cat. X Mounded or un-mounded	Cat. Y mounded or un-mounded	Cat. Z or ZZ mounded	Cat. X mounded or un-mounded	Cat. Y mounded or un-mounded	Cat. Z or ZZ mounded	Cat. X mounded or un-mounded	Cat. Y mounded or un-mounded	Cat. Z or ZZ mounded
500	20	9	12	19	15	25	47	31	50	95
750	30	9	13	22	17	29	61	33	57	122
1 000	40	9	14	24	18	32	75	36	63	150
1 250	50	10	15	26	18	34	85	37	68	170
2 500	100	13	18	32	21	43	130	42	86	260
5 000	200	17	21	40	23	54	180	46	108	360
10 000	400	21	28	50	25	68	235	50	136	470
12 500	500	23	30	55	26	73	255	52	146	510
15000	600	24	33	58	27	78	270	54	156	540
20 000	800	25	37	65	28	85	300	55	170	600
25 000	1 000	26	40	70	29	90	320	57	180	640
30 000	1 200	27	45	75	30	100	345	60	200	690
40 000	1 600	27	50	80	30	110	380	60	220	760
50 000	2 000	27	55	85	30	115	400	60	230	800
75 000	3 000	27	65	100	32	135	470	65	270	940
100 000	4 000	27	75	110	33	145	510	65	290	1 020
150 000	6 000	27	90	125	35	170	590	70	340	1 180
200 000	8 000	27	95	135	35	180	640	70	360	1 280

Category X: Explosives having fire or slight explosion risk or both, with only local effect. Category Y: Explosives having mass fire risk, or moderate explosion risk, but not mass explosion risk. Category Z: Explosives having mass explosion risk with serious missile effect. Category ZZ: Explosives having mass explosion risk minor missile effect. Source: GNR 1604 of 8 September 1972, Namibia.

The Haib deposit has suitable areas to build a magazine since the surrounding area is unoccupied and the nearest settlement is 12 km away from the Haib deposit.

18.4 Waste Dumps

Suitable and sufficient areas for recovery plant, waste dumps and heap leach pads are available within the EPL area, but the chosen sites will be dependent on the eventual mine and plant design. The area of the property and surrounding remainder of the farm is state land

and currently only used for emergency stock grazing purposes under lease from the State so mining will not conflict with any formal farming activities.

18.5 Power Transmission Line

The main north-south national power grid lines are some 85 km to the east of the Haib project area (Figure 18-2). Thus, an 85 km link and upgrade of the line capacity would likely be required should the project be developed.

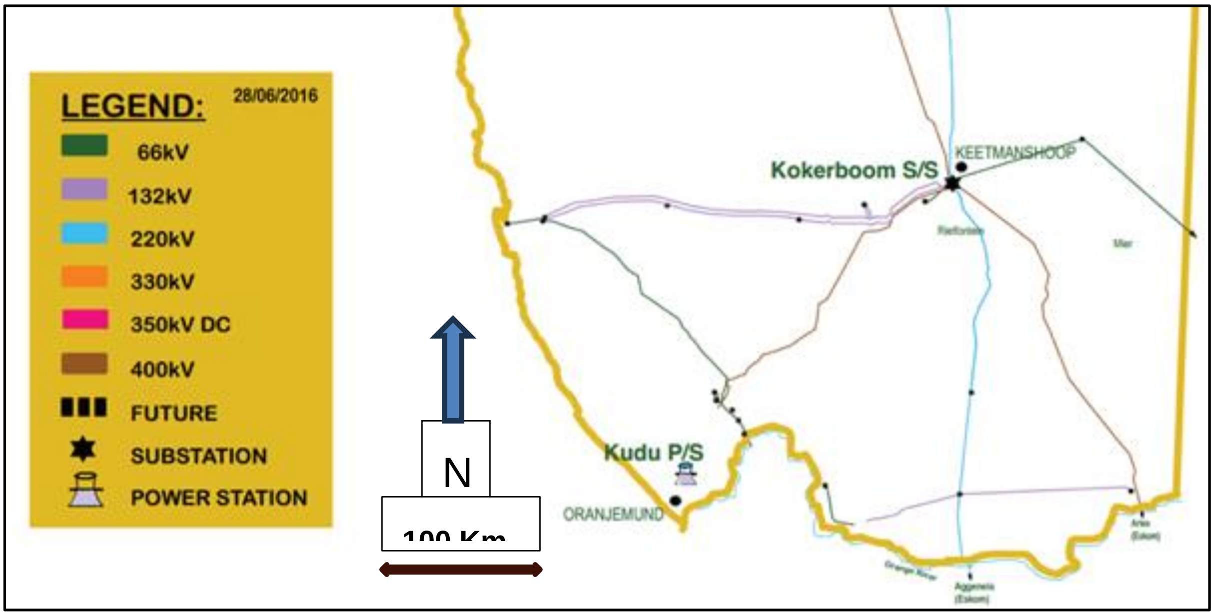


Figure 18-2: Power line transmission and substations in the south of Namibia. Source: Nampower annual report, 2016

18.6 Water

The Haib deposit straddles the Volstruis River (meaning the Ostrich river in Afrikaans), which is a tributary of the Haib River. Both are ephemeral tributaries of the Orange River which lies south of Haib.

The major water source is from the Orange River which is located about 15 kilometres by pipeline south of the main Haib deposit. However due to the river being a shared resource between more than one country, there are regulations that apply, and future demand upstream may lessen the available water supply.

The Orange River is a deeply incised drainage with several nick-points. Haib lies below all of the main nick-points at a location where the Orange River elevation is approximately 200 metres above sea level.

The banks of the Orange River downstream of Vanderkloof Dam are heavily developed in many areas, principally for irrigation purposes. Both the Gariep and Vanderkloof dams are used to regulate the river flow for irrigation as well as to produce hydroelectricity during peak demand periods. Very little Orange River water is used for domestic or industrial purposes with the exception of that used in the Vaal River basin.

Very limited volumes of groundwater are available in the basement rocks of the southern Karas Region, since there are no productive aquifers. Lack of recharge and poor groundwater quality in most areas further aggravates the situation.

18.7 Water Management Pond

The Karas Region, where the Haib deposit is located, is an arid zone with low and erratic rainfall of about 50-100 mm/a, which can occur in the summer and winter seasons. Additionally, loss of water through evaporation only worsens the situation. Reliable water supply will therefore be critical for the successful and efficient operation of the mine.

Based on the evaluation of water for the project, 125-320 m^3/h (depending on the selected throughput) would be required. The key source of water will be the Orange River and the water recovered from tailings through the dry stacking process.

18.8 Telecommunication

Namibia has one of the most modern and sophisticated backbone infrastructures in Africa. Fibre optic cables are connected throughout the length of the country on the north-south and west to east axis. The countries telecommunications regulator is the Namibian Communications commission (NCC) working under the Namibian Communications Act of 1992. Telecom Namibia runs the largest Telecommunication network in Namibia.

A site telephone system will be used to connect together through various parts of the operation. Two-way radios will be used for communication between supervisors, mobile equipment operators, crusher operators and conveyor operators.

To facilitate the plant control system and communication between process areas, a wire network will be installed around the site.

18.9 Workforce Accommodation

The closest towns near the Haib deposit are Noordoewer and Vioolsdrift with a total population of approximately 5000. The towns are 2 km apart and are about 25 km west of the Haib deposit. Basic infrastructure including a medical clinic, hotels, petrol station, shops stocking basic foodstuff, taxi services, buses, police station and border control have already been established in the area.

The camp site for workforce accommodation can be constructed at Noordoewer which will allow the project to share the existing infrastructure and reduce the project costs.

18.10 Workshop and Offices

Site maintenance workshop and warehouse will be constructed on site to facilitate the maintenance of processing equipment and mobile equipment as well as to provide storage room for equipment spares.

Administration office building, laboratory and store will be constructed to accommodate personnel from plant operations, maintenance, mining operations, management, and administration.

18.11 BUILDINGS

The project will require the development of the following infrastructure items (Table 18-3) in order to operate:

Table 18-3: Buildings required at Haib project

Building	Description
Camps	Will provide accommodation for management, workforce and visitors.
Crusher Control Room	Will provide a working space for engineers.
Reagent Shed	Will provide storage for reagents.
Canteen	Will provide area for cooking and dining facilities.
Metallurgical Laboratory	Laboratory to perform metallurgical testwork.
Assay Laboratory	Will provide laboratory equipment for grade control.
Open Area Storage	A fenced-off open storage area for equipment and materials that can be stored outside.
Maintenance/Warehouse	A facility to service the mobile equipment and for storage of equipment spares.
Control Room	Will provide working space for geology, engineering, and other operations support staff.
Office building	Will provide a working space for management, supervision.
Security Gate House	Will provide access control and security to the project.
Medical Centre	Will provide first aid services and emergency care.

18.12 Roads

Roads located near the deposit are well established and of sufficient quality (Figure 18-3). The deposit is located next to a main road that connects Namibia to South Africa, which is well maintained and suitable for large freight trucks. The road on the Namibian side is named Rundreise Namibia or state road B1 that extends from the North of Namibia at Oshikango to the South at Vioolsdrift. The only road construction required would be an upgrade to the existing 12 km long access road to site.

Figure 18-3: Roads close to Haib project. Source Google Maps, 2017

18.13 Air Services

The airport of Oranjemund is located on the South West corner of the Namibian border at approximately 250 km from the deposit and has the appropriate services already established to transport the required personnel. The Keetmanshoop Airport located 300 km from the deposit is the biggest airport in the Karas region in southern Namibia. It is situated 5 km outside the town of Keetmanshoop.

Additionally, there is the airport of Springbok in South Africa located 157 km from the deposit. Another option is the Kleizee Airport located in South Africa. Its distance to the Haib area is 224 km.

Both Noordoewer and the project site have gravel runway air strips suitable for small light aircraft.

18.14 Railways

The nearest railway station is located at the town of Grunau, some 120 km north on the main highway (Figure 18-4).

The area between the Haib and Grunau is almost completely flat, and the local rail authority has confirmed that a link could be laid relatively easily; this would provide access to either the port of Luderitz or the port of Walvis Bay via Windhoek. Considering the available rail network in Namibia, the distance from Grunau to the port of Walvis Bay by rail is about 1200 km and 600 km to the port of Luderitz.

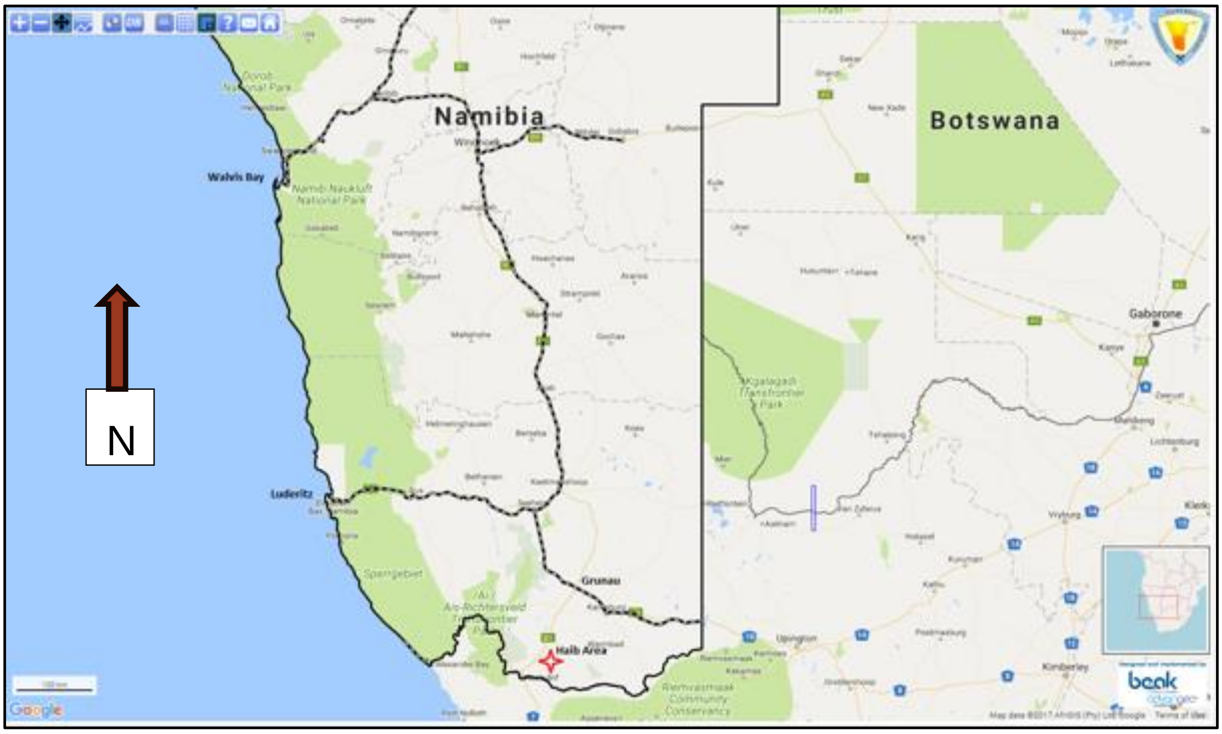


Figure 18-4: Railway network nearby to Haib deposit showing the ports of Luderitz and Walvis bay.

18.15 Ports

Walvis Bay is Namibia's largest commercial port that is located approximately 1200 km away from the Haib deposit. It is located halfway down the coast of Namibia, with direct access to principal shipping routes. Walvis Bay is a natural gateway for international trade and is a sheltered deep-water harbour benefiting from a temperate climate. The long freight distance will incur significant costs for both import of raw materials and product export.

An alternative and preferable port that could be used is the port of Luderitz. It is located on the south-west coast of Namibia approximately 600 km away from the Haib deposit. Traditionally, Lüderitz has been a fishing port, serving the needs of the Namibian fishing industry at a national level. The port is also an important shore base for oil and gas drilling operations off the southern coast and has also catered for the needs of the offshore diamond industry.

The Haib – Grunau rail connection could provide access to either the port of Luderitz or to Walvis Bay via Windhoek.

19. MARKET STUDIES & CONTRACTS

19.1 Copper

Copper is the main product that will be obtained from the process which will exist in the form of copper metal from electrowinning.

19.1.1 LME Copper

Copper is one of the most widely used metals on the planet. China, Europe and the USA are the main global consumers of copper. Copper will be produced on the cathode of the electrowinning cell as pure sheets which will be a pure (99%) solid. Pure copper metal is used for a variety of purposes. The major use is electrical wiring due to the great electrical conductivity of copper. Additionally, copper is used in many metal alloys such as brass and bronze which are stronger and more corrosion resistant than pure copper. Copper prices of $2.00/lb, $2.25/lb, $2.50/lb, $2.85/lb, $3.00/lb, $3.25/lb, $3.50/lb. $3.75/lb and $4.00/lb were incorporated in this economic analysis.

19.1.2 Copper Sulfate

Copper sulfate will be sold as a blue powder when the crystals are crushed and dried. Copper sulfate is used in multiple industries such as arts, mining, chemical, pharmaceutical, healthcare and agricultural. The biggest use is for farming as an herbicide or fungicide as it can be used to control fungus on grapes, melons and berries. Additionally, it inhibits the growth of E-Coli. Other uses include analytical reagents and past use as an emetic and dyes. In the healthcare sector, it is used in sterilisers and disinfectants. Industrial usage could be in adhesives, building, chemical, textiles industries, etc. where it is used to manufacture products like insecticides, wood preservatives and paints.

The Asia-Pacific region is the biggest consumer of copper sulfate due to the presence of large agricultural and animal husbandry industries. Other major consumers are North and South America and Europe. The main importers are listed as the United States with one fifth of the total global import volumes followed by Australia, Indonesia and the Netherlands.

High purity copper sulfate has a 25% premium price based on the copper content in the sulfate. The following copper sulfate pentahydrate prices have been used in the economic analysis based on the different copper prices:

- At US$ 2.00/lb of copper, US$ 0.64/lb copper sulfate pentahydrate
- At US$ 2.25/lb of copper, US$ 0.72/lb copper sulfate pentahydrate
- At US$ 2.50/lb of copper, US$ 0.80/lb copper sulfate pentahydrate
- At US$ 2.85/lb of copper, US$ 0.91/lb copper sulfate pentahydrate
- At US$ 3.00/lb of copper, US$ 0.95/lb copper sulfate pentahydrate

The copper sulfate production was capped at 50,000 tonnes of copper sulfate pentahydrate (32,000 tonnes of anhydrous copper sulfate). According to a recent market study published by IMARC, the global copper sulfate market is expected to be more than 400,000 tonnes per annum by 2022. At the proposed production cap of 32,000 tonnes of anhydrous copper sulfate equivalent, this would represent approximately an 8% market share.

19.2 Copper Supply Contracts

The Issuer has not entered into nor is in the process of negotiating any supply agreements or contracts.

20. ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

20.1 Baseline Study

A multidisciplinary site survey is conducted prior to or in the initial stage of a joint operational deployment. The survey documents existing deployment area environmental conditions, determines the potential for present and past site contamination (e.g., hazardous substances, petroleum products, and derivatives), and identifies potential vulnerabilities (to include occupational and environmental health risks).

Surveys accomplished in conjunction with joint operational deployments that do not involve training or exercises (e.g., contingency operations) should be completed to the extent practicable consistent with operational requirements.

20.2 Environmental Management Plan

The following draft Environmental Management Plan (EMP) details the measures to be adopted to address identified impacts during the construction and operational phases of the Project. The EMP details:

- Environmental elements – the environmental aspects requiring management consideration;
- Potential impacts – potential impacts identified in the EIS;
- Performance objective – the target or strategy to be achieved through management;
- Management actions – the actions to be undertaken to achieve the performance objective, including any necessary approvals, applications, and consultation;
- Performance indicators – criteria against which the implementation of the actions and the level of achievement of the performance objectives will be measured;
- Monitoring – the intended monitoring program and the process of measuring actual performance;
- Responsibility – responsibility for carrying out each action is assigned to a relevant person/organisation;
- Reporting – the process and responsibility for reporting monitoring results; and
- Corrective action – the action to be implemented in the case of non-compliance and the person/organisation responsible for action.

20.3 Project Environmental Assessment

Environmental impact assessments (EIA) ensure that the environmental impacts of a development proposal are fully considered before it is implemented. An environmental impact assessment determines the type and severity of an activity's environmental impact and is a normal part of the regulatory approval process and good due diligence practice.

Environmental impact assessment capabilities include:

- Flora and vegetation assessment
- Fauna and related habitat assessment
- Site specific characteristics assessment (aspect and relationship to the surrounding area)
- Formulation of environmental management plans
- Liaison with relevant government authorities (Environmental Protection Authority, Department of Parks and Wildlife, Department of Environment Regulation, Commonwealth Department of Environment and Energy, Water Corporation, heritage and the arts, and other local government bodies)
- Advice on other specialist scientific expertise that may be required
- Documentation of the assessment in the format required by regulators which can be used as part of an environmental management plan

20.4 Environmental Issues

20.4.1 Dust

The company will incorporate dust mitigation strategies, within reason, to minimise the negative impact on the environment, on site personnel and the community. Personnel will continually monitor the site for excessive dust and take appropriate action to minimise exposure and dispersion. Mitigation strategies include:

- Job execution in a manner that reduces dust production
- Provide dust suppression equipment where needed
- Monitor, assess and respond to on-site dust observations
- Ensure vehicles, mobile equipment and significant foot traffic are primarily kept to sealed/stabilised regions
- Awareness of the prevailing wind direction to populated areas and implementation of job schedule accordingly

20.4.2 Noise

The company will implement measures to reduce noise production beyond unacceptable levels to ensure the environment, personnel and the community are not negatively impacted. The company will always comply with noise regulations of the area in which the site is located. If the site is situated in close proximity to residential dwellings, the company will not conduct noise generating work outside of the specified hours for weekdays and weekends.

When performing work, the company will ensure the environment, on site personnel and the community are not adversely impacted by incorporating the following strategies:

- Hearing PPE for personnel located within areas of elevated noise
- Noise suppression systems on equipment generating significant or ongoing noise
- Speed regulations to limit the noise from vehicles
- Awareness of the prevailing wind direction to populated areas and implementation of job schedule accordingly

20.4.3 Spillages

The company will be responsible for the prompt response and clean-up of any spillages that occur on the controlled site. On-site personnel will be trained and advised of the location for spill kits, if applicable, and the swift alleviation of a spillage.

All spillages, their contents matter, size, and response are to be treated as an on-site incident and are to be reported to the site manager.

20.4.4 Contamination

The company will actively implement measures to avoid contamination of foreign objects, whether harmful or not, to areas outside of the site boundaries. This will include utilising and performing the following:

- Avoid seepage of materials into groundwater
- Clean vehicles and mobile equipment that cross site boundaries on a regular basis

The company will also ensure contamination of certain materials, particularly chemicals, is localised within sections of the site. This is primarily applicable to the adequate storage of chemicals, which are to meet the requirements outlined on the MSDS. Where applicable, bunding will be in place to ensure the containment of particularly hazardous materials.

20.4.5 Process Waste

The company will control and correctly dispose of any waste produced during the site operations. Any process waste shall be disposed of in accordance with statutory requirements. If waste materials are not suitable for disposal, the company will utilise treatment processes to ensure safe disposal or will alternatively send the waste to a licensed facility for subsequent treatment and disposal.

Process waste disposal will meet local Government and other statutory bodies' requirements. In order to minimise process waste, the company will ensure the design and management of a site-based landfill facility.

20.4.6 Domestic/Municipal Waste

The company shall provide sufficient rubbish receptacles and industrial disposal bins for collection of waste and ensure that all such bins are emptied on a regular basis to prevent overfilling. Any hazardous substances shall be disposed of in accordance with statutory requirements at licensed facilities. All rubbish is to be placed in closed containers and no personnel should litter. The Site Supervisor will monitor the cleanliness of the site and take appropriate action if necessary. Personnel must actively seek to minimise rubbish and waste on site.

20.5 Occupational Health, Hygiene + Safety

The company is committed to creating and maintaining safe work environments with an aim to have zero workplace health, safety, and environmental incidents. The company has clearly outlined the management strategy required to be upheld at all times in order to achieve this goal.

The following document illustrates the Haib Site Safety Management Plan and is to be considered as the minimum requirements. Haib will strongly advocate that personnel seek to exceed measures outlined in this document, where reasonably practicable, in order to create and maintain safe working conditions.

Haib will continually review health, safety and environmental KPI's and targets in order to re-evaluate and improve the management plan. This plan has been created to be utilised and well understood by all employees and contractors.

20.6 Management Plan Objectives

The Haib Site Safety Management Plan aims to complete the following:

- Have zero health, safety and environmental incidents
- Ensure operations are compliant with local and statutory regulations
- Ensure all personnel and contractors are readily able to understand the minimum safety requirements expected
- Develop a system that can be evaluated and improved on
- Ensure absolute transparency regarding health, safety and the environment between all affiliated parties on site
- Maintain the obligation to all stakeholders
- Ensure all operations and outcomes are aligned with the core values

20.7 Management And Safety Accountability

20.7.1 Health, Safety and Environment Management

The following contains a Health, Safety and the Environment (HSE) Management System with documented standards and procedures detailing the company's commitment, responsibilities and methods to achieve leading HSE performance. In the implementation of this HSE Management plan, the following will be executed:

- Specifically address and develop Standards and Procedures that meet company Legislative Requirements
- Make available all relevant Statutory Acts and Regulations, Australian Standards, Codes of Practice and the HSE Management Plan
- Ensure a communication and consultative mechanism is developed and promoted in the implementation the HSE Management Plan

20.7.2 Management Responsibility and Accountability

The company will:

- Have in place a visible HSE Policy and objectives which have been distributed and communicated to all workers
- Provide information regarding HSE requirements to all workers including subcontractors and visitors
- Monitor, review and communicate the HSE Management System
- Provide adequate, suitably qualified and experienced supervision to act in Supervisor positions
- Audit and monitor the HSE performance
- Identify safety critical roles and ensure these roles are suitably fulfilled
- Consult, communicate and coordinate HSE requirements with all key stakeholders
- Maintain an up-to-date Organisational Structure

20.7.3 On-site Manager/Supervisor

Supervisor roles and responsibilities include (but are not limited to) the following:

- Complying with the HSE Management Plan and HSE Management System requirements
- Ensuring risk control measures are implemented in areas and activities for which they are responsible
- Communicating safety information to relevant persons, including between supervisors at the change of shifts.
- Are responsible for ensuring that workplace inspections are carried out in accordance to regulative policy
- Ensuring personnel under their supervision have the appropriate skills, training, competency and knowledge (including access to relevant procedures) to perform their required tasks
- Ensuring all employees associated with their department can attend a toolbox talk each month and the minutes of the meeting distributed appropriately and outcomes communicated to the appropriate people

- Being aware of the Emergency Response and Crisis Management Procedure and act accordingly.
- Giving appropriate feedback to those employees seeking clarification on Health, Safety and Environmental issues
- Investigating and reviewing all accident/incidents within their work area and ensures all information from accidents/incidents is communicated to all personnel within the department and other relevant parties

20.7.4 Personal Protective Equipment

The company will ensure that personal protective equipment (PPE) is provided to all personnel and that personnel are trained in the correct use and maintenance of all PPE they are required to use whilst undertaking their assigned duties.

Risk Management principles will be used to determine appropriate PPE for all site activities, whenever PPE requirements are not covered by existing Procedures.

Minimum site requirements:

- High Visibility Long sleeved shirts and/or High Visibility Vests (with reflective stripes at night or in dark periods)
- Long trousers
- Safety footwear
- Safety helmets
- Safety glasses
- Gloves

Additional PPE may be required for particular areas of the site, which may include, but not limited to:

- Hearing protection
- Chemical resistant gloves
- Chemical goggles
- Chemical suits
- Welding gloves, eye protection, apron/clothed protection

All jobs must be accompanied with a risk assessment, which will identify the necessary PPE required to safely complete the job.

20.7.5 Subcontractor Policy

The company has established and implemented a process for the selection and engagement of subcontractors. This process ensures that information is gathered and an assessment of the contractors HSE Management activities, quality programs and insurances prior to engagement.

Subcontractors shall be audited for HSE compliance during the work as part of planned audits.

Any contractor who is unable to satisfactorily meet the minimum HSE requirements shall be required to follow the HSE Management whilst working on site.

Any contractor who is unable to provide sufficient evidence of a commitment to HSE policies, principles, procedures and/or statutory compliance shall be excluded from the tendering, selection or work process.

20.7.6 General Hazards

Mining and the subsequent processing of the ore are occupations where workers confront exposure to a broad array of hazards including rock falls, fire, chemical exposure, physical injuries and heat exposure, just to list a few. Identification of hazards (including recognition of the high potential for personal injury, equipment damage and production interruptions), allocation of control measures to each and assessment of the level of risk is the basis for provision of a workplace which presents as little risk as possible to the project, its staff, contractors, visitors, the local community and the environment. Risk assessments are conducted to help identify the risks and the control measures and to determine areas where further controls may be necessary to reduce the risk to an acceptable level.

A significant component of maintaining a safe workplace and a high standard of safety management is regular and effective communication with the involvement of all personnel. This can help increase awareness of hazards, encourage input and discussion regarding solutions to problems which may be encountered, and generally improve involvement of the workforce in the management of their own safety. Communications about safety can be conducted formally or informally and can include meetings in the workplace among employees, training, regular meetings with supervisors and management, and regular workplace inspections involving members of the workforce. Provision of appropriate tools and equipment (including personal protective equipment) for completing work tasks is also important in the management of workplace hazards.

The general hazards identified include the following:

- Occupational health and hygiene (including injury prevention and rehabilitation, infectious disease management, noise and dust exposure, health surveillance, and fatigue management and fitness for work)
- Vehicle and machinery hazards
- Electrical hazards and isolation systems
- Use and storage of hazardous materials
- Cranes, associated lifting equipment and working at height
- Explosives hazards
- Machine guarding
- Ground control processes, and
- Mine ventilation.

Further to these, general sections are included covering risk management, incident recording and investigation, corrective and preventative actions, and business continuity and emergency response.

This management system is designed to be used as a stand-alone document and it is recommended that its requirements are implemented prior to commencement of operations at the site.

20.7.7 Safety – General

The following section of this document outlines the general safety and health requirements and issues as they apply throughout the operation – inclusive of both the mine and the plant. It also includes discussion on mitigation measures in each section.

20.7.8 Standard Operating Procedures and Training

Standard operating procedures are useful, and even vital, for situations where a task must be completed the same way each time for safety or quality control reasons, or where there are risks inherent in the task that may be more effectively controlled by the use of a specific method of completing the task. Some standard operating procedures have already been developed, and more will be developed as the need arises throughout the operational life. These standard operating procedures will be used as the basis for training and competency assessment of mine and plant operators, and maintenance personnel, under the site training programme.

The mining method to be utilised at the operation is the same as that previously used and it is therefore anticipated that many of the employees will already have some skills in equipment operation and production methods applicable to the operation. These employees will still receive some “refresher” training to ensure current competency and compliance with safe operating standards.

Induction training is also required, and will be provided at three levels – visitor, general and area-specific.

- The visitor’s induction will take about 15 minutes to complete and is designed to create awareness among short-term visitors (visits of less than one week) to the site of the types of hazards that they may encounter. Even following completion of the visitor’s induction visitors will be required to be supervised by a fully inducted person at all times.
- Prior to employees, contractors and visitors being granted unaccompanied access to the surface areas of the site (not including the plant) a general induction must be completed. This induction will be more extensive than the visitor’s induction and will include greater detail about site hazards and operating and emergency procedures. Completion of this induction is necessary for all personnel who will be on site for periods greater than one week.

Task observations may also be included as part of a training system. Following initial training and competency assessment, regular task observations can be undertaken to ensure employees remain competent, and where they may have feedback for the improvement of the method for undertaking a task, these modifications can be discussed and recorded. Task observations are based on the requirements outlined in the training and assessment for the task and can include preparation to undertake the task, conduct of the task, and completion.

20.8 Occupational Health and Hygiene

Occupational health is defined by the World Health Organisation (WHO) as the promotion and maintenance of the highest degree of physical, mental, and social well-being of workers in all occupations by preventing departures from health, controlling risks, and the adaptation of work to people and people to their jobs. Generally, occupational health requirements are backed up by national legislation.

The specific occupational health measures for discussion include injury prevention and rehabilitation, health surveillance and biological monitoring, infectious disease management, fatigue management, and noise and dust monitoring and control. Ventilation and diesel particulate exposure control are discussed in the Mining section.

20.8.1 Injury Prevention and Rehabilitation

About 250 million occupational injuries occur throughout the world each year, and around 350,000 workers die each year as a result of these injuries. Occupational injuries and diseases present a major public health issue and place a huge burden on the individual employee and the health system which will help rehabilitate them.

While all care is taken in ensuring that employees, contractors and visitors are not injured in the course of their work or visit to the site, personal injuries may still occur. Following the occurrence of personal injury at the site, a rehabilitation and return-to-work programme will be utilised to ensure employees receive appropriate care for their injury and can return to a physical state equivalent to that before their incident. The return-to-work programme will include ongoing treatment, and provision of alternative duties for employees who are unable to perform their normal work tasks for a time during their rehabilitation.

The physically demanding work involved in the use of hand-held air-leg equipment may present potential for manual handling issues during the mine operation. The ground support – bolts and mesh – will also be installed by hand using jackhammers. Each of the drills will have two operators, each working for a length of time and then exchanging with the other to help reduce the incidence of sprain, strain, and vibration-related injuries. Vibration-related injuries are also a consideration for mobile plant operators, and these can be reduced through the installation of appropriate seating in the equipment.

20.8.2 Medical Facility

A medical centre post will be constructed at the processing plant. The facilities will be staffed by a doctor in the employ of the operation. The medical centre will be stocked with emergency equipment and supplies.

20.8.3 Infectious Disease Management

Malaria, plague, and African trypanosomiasis (sleeping sickness) pose high risk in some areas. Human immunodeficiency virus (HIV) infection is also prevalent with approximately 4.5% of the adult population infected and, consequently, about 100,000 deaths annually. Due to the huge impact of infectious disease, the life expectancy at birth is approximately 51 years (2006 estimate). Approximately 46% of the total population has access to improved drinking water services and only 29% (approx.) have access to adequate sanitation facilities.

Malaria infection makes a huge impact on an employee's ability to attend work every day. A study released by BHP-Billiton showed that 1 in 3 employees fell ill with malaria which translated into 6,600 cases in 2 years. Thirteen employees died from complications related to their malaria infection and all this despite the provision of a site medical centre, local spraying to kill the mosquitoes and provision of bed nets to employees. The operation believed it was unable to support absenteeism on this scale and so joined forces with local authorities to implement a region-wide malaria control program. Consideration for involvement in a similar program is recommended to help infectious disease management by the operation and also as an external relations project for the benefit of the wider community.

20.8.4 Health Surveillance and Biological Monitoring

Health surveillance is generally the responsibility of the employer, and the type and regularity of surveillance should be determined by risk assessment. All potential workplace exposures need to be determined and assessed to show the level of risk posed to employees working in different locations, performing different tasks. Employee health surveillance is conducted in conjunction with the monitoring of the work environment. Biological monitoring forms part of the health surveillance regime by accounting for personal exposure to chemical substances through blood and urine sampling. The need for biological monitoring for specific employees or tasks, and the regularity of the monitoring, is determined by risk assessment.

A baseline of employee health (prior to commencement of work) can be established through conduct of pre-employment medical examinations which include questionnaires, diagnostic and biological tests, and function measurements. Subsequent regular health evaluations can then be compared with this initial baseline by undertaking the same tests to determine whether there is a change in the health of the employee. Consideration should be given in the questionnaire to determining what events and injuries may have occurred outside the workplace that may contribute to changes in each of the health assessment areas.

Results of all health surveillance tests and monitoring, and other environmental monitoring, will be recorded and assessed to determine whether further exposure control measures are required, and in which locations. Personnel will receive confidential notification of any changes that have been determined through their personal health surveillance and biological monitoring. They will also receive treatment or other measures which may be required as a result of their exposure.

20.8.5 Noise Exposure

Exposure to noise is a generic hazard in most areas of the mine and mineral processing work environment. Generally, the mining task which produces the greatest noise level is the operation of drilling equipment. High levels of noise are also generated by ventilation fans and diesel-powered equipment. High levels of noise exposure may also be experiences in the surface operations in workshops and when using noisy equipment in confined spaces.

Noise exposure is expressed as a function of exposure level and duration. According to the National Institute for Occupational Safety and Health (NIOSH) in the United States, the recommended exposure limit (REL) is a time weighted average (TWA) of 85 decibels (A-weighted) – 85 dB(A). Exposures above this level are considered hazardous and exposure to continuous, varying, intermittent, or impulsive noise should never exceed 140 dB(A) under any circumstances for even a short period of time. Monitoring of noise levels in static locations throughout the operation is recommended, as is personal noise monitoring in the hearing zone of the employee over the duration of a shift.

Hearing protection will be included as part of the basic personal protective equipment provisions and wearing it will be mandatory where work is undertaken in the vicinity of loud equipment items. The most effective method for reduction of noise exposure is the purchase of low noise producing equipment, and where this is not possible, separation of the equipment from personnel through the use of enclosures. Training will be provided to all employees in relation to the correct use and operation of hearing protection devices, and the types of hearing protection devices necessary in each location. Signage will also be provided in locations throughout the site where hearing protection is required.

20.8.6 Dust Exposure

The production of dust in hard-rock mining is an inevitable part of the process, although, when less dust is generated, less effort needs to be expended on suppression. The crushing of the ore and the fall of ore from one conveyor to another or onto the ore stockpile as well as unsealed roadways are other situations where significant dust levels may be encountered.

Respirators and dust masks, appropriate for the dust type and particle size, will be provided to employees for use in locations where methods of dust suppression or control are unable to be used, or are deemed inadequate. Training will be provided for use of the correct respirator or mask for each situation, and the correct method for their use. It may also be a requirement for employees to remain clean-shaven to ensure an appropriate respirator seal when required.

Throughout the surface operations, roadway and open-area watering using a water truck is recommended to reduce dust. Dust collectors are also included in the plant design to reduce personal exposure to dust from the stockpile feeders and lime bin. Where it is determined that dust may be generated over large areas with no vegetation, dust control barriers can be installed to reduce dust movement.

Regular monitoring of dust generation and exposure is also recommended. This should include fixed dust collection/sampling locations throughout the site to determine the composition and quantity of background dust and personal monitoring through measurement of dust composition and exposure levels in the breathing zone of persons over the period of a work shift.

20.8.7 Fatigue Management

Fatigue is defined as tiredness arising from mental or physical exertion, or insufficient sleep. Shift work is a common cause of disruption to sleeping patterns, with night shift causing the most difficulty (it is often difficult to get adequate sleep during the day). Fatigue can increase the risk of human error and therefore increase the potential for incidents to occur as a result of the errors. Working overtime hours/shifts can also contribute to fatigue in the workplace.

Fatigue can be managed through regular work schedules, control of humidity, noise and vibration levels in the workplace, adequate rest and a balanced diet. The risk of error through fatigue can also be increased by repetitive and very physical work which these can be managed through job rotation and regular breaks. As mentioned above, employees required to operate the manual drilling and jack-hammering equipment will rotate regularly to reduce fatigue.

20.8.8 Fitness for Work

Fatigue, caused by sleep deprivation, excessive working hours, consumption of alcohol or other drugs, or other situations are all circumstances which may cause an employee to be unfit to carry out their work duties in a safe manner. It is the responsibility of the employee to present at work in a fit state to complete their work. Where an employee is unfit for work, they must notify their supervisor of the situation, including the reason, prior to the commencement of their shift. If employees are taking prescribed medication which may impair their ability to conduct their work safely, without risk to others, the supervisor must also be notified.

20.8.9 Vehicles and Machinery

Incidents involving mobile equipment and machinery are one of the highest causes of fatalities, and accidents causing permanent disability, in the mining industry. One factor that contributes significantly to these incidents is the operational blind spots experienced by the operators of both small and large machinery and equipment. These blind spots can present significant risk even on the surface where visibility is increased because of the light.

Incidents involving human-mobile plant interaction can be greatly reduced through the installation of proximity warning equipment and cameras to give the operator vision in some of the blind spot areas. Procedures should also be developed which can include exclusion zones surrounding mobile plants, design of the process to reduce the need for reversing, routing traffic away from pedestrian areas, communication with equipment operators when in proximity to the equipment and appropriate isolation of equipment when undergoing maintenance. As an example, the operator of a load-haul-dump (LHD) machine has particularly poor vision from the cab due to the size of the bucket (often exceeding the height of a human), the position of the operator (seated in a sideways position relative to the travel of the machine), and restricted visibility from the cabin (due to the equipment design). These factors, and others including adjustable seating, should be considered when purchasing the equipment. Another avenue for reduction of risk associated with visibility from the machinery is to ensure lights, front and rear, remain clean to allow as much light to emit as possible.

Incidents and injuries involving the operation of forklifts are also very common. These can result from restricted operator visibility when carrying a load, interruptions to the operator's concentration, and lack of operator competency. These incidents can be reduced through open and unobstructed design of the areas where fork-lifts will operate on a regular basis (particularly for unloading and loading in the store), training and competency assessment of operators, procedures relating to exclusion zones around operating equipment, and requirements for communication with the operator when in proximity.

20.8.10 Hazardous Materials

The use of hazardous materials is inherent in the operation of a mine and processing plant. At the Haib Copper Project a significant proportion of the chemical and hazardous materials use will occur in the plant (see detailed discussion relating to hazardous materials used in the plant), but the mining operation will use large quantities of sulfuric acid, lime and diesel (for the operation of plant and equipment). Machinery maintenance personnel will also use hydraulic oil, lubricants and other machinery fluids, acids (for batteries), and cleaning compounds. Material safety data sheets (MSDS) will be provided to ensure appropriate chemical information is available in each location where chemicals are used. Standard operating procedures and associated training will also include information about hazardous materials and safe handling requirements as they pertain to each task.

Explosives are also classified as hazardous materials.

20.8.11 Electrical Safety

Personal contact with electricity can result in electrocution, electric shock (and its effects), explosions and fires. This contact can occur in a variety of ways including vehicles or equipment contact with the power supply cabling, water ingress into power supply components, inadequate isolation during maintenance, short circuits and earthing faults. Electrical cabling and power boxes are required throughout the entire site for the operation of all electrical equipment. All electric shocks are serious and should be reported and investigated (in accordance with the incident and accident reporting process. The employee who received the shock should be monitored closely by medical personnel immediately following the incident.

All electrical cabling and electrical connections are to be installed by appropriately qualified electricians. All equipment will be regularly tested and maintained in accordance with local regulations and standards. Standard operating procedures will include information about electrical installations and associated hazards, in proximity to where other work is undertaken, and appropriate isolation of electrical equipment. Earth leakage protection installation and testing will be undertaken in accordance with local regulations and standards. Electrical cabling will be installed with a mechanical protection layer (included in the manufacture) to help reduce the hazards associated with mechanical impacts. Electrical equipment must only be used for its intended purpose and not abused. Residual current devices should also be installed for extra protection when using hand-held electrical tools and extension leads. These devices require regular testing to ensure they are effective.

All testing and maintenance will be recorded (as required by local regulations) and failures of equipment or procedures will be recorded and investigated through the incident/accident investigation process.

20.8.12 Energy Isolation

Energy isolation is usually associated with isolation of electrical systems, but it also includes isolation of flow and pressure to a location, procedures and equipment to prevent sudden movement of equipment e.g., a truck falling off a jack or sudden articulation of machinery, and ventilation of tyres held inside a frame to prevent explosion. The isolation process generally uses tagging and specific procedures designed to protect employees working on equipment and inform others about the operational state of the equipment, plant or system. The isolation system is to be applied throughout the site including the mine, the processing plant, all workshop areas and where work is carried out in the administration buildings.

At the Haib Copper Project international standard isolation systems and procedures will be utilised to help mitigate associated hazards. This system will include two main tags, with other tags to be added as required.

The most commonly used tag will be the ‘Out of Service’ tag which is placed on any item of equipment which is non-operational, for any reason (e.g. the switch on an electrical item is faulty and requires repair, or the engine has been removed from a truck for repairs in the workshop). This tag is designed to convey information relating to the useability of the item and should only be removed by the person completing the repairs after the repairs are complete.

The other main tag is the ‘Personal Danger’ tag which is designed to protect an employee involved in repair or maintenance in the vicinity. Systems will be disabled, blocked and locked in the ‘off’ position and this tag attached to a lock at the isolated point to convey information about the person completing the work. The tag and locking system (together) is designed to protect the employee from harm by preventing the operation of the equipment or system on which they are working. Employees will receive training based on isolation information included in standard operating procedures to ensure competency in the use of these systems.

20.8.13 Cranes, Lifting Equipment and Working at Height

Any task where there is the potential for a person or other item/s to fall can be considered as highly dangerous. Extensive control measures are put in place to help ensure incidents do not occur, equipment is not damaged and personnel are not injured.

20.8.14 Cranes and Lifting Equipment

Gantry cranes are used throughout the workshops and the plant for small lifts. These are suspended from an overhead frame in the building structure (often providing a track for the crane to move along) and are operated using hand-held controls. Other crane equipment (especially mobile cranes) may also be used throughout the site when large or heavy items require moving or lifting. All crane equipment requires ongoing inspection and maintenance, in accordance with manufacturers’ instructions and standard maintenance programs, to ensure it remains operational and safe. Personnel required to operate this type of equipment should receive initial training and competency assessment, and regular refresher training to help ensure the equipment is operated safely and within its limits.

It is recommended that chains, hooks, ropes and slings for lifting should be inspected by operators prior to each use (and their condition recorded), and inspected and tested by authorised personnel regularly (e.g. every three months) to ensure they remain in good condition and are capable of performing to their rated capacity. All personnel required to inspect and use items of lifting equipment will receive training and competency assessment which will include recognition of equipment faults. A tagging system may also be used, following authorised testing, to provide information to users about the condition of the lifting equipment.

20.8.15 Work at Height

Work at height is defined as work undertaken in any area, including at or below ground level, or entering/exiting from such an area (except by a staircase) where a person could fall a distance liable to cause personal injury. Generally, working at high levels in a plant, for example, does not constitute work at height due to the area being accessible by stairs and fitted with handrail. The platform constitutes a normal work space. However, work conducted in proximity to the edge of the platform, where there is the potential of falling over the edge is classified as work at height. Incidents involving fall from height constituted approximately 30% of fatal injuries in all industries across the United Kingdom between 1997 and 2001, and also a significant proportion (approximately 9%) of non-fatal injuries.

Reduction of the risk of fall from height incidents can include the following measures:

- Elimination of the need to work at height (at the design stage of the project),
- Construction of permanent structures in locations where work at height is required on a regular basis,
- Plan for, and install, appropriate attachment devices for use by workers when required at a later point in the operation,
- Training and competency assessment for the use and maintenance of fall protection equipment,
- Risk assessments and other hazard identification sessions to identify locations where there is a risk of fall from height, and
- Provision of harnesses, fall arrest and restraint devices, ropes and other attachments.

20.8.16 Personal Protective Equipment

Personal protective equipment is the least effective form of protection against workplace hazards. It is designed to help protect employees against hazards that were not able to be eliminated by other means. Personal protective equipment will be provided to all employees (at no cost to them) for use in the course of their work. This will include a minimum of safety boots, hard-hats (helmets), glasses (medium to high impact protection) and long sleeve/long trousers clothing.

Further items of personal protective equipment will be provided for use during specific tasks, as determined by risk assessment and as recommended by product manufacturers (particularly for chemical products). Items of specific personal protective equipment will be located in proximity to the areas where the equipment is required to be used. Training will be provided for all employees regarding the appropriate fitting and care of provided items of personal protective equipment. Personal protective equipment information will also be included in standard operating procedures. Personal protective equipment will be provided to employees at no cost. The wearing of provided minimum personal protective will be mandatory for all employees and disciplinary action will be taken where employees do not comply with requirements.

20.8.17 Inspections and Housekeeping

Workplace inspections can provide a thorough, critical examination of a work area, record hazards for corrective action, and provide a follow-up opportunity to determine whether recommended actions have been implemented. Workplace inspections are designed to be conducted on a regular basis. The frequency of inspections should occur in accordance with the types and levels of risks in the location. Inspections can occur as a quick check and occur with high frequency (e.g., once per shift), or a detailed 'audit' of an area with lower frequency (e.g. six monthly to annually).

The less frequent, more detailed, inspections should cover legal aspects, physical, behavioural and system controls as well as housekeeping. The inclusion of these sections in the inspection, and the requirement for a variety of personnel to participate, can highlight a variety of areas for improvement by requiring the assessment to be undertaken systematically. They also provide focal points for the inspectors, although care needs to be taken to ensure other aspects are not over-looked. For the less frequent inspections, a roster can be established to ensure that these are allocated and marked off as they occur throughout the assigned time period.

The changes in the work area from one rostered shift to the next can be significant, and employees should complete these inspections to ensure they are aware of any hazards particular to their work area where the site has changed since their last shift.

Effective housekeeping can help eliminate workplace hazards through the removal of trip hazards, maintaining a tidy workplace and ensuring equipment is put away after use. Housekeeping is ongoing and the state of a workplace can often be a good indicator of the safety culture within the workplace. Appropriate housekeeping in the workplace can also include repair of damaged or broken items (like shelving), removing nails, wire etc., which protrude, and appropriate storage of items which are hazardous or used infrequently. Rubbish removal, an integral part of housekeeping, also reduces the potential for fires to occur in the workplace and not allow items to impede egress in the case of an emergency.

20.9 Social and Community Management

The company shall ensure the following aspects are considered to minimise the impact of its operations on the local community.

20.9.1 Community and Stakeholder Relations

The following actions shall be taken to ensure the community and all stakeholders are considered throughout the site operations. The local community concerns include:

- Community consultation as and when required

- Safe driving and road courtesy by all
- Respect for the community and natural environment
- Consideration of local people
- Establishing a mechanism for the reporting of public complaints

20.9.2 Local Environment Consideration

The following shall be clearly communicated to site personnel and appropriate controls are implemented accordingly:

- Dispose of your own rubbish
- Respect and care for native bush, no driving of off-road vehicles except in designated tracks and areas
- Native vegetation is not cleared or damaged without consent
- A permit to clear vegetation must be submitted and approved prior to clearance
- No ground disturbance without consent
- Native fauna is not injured due to poor work practices
- Our workers are aware of potential impact on native fauna
- No deliberate harm inflicted on all native fauna
- Local fire regulations are adhered to, the district is subject to extreme risk of bushfires
- Obtain a hot work permit before conducting hot work
- Participate in fire fighting training
- Provide and maintain fire fighting equipment

21. CAPITAL AND OPERATING COSTS

21.1 Capital Cost Estimates

21.1.1 Scope and Methodology

The Capital cost ("CAPEX") estimations are for processing only which excludes the capital costs associated with mining. METS estimated capital costs for crushing, screening, grinding, heap loading, leaching, solvent extraction and refining. Workshops and offices are covered under the plant infrastructure which mining will use. At this stage it was assumed that the mining would be executed via contract mining and all associated capital was to be included in the mining operating expense. It is anticipated that mining capital cost will be covered at the Feasibility Study stage where more work will be done for mining. The estimates were made for a plant with different plant capacities and were made for individual options. The base case is considered as the most conservative and attainable option:

- Base case: 20 Mtpa with 80% copper recovery with $CuSO_4$

21.1.2 Basis of the Estimate

The scoping level study capital cost estimates are based on historical equipment pricing and then factoring the materials and installation costs along with using the appropriate scaling factors. Vendors were contacted for major equipment such as crushers, HPGRs and ore sorters to obtain budgetary estimates. These quotes were scaled for options which had different throughput rates to the quoted amount.

21.1.3 Direct Costs

All direct equipment and infrastructure costs will be assumed to be new for this estimate and no second-hand purchases are included. The cost of this equipment was estimated based on historical cost data collected by METS engineering and the installation costs factored to include costs for the following:

Earthworks

- Clearing of the site of vegetation
- Grubbing of roots and other materials from the site
- Bulk Earthworks
- Initial grading of the site for construction
- Major excavation (by machine) for concrete foundations
- Major backfilling (by machine) for concrete foundations
- Final grading and drainage contouring of the site
- Paving

Concrete

- Final trimming of the excavations
- Supplying and setting of formwork and shoring
- Supplying and installing reinforcing steel
- Supplying and installing embedded items
- Supplying and placing mixed concrete
- Finishing of the concrete
- Curing of the concrete
- Stripping of the formwork and shoring
- Final patching and finish
- Protective coatings for concrete surfaces
- Supplying and installing pre-cast concrete
- Supplying and installing concrete masonry

Structural Steel

- Detailing of structural steel from engineers' drawings
- Supply and fabrication of steel materials and their fastenings
- Dismantling and salvage of steel materials
- Sandblasting and painting as required
- Transporting steel to site
- Unloading and "shaking out" of steel in laydown areas
- Transporting steel to erection areas
- Checking the concrete dimensions before erection
- Erecting structural steel
- Plumbing and alignment of erected steel structures
- Tightening of all bolts according to specification
- Installation of metal roof and wall sheeting
- Installation of all ventilators and louvers
- Installation of doors and windows including frames
- Installation of flashing, edge strips, and sealers
- Installation of gutters and downspouts

Equipment

- Furnishing of the equipment by vendors

- Dismantling and salvaging equipment
- Transporting the equipment to site
- Unloading and storing on site
- Installing the equipment
- Mechanical testing of the equipment prior to start-up
- Sole plates, anchor bolts, safety guards, and all other items necessary to make the equipment operable

Piping

- Furnishing all pipe, valves and fittings
- Fabricating all pipe in a shop or on site
- Installing all pipe, valves and fittings
- Installing pipeline bodies for instruments
- Installing instrument airlines to final block valve
- Cleaning of the pipelines as specified
- Testing the pipelines as specified

Electrical and Instrumentation

- Installing all electrical equipment
- Installing all pull boxes, junction boxes etc.
- Installing all electrical cable and wire
- Furnishing all electrical equipment and bulk materials
- Dismantling and salvaging electrical equipment
- Installing all cable tray and conduit
- Furnishing and installing all hangers and supports
- Connecting all terminations
- Testing of all circuits and high voltage splices
- Furnishing all instruments at site
- Bench testing and calibration of all instruments as required prior to installation
- Furnishing and installing all supports and hangers
- Installing all pipe in-line instruments in pipeline bodies
- Installing all instrument airlines from block valve to instrument
- Installing all wiring between controllers, instruments, instrument blocks, power sources, and sending units

- Testing of all instruments, interlocks etc. after installation

21.1.4 Indirect Costs

As the costing is a Class 5 estimate, all indirect costs were calculated by factoring from the direct costs. The indirect costs include:

Engineering and Procurement

- Revising the Mission engineering drawings to accommodate the revised elevations and coordinates.
- Performing engineering on new equipment and associated equipment
- Planning, prioritising and coordinating the engineering work
- Review or various trade off studies to minimize installation costs
- Review and finalisation of the design criteria
- Review and finalisation of the process flow sheet drawings
- Development of all process calculations
- Preparation of the Water Balance
- Preparation of the Material Balance
- Final sizing of all new equipment
- Development of the Equipment List
- Preparation of the Piping and Instrument Diagrams (P&IDs)
- Review of existing drawings
- Site visits as required
- Meetings as required
- Checking and collecting on-site dimensions
- Coordinate and evaluate geotechnical studies and reports
- Surveying
- Preparation of the General Arrangement Drawings
- Preparation of Detail Engineering drawings
- Preparation of all Civil and Site drawings
- Preparation of Electrical cable and conduit drawings
- Preparation of all Instrumentation layout drawings
- All other drawings required to provide a complete engineering design
- Preparation of specifications for new equipment

- Preparation of Requests for Quotation (RFQs)
- Preparation of contractor bid documents
- Evaluation of all bids
- Recommendations for all bids
- Preparation of the contract or purchase order documents
- Processing all change orders to contracts and purchase orders
- Preparation of the project schedule
- Preparation of the operating cost estimate
- Preparation of the capital cost estimate
- Provision of technical assistance during construction
- Provision of changes to the design during construction
- Management and administration of the engineering work
- Travel, communications, living cost, supplies, computers and all other costs necessary to engineer and procure for the project

Construction Management

- Coordination of the overall safety program
- Coordination of the construction work around the operation schedule
- Planning, coordination, and organization of the construction work with the contractors
- Construction surveying and survey control
- Inspection of the quality and progress of the work
- Surveying the work for correctness and quantities installed
- Approval/disapproval of all progress reports submitted for payment
- Identify potential problem areas and recommend solutions
- Review and approve/disapprove of change order requests
- Provision of quality testing, control and assurance of the work
- Provision of coordination and progress meetings with contractors and vendors
- Provision of all engineering documents to contractors
- Coordination of all engineering changes
- Provision of technical assistance as required
- Maintaining records of actual on-site installation
- Preparation of the As-built drawings

- Administration of the construction contracts
- Controlling and reporting of the project cost and schedule
- Approving and processing of all invoices
- Expediting, inspection and receipt of all deliveries

Field Office

- Provision of offices for contractor administration
- Provision of warehouse areas
- Provision of outdoor storage areas
- Provision of all utilities and infrastructure (roads, electrical, water, sewage, telephone, etc.) associated with the above
- Provision for control of the contractor’s ingress and egress

21.2 Capital Cost – Base Case

DEEP SOUTH Resources Inc.	METS ENGINEERING PROCESS + INNOVATION	Haib Copper Project									
		20 Mtpa @ 80% Copper Recovery + CuSO4									
		Date 20/04/2020			Project Number J5329			CAPITAL COST ESTIMATE			

Whole Ore Heap Leach

	AREA	Equipment	Earthworks	Concrete	Structural Steelwork	Mechanical Installation	Pipework	Electrical and Instrumentation	Roads, etc	Freight	Total per Item
			5 %	2 %	10 %	35 %	5 %	7 %	2 %	9 %	75 %
	Direct Costs	USD	USD	USD	USD	USD	USD	USD	USD	USD	USD
1	100 Crushing	$ 33,812,000	$ 1,690,600	$ 676,240	$ 3,381,200	$ 11,834,200	$ 1,690,600	$ 2,366,840	$ 676,240	$ 3,043,080	$ 58,583,000
2	200 HPGR	$ 24,532,000	$ 1,226,600	$ 490,640	$ 2,453,200	$ 8,586,200	$ 1,226,600	$ 1,717,240	$ 490,640	$ 2,207,880	$ 42,431,000
3	300 Agglomeration and Heap Leaching	$ 24,974,000	$ 1,248,700	$ 499,480	$ 2,497,400	$ 8,740,900	$ 1,248,700	$ 1,748,180	$ 499,480	$ 2,247,660	$ 43,204,500
4	400 Copper Solvent Extraction	$ 41,819,000	$ 2,090,950	$ 836,380	$ 4,181,900	$ 14,636,650	$ 2,090,950	$ 2,927,330	$ 836,380	$ 3,763,710	$ 72,863,250
5	500 Iron Removal and Tailings	$ 3,583,000	$ 179,150	$ 71,660	$ 358,300	$ 1,254,050	$ 179,150	$ 250,810	$ 71,660	$ 322,470	$ 6,270,250
6	600 Process and Raw Water	$ 2,357,000	$ 117,850	$ 47,140	$ 235,700	$ 824,950	$ 117,850	$ 164,990	$ 47,140	$ 212,130	$ 4,124,750
7	700 Reagents	$ 2,861,200	$ 143,060	$ 57,224	$ 286,120	$ 1,001,420	$ 143,060	$ 200,284	$ 57,224	$ 257,508	$ 5,007,100
8	800 Services	$ 1,633,000	$ 81,650	$ 32,660	$ 163,300	$ 571,550	$ 81,650	$ 114,310	$ 32,660	$ 146,970	$ 2,857,750
9	First Fill	$ 7,600,000								$ 684,000	$ 8,284,000
	Infrastructure										
10	Misc	$ 328,000	$ 16,400	$ 6,560	$ 32,800						$ 383,760
11	Mobile Equipment	$ 795,000									$ 795,000
12	Laboratory	$ 136,000	$ 6,800	$ 2,720	$ 13,600						$ 159,120
13	Power Supply (overhead and underground)	$ 1,000,000	$ 50,000	$ 20,000		$ 350,000					$ 1,420,000
14	System Communications	$ 40,000									$ 40,000
15	Workshop and Store	$ 160,000	$ 8,000	$ 3,200	$ 16,000					$ 14,400	$ 201,600
											Sub Total Direct Cost
	Direct Cost Total	**$ 145,630,200**	**$ 6,859,760**	**$ 2,743,904**	**$ 13,619,520**	**$ 47,799,920**	**$ 6,778,560**	**$ 9,489,984**	**$ 2,711,424**	**$ 12,899,808**	**$ 246,625,080**

	Indirect Costs			Total per Item USD
1	Working Capital	10%	10% of Direct Costs	$ 24,662,508.00
2	Insurance	3%	3% of Equipment Cost	$ 7,398,752.40
3	EPCM	10%	10% of Direct Costs	$ 24,662,508.00
4	Contingency	10%	10% of Direct Costs	$ 24,662,508.00
5	Commissioning	2%	2% of Direct Costs	$ 4,932,501.60
6	Workforce accomm & meals, temp services	2%	2% of Direct Costs	$ 4,932,501.60
7	Spares and tools	2%	2% of Equipment Cost	$ 2,912,604.00
				Sub Total Indirect Cost
	Indirect Cost Total			**$ 94,163,884**
	TOTAL COST		***USD***	***$ 340,788,964***

21.3 Accuracy Assessment

At a scoping study level, the accuracy of our estimates is assumed to be at ±35% of the true CAPEX.

21.4 Operating Cost

21.4.1 Scope and Methodology

METS estimated operating costs ("Opex") for crushing, screening, grinding, floating, heap loading, leaching, solvent extraction and refining. It was assumed that the mining would be executed via contract mining and all associated capital was included in the mining operating expense. The estimates were made for a plant with different plant capacities and were made for individual options. The base case is considered as the most conservative and attainable:

- Base case: 20 Mtpa with 80% copper recovery with $CuSO_4$

21.4.2 Basis of Estimate

Process operating costs were estimated by METS engineering using the equipment list generated from the flowsheets, the manning requirements based on similar projects and from equipment vendors. The cost estimates cover crushing, screening, heap loading, leaching, solvent extraction and refining.

21.4.3 Estimated Labour Rates

Personnel requirements were assumed for each area. Namibian wages were used to estimate the total payroll. A 30.5% overhead was applied to the annual salary for each person.

21.4.4 Estimated Consumable Costs

Consumable costs are based on both quotes from vendors and spares prices from previous METS projects that have been converted from AUD to USD (AU $ 1 = US $ 0.67). The consumption rates are based on vendor information, past projects and METS experience.

21.4.5 Estimated Reagents Costs

The reagent costs have been estimated based on direct quotes from suppliers, past projects and from online sources such as Kemcore. All reagents' costs are in USD with an allowance for delivery to site from the Luderitz port, unless otherwise specified. The raw water price is assumed to be equivalent to the average 2016 mine tariff of N$ 10.09 corresponding to US$ 0.71/kL at the exchange rate utilised throughout the project. The diesel price has been taken as US$ 0.94/L based on the Namibian diesel price on the 24/01/20.

21.4.6 Estimated Power Cost

The power is assumed to be able to be taken from the grid from one of the surrounding towns. The 2019/20 tariff for large power used from NamPower of N$ 1.17/kWh (US$ 0.082/kWh) was incorporated for the study.

21.4.7 Estimated Maintenance Cost

The maintenance cost is estimated as a factor of the equipment capital expense for each process area. A larger portion of maintenance was allocated to Area 100 (crushing) and Area 200 (grinding).

21.5 Cost Breakdown Structure

Table 21-1 outlines the operating cost structure for the whole ore heap leaching option that was assessed. As previously mentioned, the cost of mining was assumed equal to that of a similar Namibian project.

Table 21-1: Operating Cost Breakdown – Base case

20 Mtpa @ 80% Cu Recovery + $CuSO_4$				
Area		**Annual Cost (‘000 USD)**	**Unit Cost (USD/t ROM)**	**Unit Cost (USD/lb CuEq)**
Mining		45,200	2.26	0.40
Processing		90,799	4.54	0.80
Product Freight		3,889	0.19	0.03
Wharfage & Shiploading		432	0.022	0.004
Administration		4,000	$0.20	0.04
Royalty	$2.00	6,824	0.34	0.06
	$2.25	7,677	0.38	0.07
	$2.50	8,530	0.43	0.08
	$2.85	9,724	0.49	0.09
	$3.00	10,236	0.51	0.09
	$3.25	11,089	0.55	0.10
	$3.50	11,942	0.60	0.11
	$3.75	12,795	0.64	0.11
	$4.00	13,648	0.68	0.12
Total	$2.00	**151,144**	**7.56**	**1.33**
	$2.25	**151,997**	**7.60**	**1.34**
	$2.50	**152,850**	**7.64**	**1.34**
	$2.85	**154,044**	**7.70**	**1.35**
	$3.00	**154,556**	**7.73**	**1.36**
	$3.25	**155,409**	**7.77**	**1.37**
	$3.50	**156,262**	**7.81**	**1.37**
	$3.75	**157,115**	**7.86**	**1.38**
	$4.00	**157,968**	**7.90**	**1.39**

21.6 Operating Cost – Base Case

Title:	**OPEX-20 Mtpa @ 80% Cu Recovery +CuSO4**
Document No.:	**J5329-ES-CA-000-001**
Project:	**Haib PEA**
Client:	**Deep-South Resources**
Date:	**21-Apr-20**
Rev:	**A**
Option:	**Whole Ore Heap Leach**
Accuracy:	**± 30%**
Comments:	

Key Inputs and Outputs

Plant Throughput dry	20,000,000	tpa
Utilisation (Crushing)	6,132	h/a
Utilisation (Grinding)	7,884	h/a
Plant Throughput dry	2,537	dtph
Head Grade	0.310%	% Cu
Recovery	80	% Cu
Annual Production	35,332	t Cu
	77,894,214	lb Cu
	51,081	t CuSO4.5H2O
	112,613,875	lb CuSO4.5H2O
	113,720,448	Total lb Cu Eq
Power Cost	$0.084	USD/kWh
Total Power	11.05	kWh/t
Abraision Index	0.49	
Fixed Component	$11,237,479	USD/a
Fixed Component	$0.56	USD/t ROM
Variable Component	$79,561,810	USD/a
Variable Component	$3.98	USD/t ROM
Operating Cost Estimation	**$4.54**	**USD/t ROM**
Operating Cost Estimation	**$0.80**	**USD/lb Cu Eq**

Miscellaneous Costs Only

	Cost	
	USD/a	USD/t ROM
Laboratory Costs	$1,000,000	$0.05
Contractors	$100,000	$0.01
Vehicle Fleet	$100,000	$0.01
Total	**$1,200,000**	**$0.06**

Summary 1 - Cost per pound of copper produced (Based on Commodity)

	Cost		Fixed	Fixed Cost	Variable
	USD/a	USD/lb Cu Eq	%	USD/a	USD/a
Power	$18,636,581	$0.16	15.0	$2,795,487	$15,841,094
Consumables	$13,194,092	$0.12	5.0	$659,705	$12,534,388
Reagents	$47,202,042	$0.42	0.0	$0	$47,202,042
Labour	$5,879,177	$0.05	100.0	$5,879,177	$0
Maintenance	$4,687,396	$0.04	15.0	$703,109	$3,984,287
Misc	$1,200,000	$0.01	100.0	$1,200,000	$0
Total	**$90,799,289**	**$0.80**	**12.4**	**$11,237,479**	**$79,561,810**

Summary 1 - Cost per tonne of Concentrate (Based on Commodity)

	Cost		Fixed Cost	Variable	Overall Distribution
	USD/a	USD/t ROM	USD/a	USD/a	%
Power	$18,636,581	$0.93	$2,795,487	$15,841,094	20.5
Consumables	$13,194,092	$0.66	$659,705	$12,534,388	14.5
Reagents	$47,202,042	$2.36	$0	$47,202,042	52.0
Labour	$5,879,177	$0.29	$5,879,177	$0	6.5
Maintenance	$4,687,396	$0.23	$703,109	$3,984,287	5.2
Miscellaneous	$1,200,000	$0.06	$1,200,000	$0	1.3
Total	**$90,799,289**	**$4.54**	**$11,237,479**	**$79,561,810**	**100.0**

Reagents

	Price	Unit	Consumption	Cost	
	USD/unit		(unit/a)	USD/a	USD/t ROM
Sulphuric Acid	$275	t	37607	$12,034,277	0.60
Polyacrylamide	$2,150	t	2926	$6,422,349	0.32
LIX984N	$12,000	t	548	$6,605,986	0.33
Quicklime	$300	t	13887	$4,791,125	0.24
Limestone	$150	t	46555	$9,078,250	0.45
Calcrete/Dolomite	$13	t	0	$0	0.00
Kerosene	$550	t	3108	$1,849,164	0.09
Raw Water	$1	kL	2475430	$2,268,237	0.11
Flocculant	$2,150	t	119	$262,275	0.01
Diesel	$1	L	3923449	$3,890,380	0.19
Total				**$47,202,042**	**$2.36**

Maintenance

	Mechanical	Maintenance	Cost	
	Capital USD	%	USD/a	USD/t ROM
Crushing	$33,812,000	5%	$1,690,600	$0.08
HPGR	$24,532,000	5%	$1,226,600	$0.06
Agglomeration and Heap Leaching	$24,974,000	1%	$249,740	$0.01
Copper SX and EW	$41,819,000	3%	$1,254,570	$0.06
Iron Removal and Tailings	$3,583,000	3%	$107,490	$0.01
Process and Raw Water	$2,357,000	1%	$23,570	$0.00
Reagents	$2,861,200	3%	$85,836	$0.00
Services	$1,633,000	3%	$48,990	$0.00
Total	**$135,571,200**	**3.46%**	**$4,687,396**	**$0.23**

Plant Standby Cost

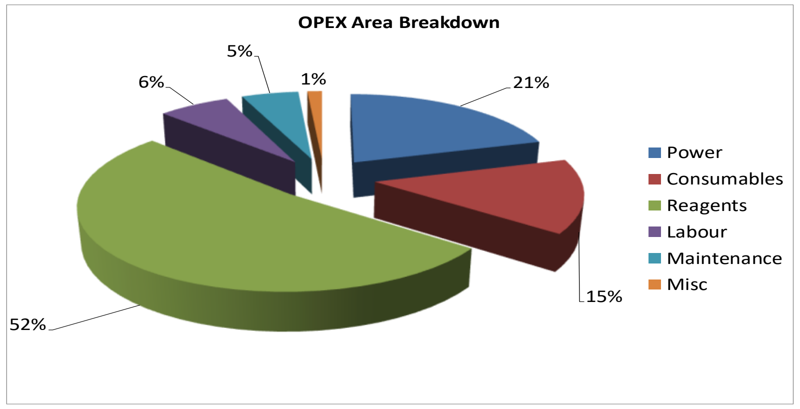
	Assumptions and Bases	% of annual total cost	Standby Cost USD/a	Dist %
Power	Agitators, thickeners and lighting persist	15.0	$2,795,487	24.9
Consumables	Air and water service costs persist	5.0	$659,705	5.9
Reagents	No reagent consumption due to no throughput	0.0	$0	0.0
Labour	All staff retain their positions	100.0	$5,879,177	52.3
Maintenance	Operational equipment maintenance	15.0	$703,109	6.3
Miscellaneous	Contract agreements	100.0	$1,200,000	10.7
Total		**12.4**	**$11,237,479**	**100.0**

Power

	Installed	Utilisation	kW	Total	Cost	
	kW	%	Draw	kWh/a	USD/a	USD/t ROM
Crushing	7,072	70	4,950	30,355,149	$2,560,882	$0.13
HPGR	8,607	90	7,746	61,071,929	$5,152,272	$0.26
Agglomeration and Heap Leaching	3,803	98	3,727	31,998,686	$2,699,537	$0.13
Copper SX and EW	12,917	90	11,625	91,653,407	$7,732,248	$0.39
Iron Removal and Tailings	309	90	278	2,192,125	$184,936	$0.01
Process and Raw Water	452	90	407	3,209,730	$270,786	$0.01
Reagents	38	90	34	268,764	$22,674	$0.00
Services	28	70	20	157,007	$13,246	$0.00
Total	**33,227**		**28,788**	**220,906,798**	**$18,636,581**	**$0.93**

Consumables

	Unit	Price	Consumption	Cost		
		USD/unit	(unit/a)	USD/a	Freight	USD/t ROM
Gyratory Crusher Liner - Mantle	set	$200,000.00	4	$800,000	$72,000	$0.04
Gyratory Crusher Liner - Concave	set	$200,000.00	8	$1,600,000	$144,000	$0.09
Cone Crusher Liners - Bowl	set	$18,000.00	12	$216,000	$19,440	$0.01
Cone Crusher Liners - Mantle	set	$18,000.00	12	$216,000	$19,440	$0.01
Secondary Screen	set	$20,000.00	8	$160,000	$14,400	$0.01
HPGR Liner and Plates	set	$1,149,512.00	1	$574,756	$51,728	$0.03
HPGR Double Deck Screen Liner	set	$25,000.00	16	$400,000	$36,000	$0.02
Pad Clearance	m2	$0.65	354918	$230,697		$0.01
Pad Earthworks	m3	$2.50	632023	$1,580,058		$0.08
Pad Liner	m2	$8.40	354918	$2,981,312	$268,318	$0.16
Irrigation Tubing	m	$7.00	5384	$37,685	$3,392	$0.00
Replacement Cathodes	set	$150.00	2259	$338,820	$30,494	$0.02
Replacement Anodes	set	$200.00	2259	$451,760	$40,658	$0.02
Copper Sulfate Bags	each	$12.50	51081	$638,511	$57,466	$0.03
Copper Sulfate Pallets	each	$15.00	51081	$766,213	$68,959	$0.04
Oil	t	$900.00	926	$833,333	$75,000	$0.05
Grease	t	$450.00	926	$416,667	$37,500	$0.02
Air Filters	set	$3,745.28	1	$1,873	$169	$0.00
Mobile Lighting Tower Parts	set	$700.00	3	$2,100	$189	$0.00
Light Vehicle Parts	set	$350.00	6	$2,100	$189	$0.00
Water Truck Parts	set	$2,100.00	1	$2,100	$189	$0.00
Forklift Parts	set	$1,750.00	2	$3,500	$315	$0.00
Ambulance Parts/Consumables	set	$700.00	1	$700	$63	$0.00
Total				**$13,194,092**		**$0.66**



Rev	Date	Engineer	Comments
A	21/04/20	DC	Issue as draft to client
A	8/04/20	BM	Began populating updated layout

21.7 Accuracy Assessment

At a scoping study level the accuracy of our Opex estimates is assumed to be at ±35% of the true Opex.

22. ECONOMIC ANALYSIS

22.1 Introduction

The project economic assessment has been conducted by METS and is developed based on accurate and up-to-date information. The economic analysis includes the calculation of Net Present Value (NPV) on both a pre-tax and post-tax basis. The estimates assume that the production, cost targets, pricing and sales goals are achieved. Any deviation from those values affects the determination of NPV. The internal rate of return (IRR), payback period and other financial metrics were calculated to assist with determining the project's viability.

22.2 Macro-Economic Assumptions

22.2.1 Metal Price Assumptions

Table 22-1: Assumed pricing data

Commodity	Units	Unit Price (US $)
LME copper	lb	2.00
LME copper	lb	2.25
LME copper	lb	2.50
LME copper	lb	2.85
LME copper	lb	3.00
LME copper	lb	3.25
LME copper	lb	3.50
LME copper	lb	3.75
LME copper	lb	4.00
Copper sulfate pentahydrate – premium	% contained copper	25
Copper sulfate pentahydrate	lb	0.64 @ 2.00 copper price
		0.72 @ 2.25 copper price
		0.80 @ 2.50 copper price
		0.91 @ 2.85 copper price
		0.95 @ 3.00 copper price
		1.03 @ 3.25 copper price
		1.11 @ 3.50 copper price
		1.19 @ 3.75 copper price
		1.27 @ 4.00 copper price

22.2.2 Royalties

The royalty for gold, copper, zinc and other base metals is 3% of the total revenue.

22.2.3 Taxes

The corporate tax for non-diamond mining in Namibia is 37.5% (as per the Chamber of Mines Namibia).

22.2.4 Financing

The economic analysis has been run on a basis of 100 percent equity financing.

22.2.5 Inflation

The economic analysis does not account for inflation.

22.2.6 Mining Costs

Mining Costs have been assumed to be US$ 2.26 per tonne. The mining is assumed to be equal to the Tschudi Heap Leach Project, which has the mining cost estimate published on the public domain.

22.2.7 Rail Freight

Rail freight has been set to US$ 45 per tonne of products to send the products to Luderitz port. This is estimated via US$ 0.075/tkm and a 600 km freight distance.

22.2.8 Wharfage and Ship Loading

The wharfage and shiploading costs have been assumed to be $US 5 per tonne of products to account for port costs and shipping costs.

22.2.9 Discount Rate

A discount rate of 7.5% has been incorporated for the base case scenarios. The sensitivity analysis assessed step changes of 1.25%.

22.2.10 Exchange Rate

Where applicable, a Namibian dollar to US dollar of 0.07 was incorporated. When estimating costs from quotes METS have received in Australian dollars, an Australian dollar to US dollar exchange rate of 0.67 was used.

22.3 Technical Assumptions

It is assumed that the project ramp up will be achieved over three years. Due to delayed leach extractions, the first year is assumed to achieve 25% of the design production, 75% in the second year and 100% by the third year.

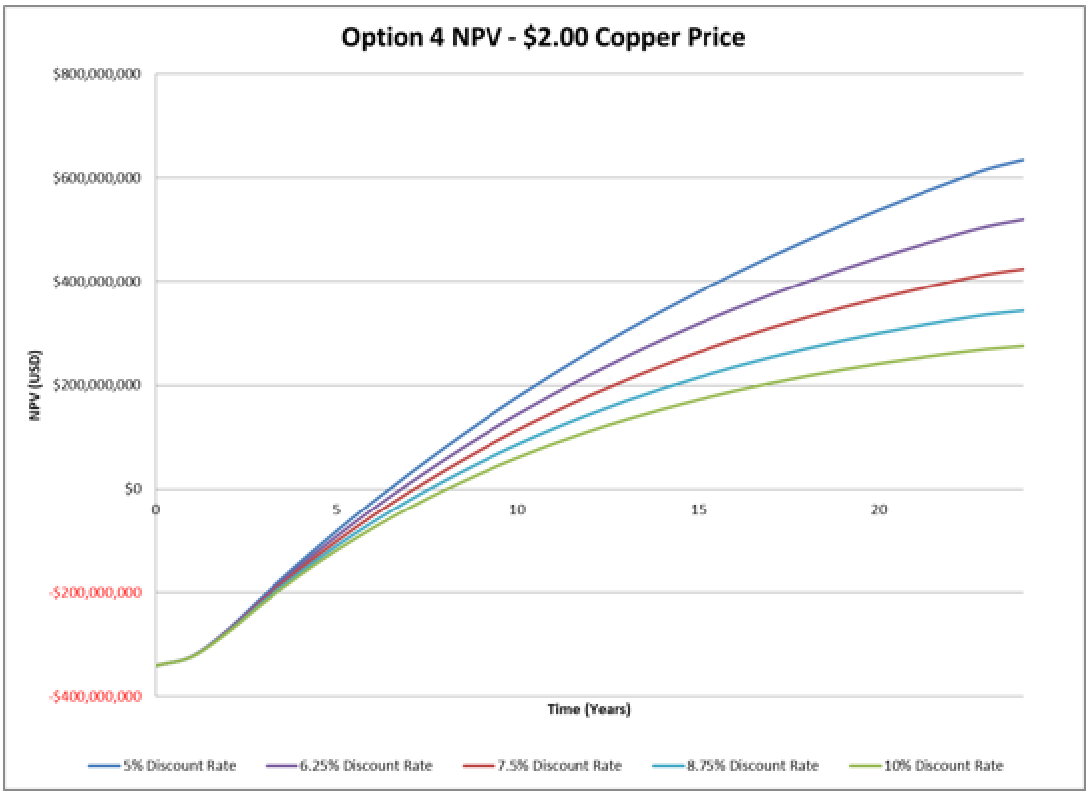
22.3.1 Economic Outcomes – Base case

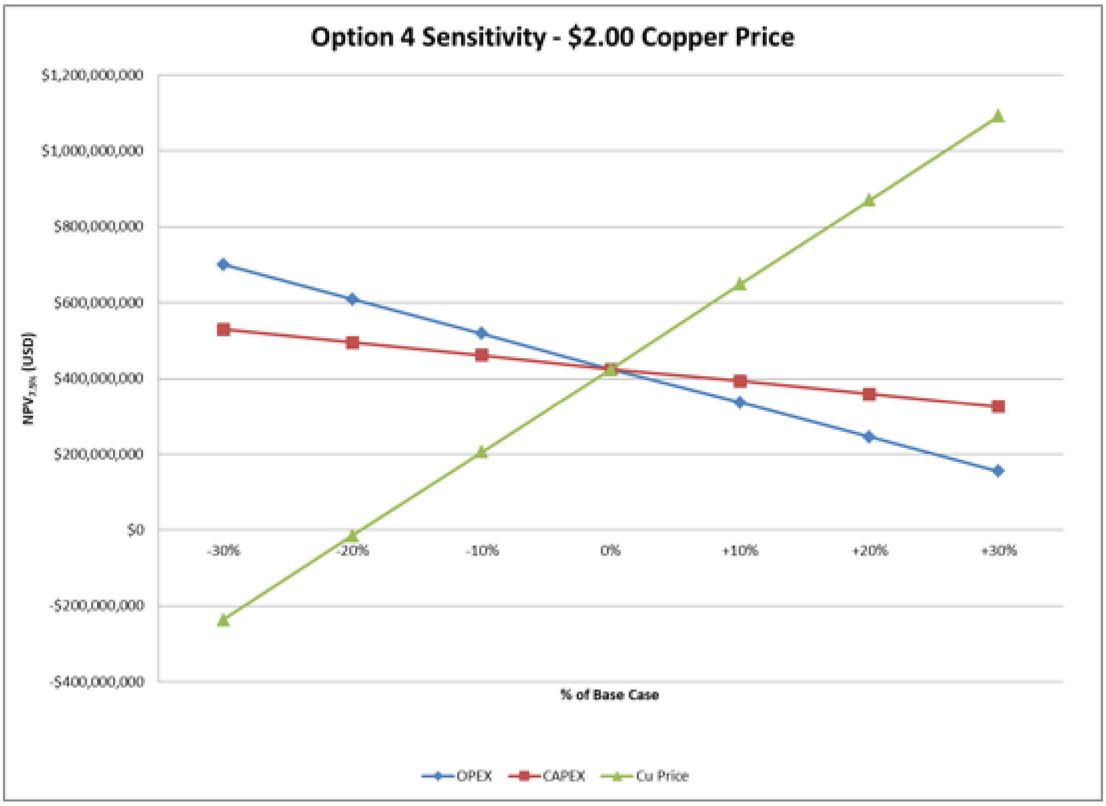
The economic outcomes of the 20 Mtpa with 80% copper recovery producing LME copper and copper sulfate scenario are summarised in table 22-5.

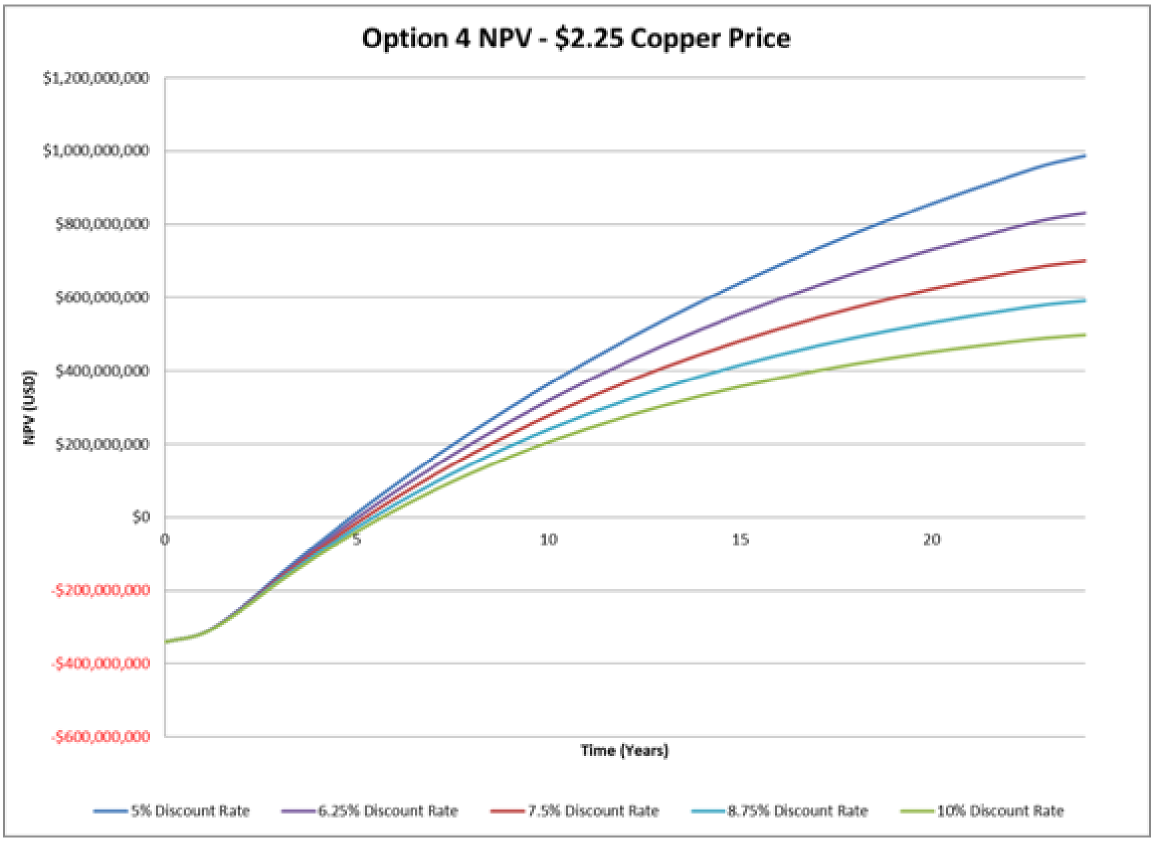
Table 22-2: Base case - Project Metrics

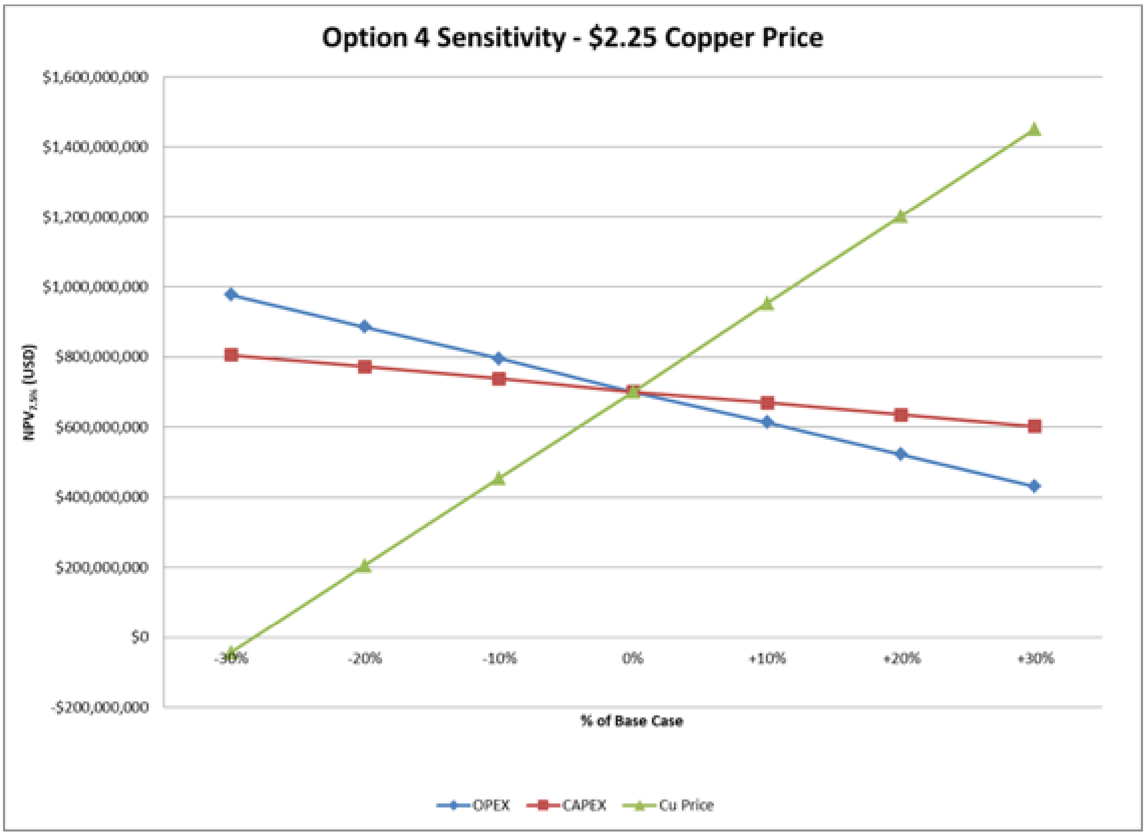
					20 Mtpa @ 80% Cu Recovery + $CuSO_4$				
LME Cu, tpa					35,332.3				
CuSO4.5H2O, tpa					51,080.9				
CAPEX, USD					$340,788,964				
Processing OPEX, USD/year					$90,799,289				
Copper Price, USD/lb	**$2.00**	**$2.25**	**$2.50**	**$2.85**	**$3.00**	**$3.25**	**$3.50**	**$3.75**	**$4.00**
Avg. Annual Revenue	$155,788,428	$175,261,982	$194,735,536	$221,998,511	$233,682,643	$253,156,196	$272,629,750	$292,103,303	$311,576,857
Avg. Annual Revenue	$71,677,731	$80,637,447	$89,597,163	$102,140,766	$107,516,596	$116,476,313	$125,436,029	$134,395,745	$143,355,462
Total Cost, USD/t ROM	$7.56	$7.60	$7.64	$7.70	$7.73	$7.77	$7.81	$7.86	$7.90
Total Cost, USD/lb CuEq	$1.33	$1.34	$1.34	$1.35	$1.36	$1.37	$1.37	$1.38	$1.39
$NPV_{7.5\%\,pre\text{-}tax}$	$424,332,976	$700,822,163	$977,311,350	$1,364,396,212	$1,530,289,724	$1,806,778,912	$2,083,268,099	$2,359,757,286	$2,636,246,473
$IRR_{pre\text{-}tax}$	18.6%	24.6%	30.1%	37.3%	40.2%	44.9%	49.4%	53.8%	58.1%
Payback Period $_{pre\text{-}tax}$	6.91	5.21	4.22	3.38	3.13	2.8	2.5	2.3	2.2
$NPV_{7.5\%\,post\text{-}tax}$	$119,122,442	$438,687,774	$611,493,516	$853,421,554	$957,105,000	$1,129,910,742	$1,302,716,483	$1,475,522,225	$1,648,327,967
$IRR_{post\text{-}tax}$	14.9%	18.9%	22.7%	27.6%	29.7%	32.9%	36.1%	39.2%	42.1%
Payback Period $_{post\text{-}tax}$	8.87	6.94	5.71	4.59	4.23	3.8	3.4	3.1	2.8
Strip Ratio					1.41:1				
LOM, years					24				

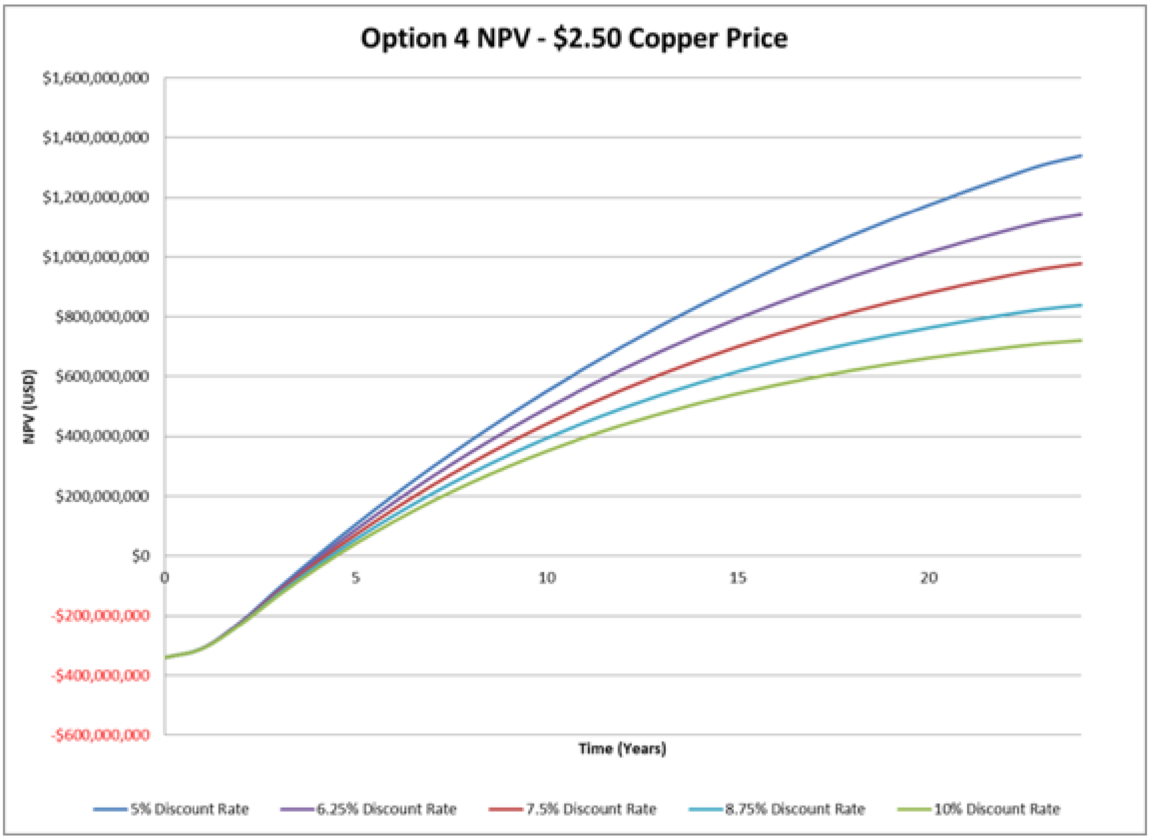
Figure 22-1: Option 4 NPV and Sensitivity Results

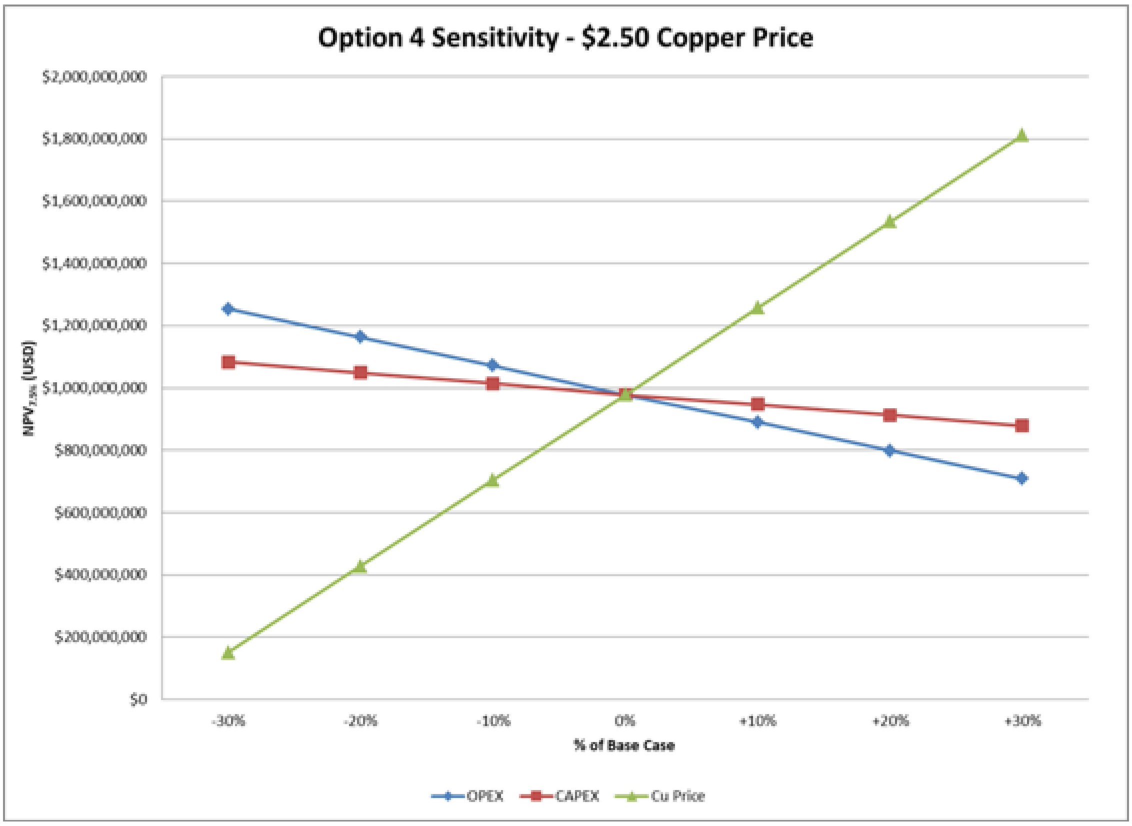


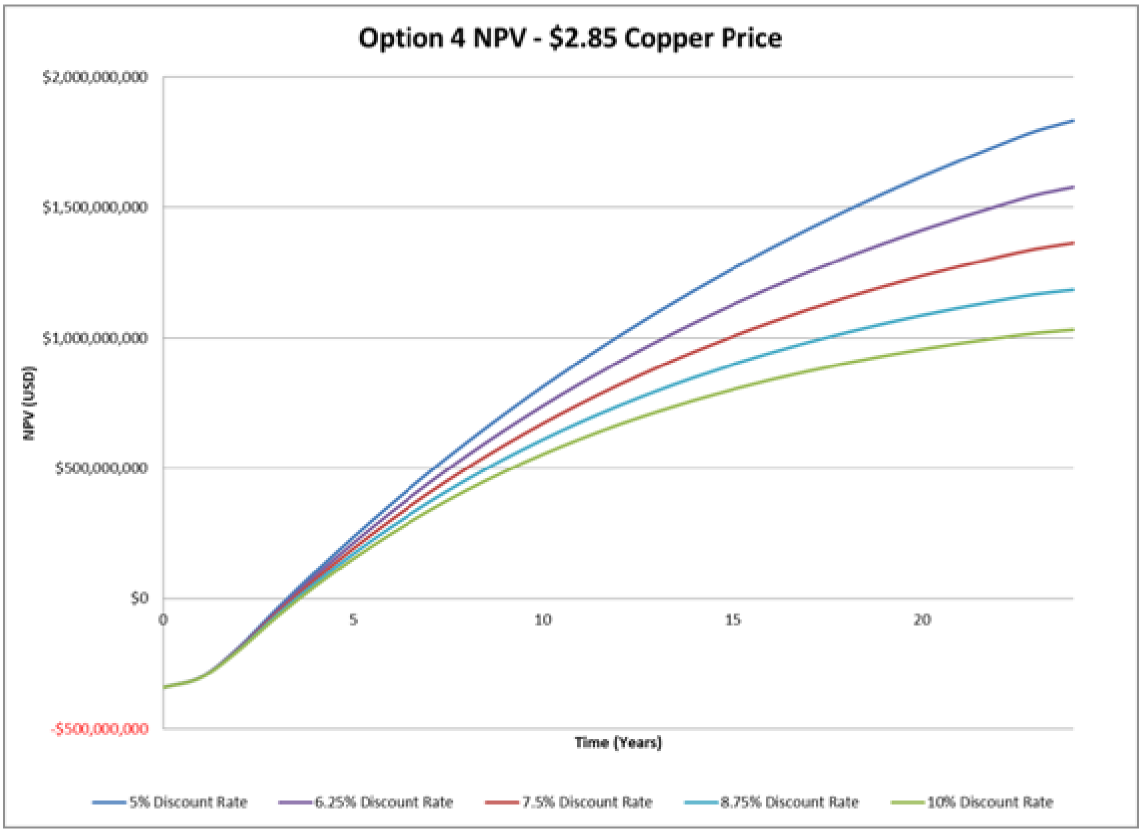



Option 4 NPV - $2.25 Copper Price
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
-$200,000,000
-$400,000,000
-$600,000,000
NPV (USD)
0
5
10
15
20
Time (Years)
5% Discount Rate
6.25% Discount Rate
7.5% Discount Rate
8.75% Discount Rate
10% Discount Rate


Option 4 Sensitivity - $2.25 Copper Price
$1,600,000,000
$1,400,000,000
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
-$200,000,000
NPV7.5% (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price


Option 4 NPV - $2.50 Copper Price
$1,600,000,000
$1,400,000,000
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
-$200,000,000
-$400,000,000
-$600,000,000
NPV (USD)
0
5
10
15
20
Time (Years)
5% Discount Rate
6.25% Discount Rate
7.5% Discount Rate
8.75% Discount Rate
10% Discount Rate


Option 4 Sensitivity - $2.50 Copper Price
$2,000,000,000
$1,800,000,000
$1,600,000,000
$1,400,000,000
$1,200,000,000
$1,000,000,000
$800,000,000
$600,000,000
$400,000,000
$200,000,000
$0
NPV7.5% (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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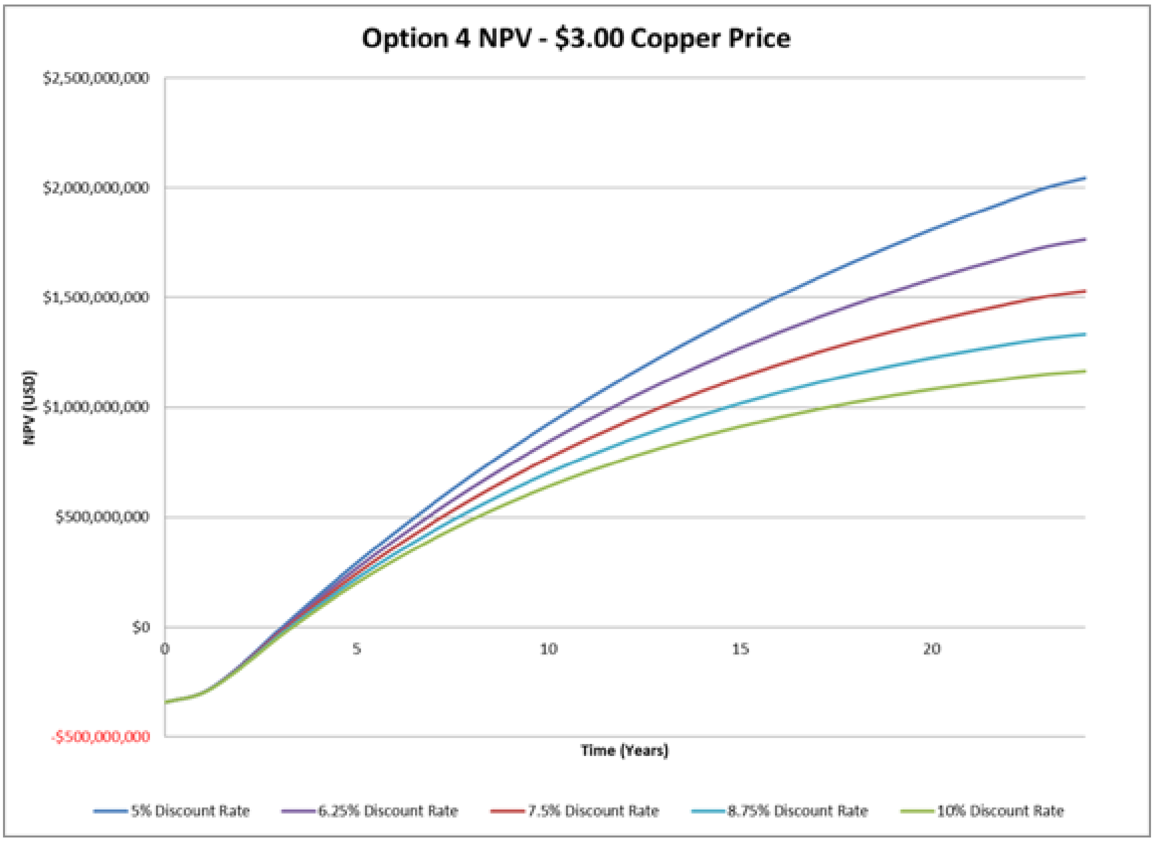
$1,000,000,000
$500,000,000
$0
-$500,000,000
NPV (USD)
0
5
10
15
20
Time (Years)
5% Discount Rate
6.25% Discount Rate
7.5% Discount Rate
8.75% Discount Rate
10% Discount Rate


Option 4 Sensitivity - $2.85 Copper Price
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
NPV7.5% (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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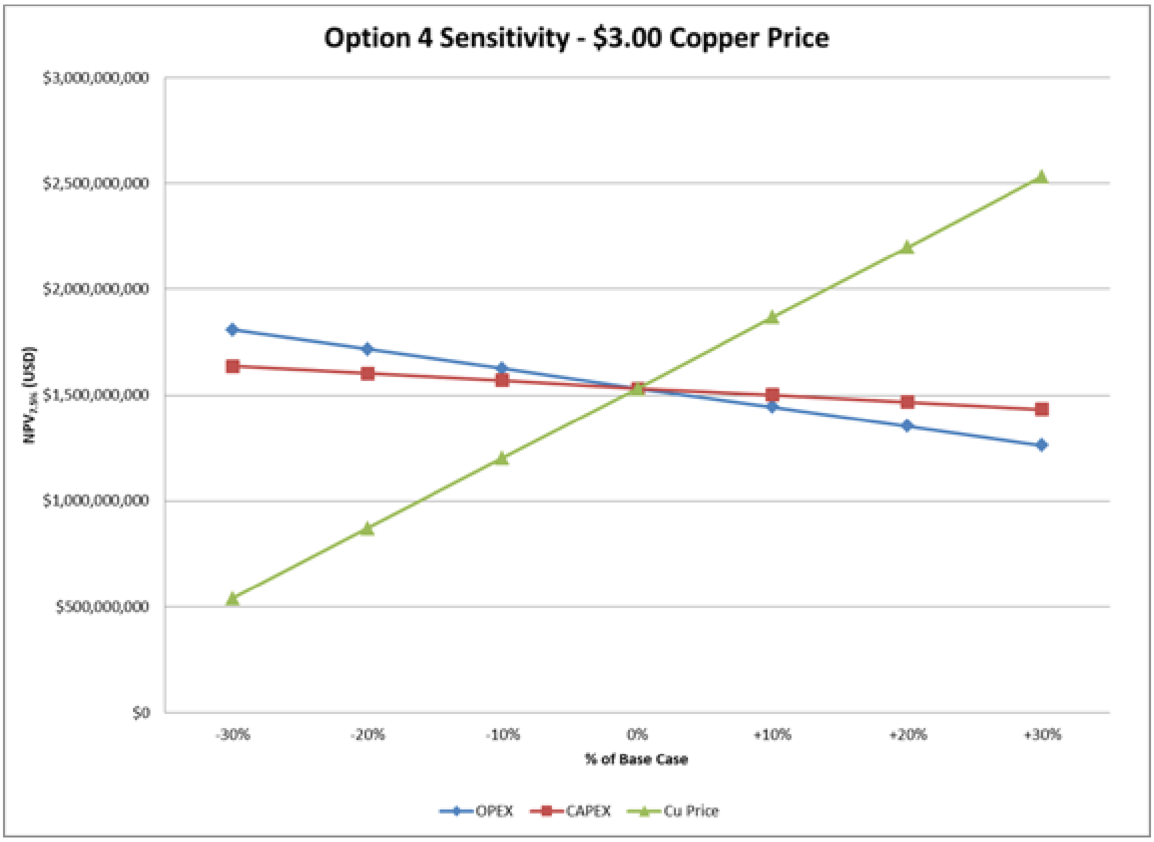
$1,500,000,000
$1,000,000,000
$500,000,000
$0
-$500,000,000
NPV (USD)
0
5
10
15
20
Time (Years)
5% Discount Rate
6.25% Discount Rate
7.5% Discount Rate
8.75% Discount Rate
10% Discount Rate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$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
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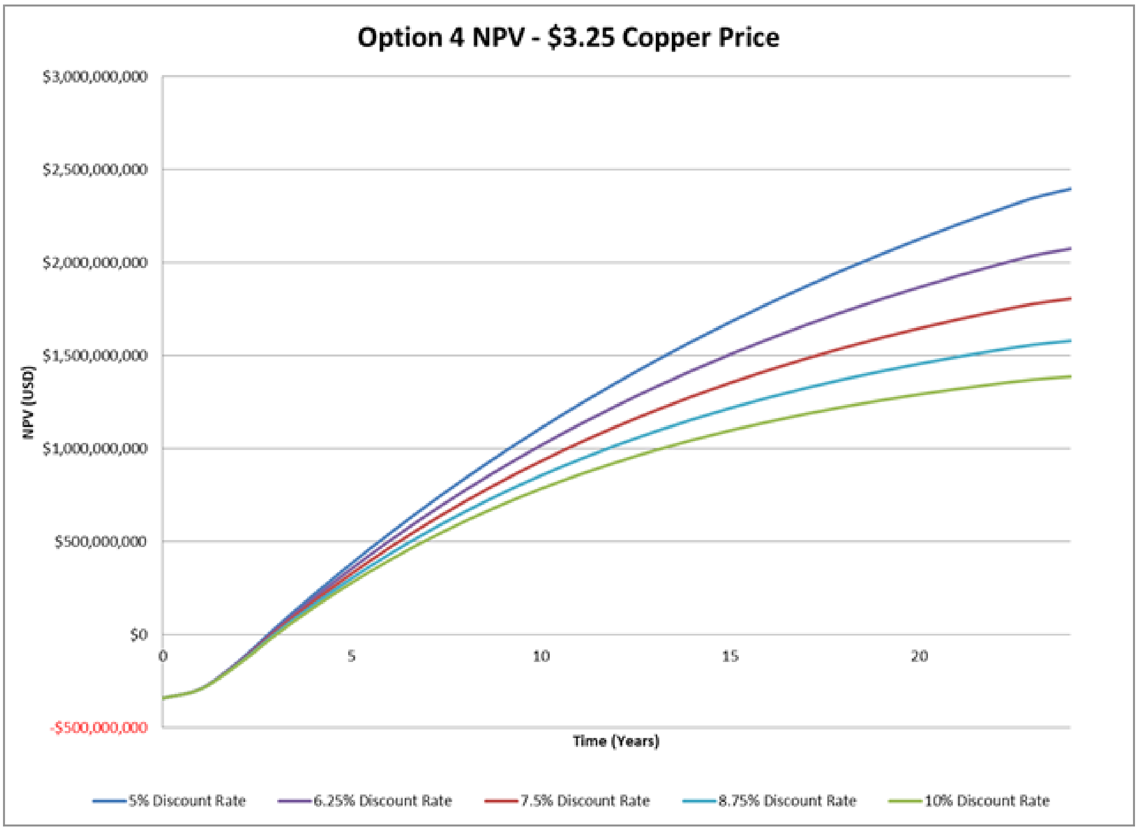
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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$1,500,000,000
$1,000,000,000
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$0
-$500,000,000
NPV (USD)
0
5
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Time (Years)
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6.25% Discount Rate
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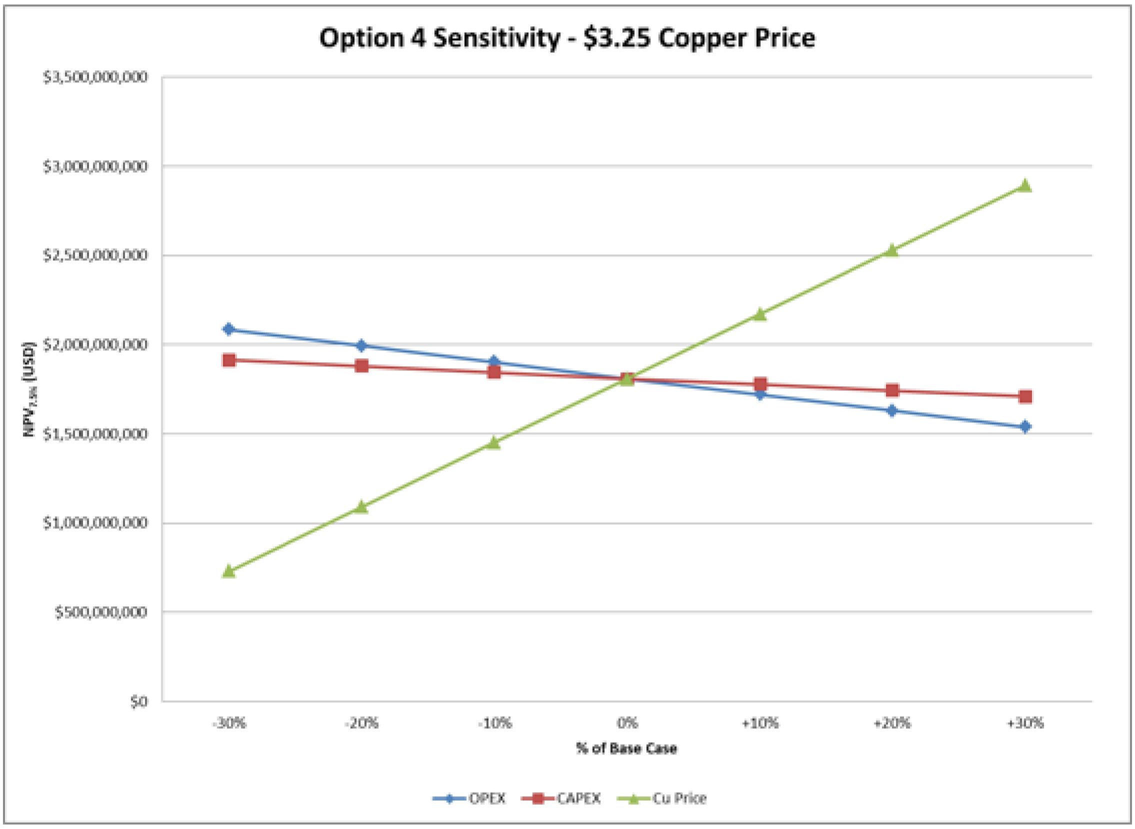
8.75% Discount Rate
10% Discount Rate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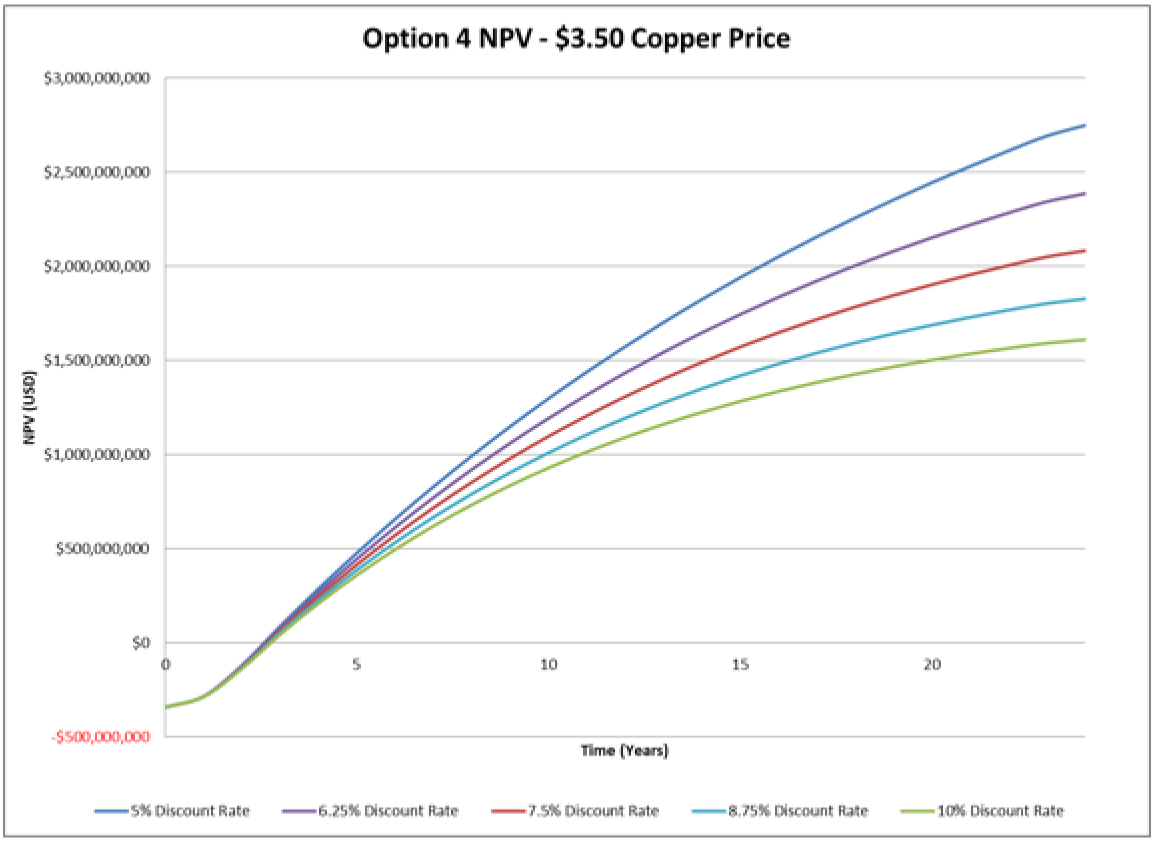
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
NPV7.5% (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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$1,500,000,000
$1,000,000,000
$500,000,000
$0
-$500,000,000
NPV (USD)
0
5
10
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20
Time (Years)
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6.25% Discount Rate
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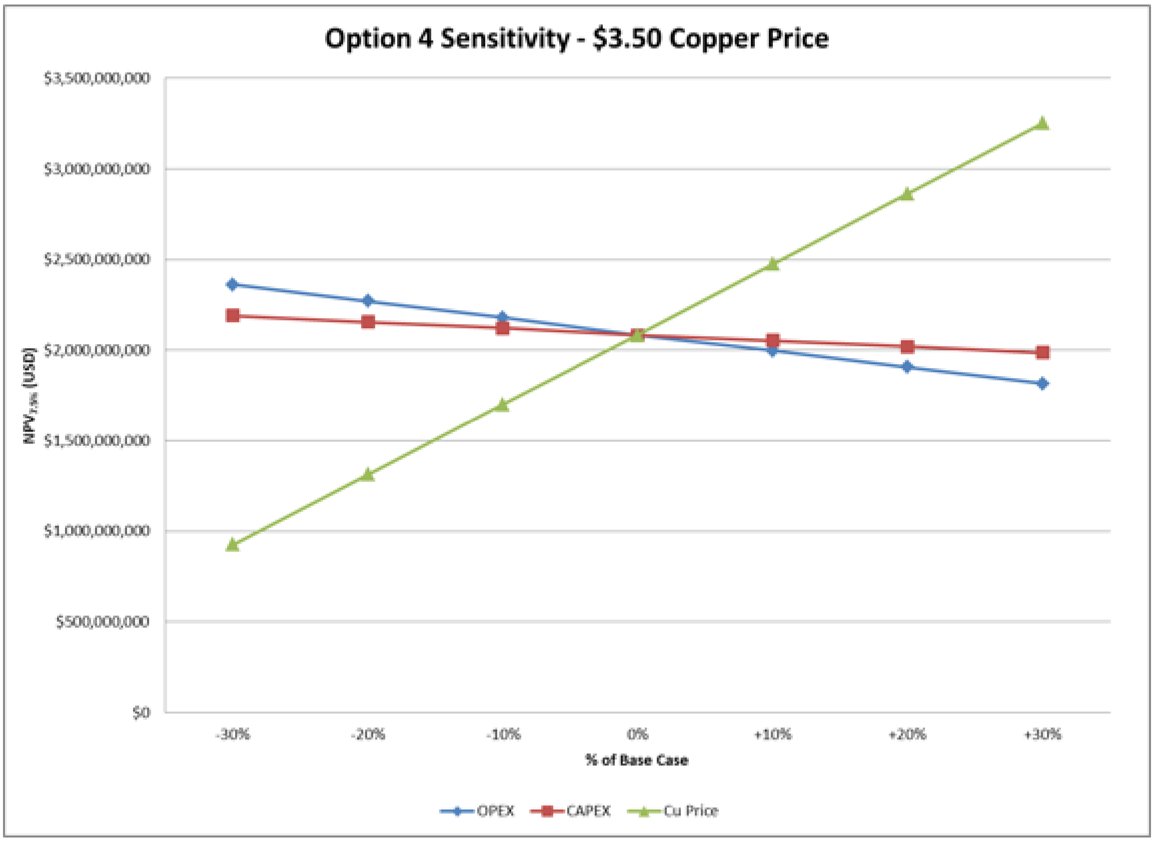
8.75% Discount Rate
10% Discount Rate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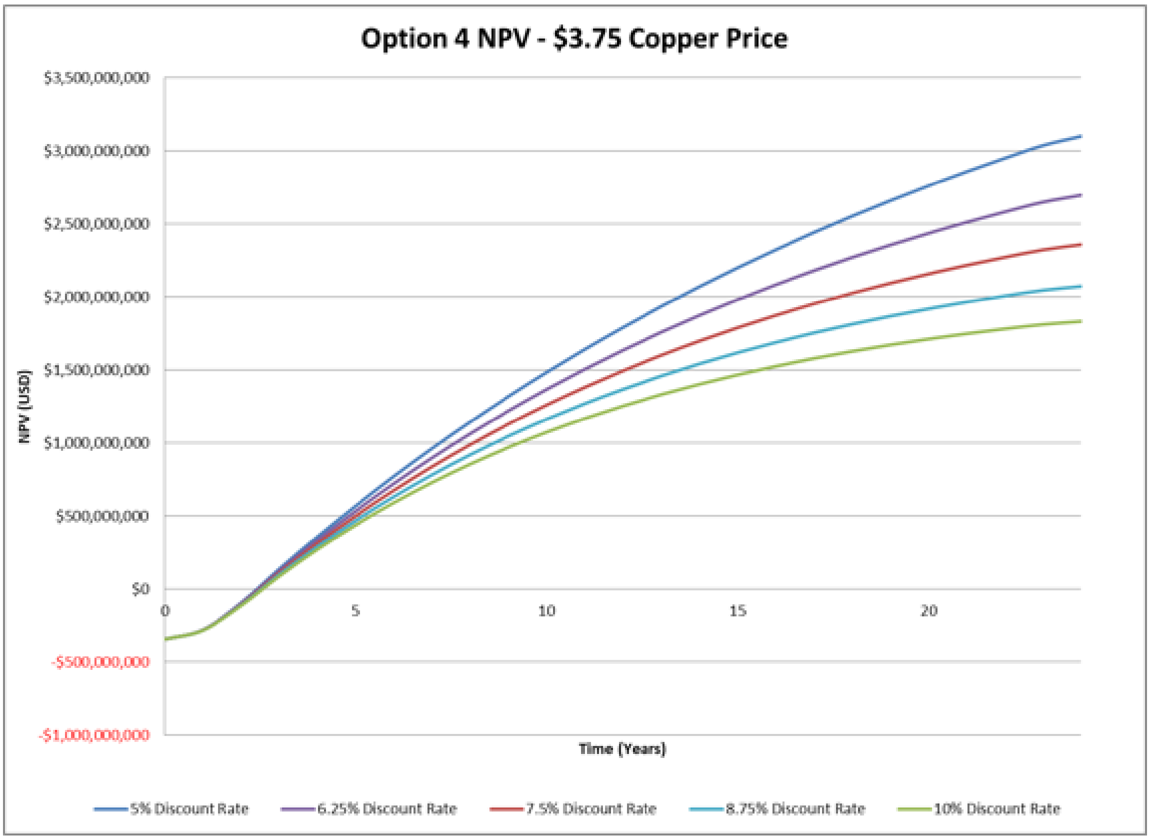
$2,500,000,000
$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
NPV7.5% (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
-$500,000,000
-$1,000,000,000
NPV (USD)
0
5
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Time (Years)
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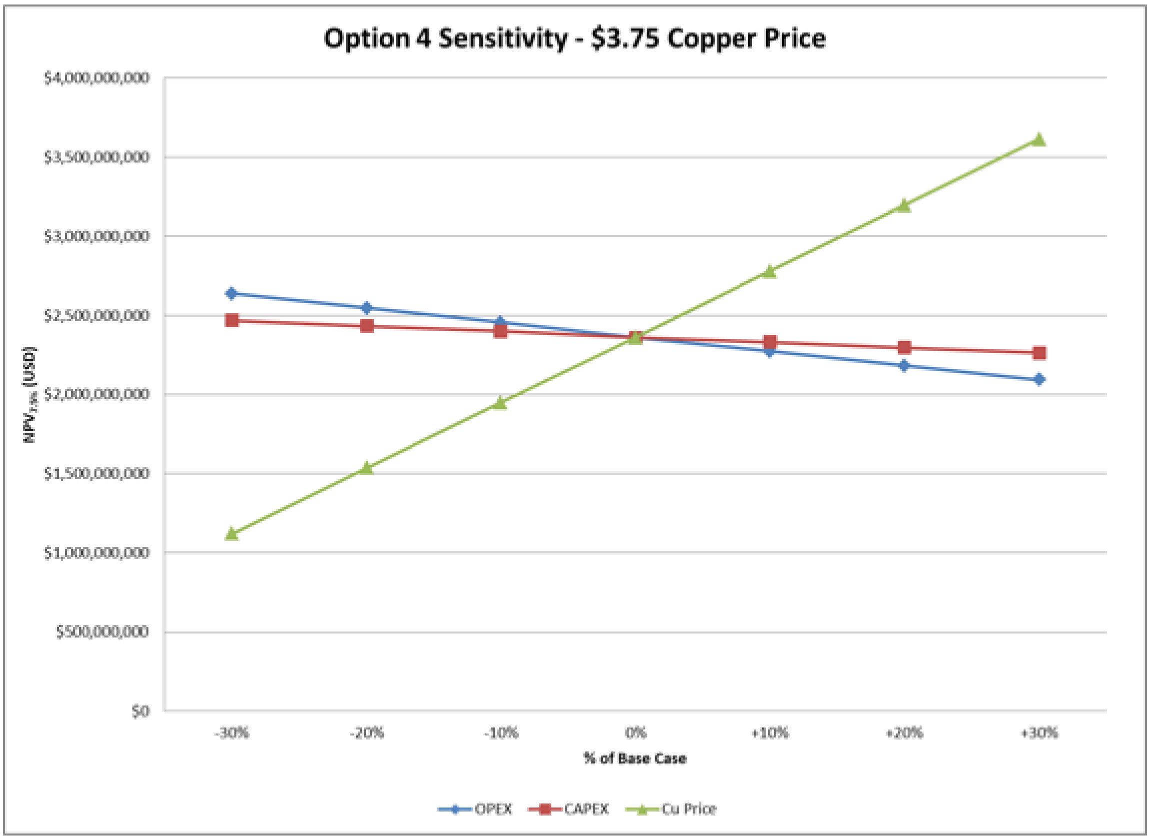
8.75% Discount Rate
10% Discount Rate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$2,500,000,000
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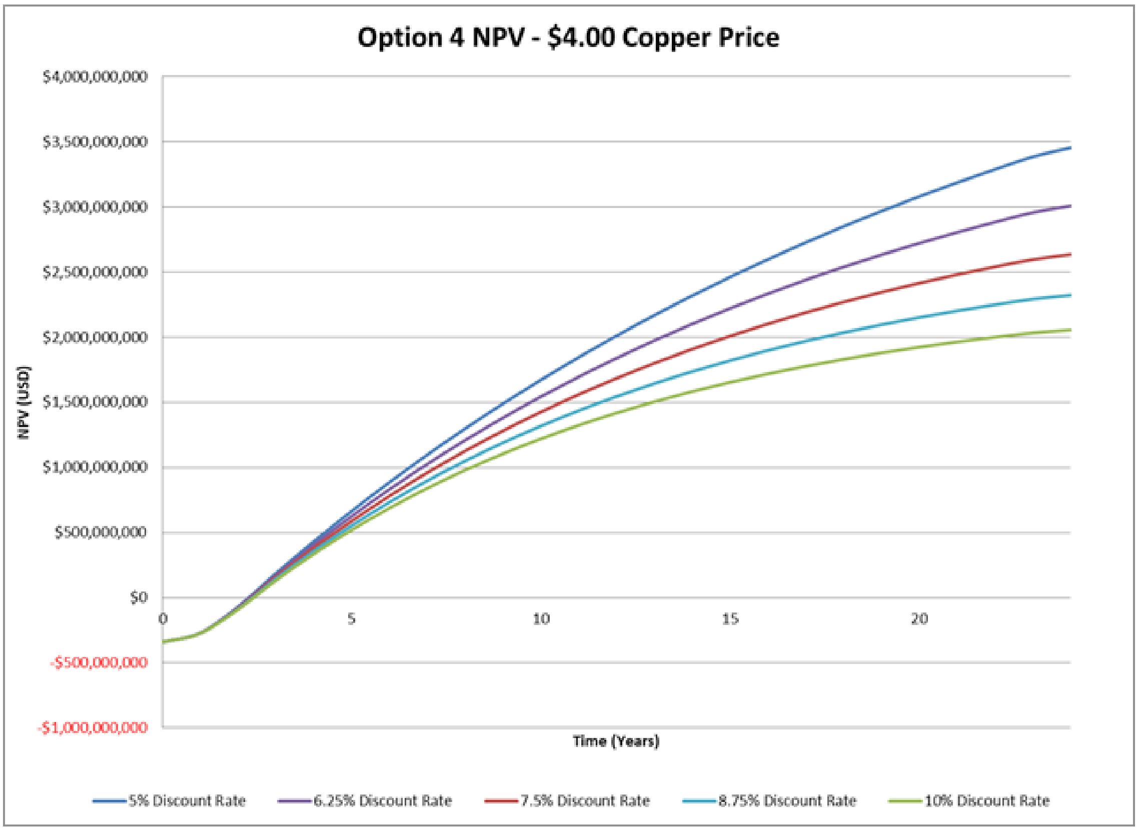
$1,500,000,000
$1,000,000,000
$500,000,000
$0
$NPV_{7.5\%}$ (USD)
-30%
-20%
-10%
0%
+10%
+20%
+30%
% of Base Case
OPEX
CAPEX
Cu Price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$2,000,000,000
$1,500,000,000
$1,000,000,000
$500,000,000
$0
-$500,000,000
-$1,000,000,000
NPV (USD)
0
5
10
15
20
Time (Years)
5% Discount Rate
6.25% Discount Rate
7.5% Discount Rate
8.75% Discount Rate
10% Discount Rate

22.4 Economic Opportunity

Based on the current testwork programme, the low-grade pyrite bearing ore will generate a significant amount of sulfuric acid during the heap leaching process. As a result, the acid requirement for the plant has been reduced which resulted in the removal of the sulfur burning plant for the 20 Mtpa scenarios. The cost of sulfuric acid has been estimated at a cost of US$ 275 per tonne DPA to Noordoewer according to quotations received. There are opportunities of reducing the sulfuric acid cost such as sourcing acid from local smelters and off-gas cleaning facility. Alternatively, the option of including a sulfur burning plant can still be considered as it reduces the reagent costs and generates power for producing sulfuric acid. There will also be waste heat for heating the heap solutions.

The limestone cost has been estimated at a cost of US$150 per tonne which is very expensive as it is sourced internationally. The project economics can be improved if limestone can be sourced from local resources.

22.4.1 Project Viability

Based on the findings of the economic analysis, the Haib project has a significant potential to be a profitable project. Modern processing technology can be used to assist in maximising the economic potential of such a large resource.

23. ADJACENT PROPERTIES

There are several large properties currently held by other exploration companies that completely surround the Haib property. These properties can be viewed from maps and lists extracted from the Namibian Department of Mines and Energy website http://www.mme.gov.na/publications/?designation=dm.

As far as I am aware, no comprehensive exploration programme for copper or base metal mineralisation has been reported on any of these properties despite historically reported visible surface indications of oxide copper, particularly to the southeast and east of Haib in Haib Volcanics and Vioolsdrift Intrusives.

24. OTHER RELEVANT DATA AND INFORMATION

There are no other relevant data and information contained in this report.

25. INTERPRETATION AND CONCLUSIONS

25.1 General Summary

The Haib mineralization is undoubtedly a porphyry copper system and is probably one of the oldest known, preserved, porphyry deposits in the world.

Historical exploration work showed that the Haib project has large but low-grade copper mineralization.

Teck's exploration results from the geological mapping, stream and soil sampling, geophysical survey and core drilling programmes to date contribute positively towards achieving HM's objective of providing a better understanding of the controls on high grade sections of the main Haib mineralized body and the nature of the satellite anomalies proximal to the main Haib body.

The deposit has been the subject of a new Resource Estimate using the results of historical drilling and also the newer Teck drilling and this study estimates that the Haib deposit has, using a 0,25% Cu cut-off grade, an in situ Indicated Resource of 457 million tonnes at an average grade of 0,31% Cu and an Inferred Resource of 342 million tonnes at an average grade of 0,29% Cu.

The Directors and majority shareholders of DSM and their wholly owned subsidiary HM are positive about the further development of the project and have commissioned this Preliminary Economic Assessment in order to show economic merit in development of the project towards full feasibility.

Damian Connelly believes the low-grade nature of the Haib porphyry copper deposit makes it an ideal candidate for heap leaching. Developments in heap leaching of refractory ores in conjunction with modern ore sorting technology have the ability to maximise the economic potential of the Haib project.

Mark Gallagher believes that the characteristics and geometry of the Haib deposit as well as its proximity to surface mean that the deposit lends itself to extraction by open pit mining methods. The deposit is basically composed of hard rock material and the mining operations will involve drill and blast of all excavated material, which will be designated as either mineralized material or waste on the basis of samples taken from blast hole drilling and application of the cut-off grade.

Based on the findings of this PEA, the Haib project has reasonable prospects for eventual economic extraction. Modern processing technology can be used to maximise the economic potential of such a large resource.

25.2 Significant Risks and Uncertainties

25.2.1 Risks

Risk is defined in the Australian Standard on Risk Management (AS/NZS 4360:1995), as "the chance of something happening that will have an impact on objectives".

Risk has two characteristics that need to be understood to be managed. They are:

1. It has a focus on future events; therefore it deals with *uncertainty*.
2. It generally focuses on *unfavourable events*, although the process can be used to identify opportunities.

Risk has two dimensions that need to be jointly assessed to determine the magnitude of risk. They are *likelihood* and *consequence*:

1. *Likelihood* refers to the possibility that a particular event will (or won't) occur. It is a general term, which applies to *probability* or *frequency*.
2. Consequence refers to the extent to which a given event has an adverse impact on objectives. It is also referred to as severity and the two terms are interchangeable. Consequences can be expressed quantitatively (High or $2M)

Risk management is a structured approach to managing risks. The standard defines risk as "the systematic application of management policies, procedures and practises to the tasks of identifying, analysing, assessing, treating and monitoring risks."

Risk management process can be applied to resource projects as an essential part of good business management practice.

25.2.2 Haib Risk Assessment Process

We have focussed on events, which will happen in the future and therefore have an uncertain or unpredictable outcome. The extent to which an event is predictable is dependent on a number of factors including its uniqueness, the amount of information available from previous similar events and the degree of correlation between the event and other predictable or measured factors.

Resource projects by their very nature are unique; therefore, there is a high degree of uncertainty about whether or not the project objectives will be achieved. Even though the unit processes within the project are relatively predictable and not new technology, the relationship between the processes and interlinking is such that the outcome is less certain.

25.2.3 Establish the Context of the Review

This was an important step because it determined the scope of the review and the extent of the risk management study.

The scope included the mining, process, infrastructure and planning, power supply and transmission, water and tailings, financial analysis, project schedule and environmental management.

25.2.4 Identify the Risks

The analysis looked at each unit process step for the project and based on the information provided and our own experience we have identified all possible events that could impact on the project. We have also used discussions with the client, reviewed the laboratory reports, creative thinking techniques and internal discussions with colleagues to ensure we have captured all of the likely events.

25.2.5 Analyse the Risks

This involved assessing the likelihood of the identified risk events. The analysis was then quantitatively or qualitatively assessed to provide the information and determine probabilities the main purpose being to rank risk rather than assign a value.

25.2.6 Prioritise the Risks

This has been achieved by ranking the risks in each area and sorting the ranking from the highest to the lowest. This is necessary because with limited resources the major effort must be put into addressing the highest risk area (Paretto principle 80/20 rule).

25.2.7 Haib Risk Table

The risk matrix used for the Haib project is shown in Table 25.1

Table 25-1: Subjective ranking matrix

		Consequence		
		Low	**Moderate**	**High**
Likelihood	**Low**	*Low*	*Low/moderate*	*Moderate*
	Moderate	*Low/moderate*	*Moderate*	*Moderate/High*
	High	*Moderate*	*Moderate/High*	*High*

25.2.8 Risks Identified

The major risks identified are detailed in the following list and Table 25-2.

1. Insufficient metallurgical testwork has been undertaken. It is anticipated that the following testwork will be required:
    - Comminution on representative samples (HPGR)
    - Close circuit column leach tests on representative samples
    - Solvent extraction testwork
    - Acid generation tests of low grade mineralized material
    - Geotechnical tests to confirm the stacking height of the heaps
    - Variability testing
2. Trade off studies is required regarding purchasing sulfur and making acid on site or purchasing sulfuric acid.
3. The optimum port and infrastructure need further study work.
4. Variability within the deposit.
5. Optimised transport routes.
6. Limited work was done for mining. This will be fully addressed in the Pre-Feasibility Study.

Table 25-2: Risk register

Item	Likelihood	Consequence	Current Risk	Discussion	Amelioration	Residual Risk
1	Moderate	High	Moderate/High	Current testwork does not reflect the entire proposed design	Perform testwork to validate process.	Moderate
2	Low	Moderate	Low/Moderate	There are several options for acid and possible shortfall in supply	Perform a study into possible suppliers and sulfur burning options.	Low/ Moderate
3	Moderate	Moderate	Moderate	The Luderitz port may not have the facilities required to facilitate goods inward and outward	Ensure the Luderitz port is capable of handling the import and export goods. Assess the impact of using the Walvis Bay port.	Low/ Moderate
4	Moderate	High	Moderate/High	Off specification product (very high dilution).	Extensive drilling and geometallurgy to be conducted.	Moderate
5	Low	Low	Low	Particularly for the mine-to-plant. If a conveyor is used will there be enough excess to allow for expansions.	Develop an expansion plan and build the conveyor accordingly.	Low
6	Moderate	Moderate	Moderate	Limited mining work was done leading to conservative mining design	Perform additional and appropriate mining work.	Low/ Moderate

25.3 Opportunities

The following opportunities have been identified which need further study to determine their effect on project economics: -

25.3.1 Solar Energy

Given the semi-arid climate and the annual hours of daylight in southern Namibia, a solar energy farm may be an option for reducing the unit cost of power. This will also have positive social impacts for the project, which is expected to have a long life. This will be evaluated in the Pre feasibility Study.

25.3.2 Project Expansion

The vast resource tonnage already identified allows for multiple expansion stages to be executed once in production. A staged approach is recommended in order to de-risk the project by ensuring the project achieves positive cash flow prior to plant expansions. This will be evaluated in the Pre-feasibility Study.

25.3.3 Optimisation

During operation there should be ongoing optimisation studies to ensure the project financials are maximised. This should include optimisation of the metallurgy, recoveries, products and raw materials. This will be evaluated in the Pre-feasibility Study.

25.3.4 Sulfur Burning Plant

There are several possibilities for sulfuric acid sourcing, including purchasing from smelters within Namibia. Tsumeb has an off-gas cleaning facility that produces sulfuric acid for sale. An alternative would be Vedanta Resources who have suggested producing and sending zinc concentrate from their Gamsberg zinc mine to Skorpion mine at Rosh Pinah which is located closer to the Haib site than the alternative options. Buying in sulfuric acid at the start of the project life and building a sulfur burning plant once the project is cash flow positive may provide a better economic scenario. This will allow for the sulfur burning plant capital to be deferred and the payback period to be shortened. This trade-off study will have to be completed once accurate sulfuric acid pricing and the source of the acid have been obtained.

This could also involve floating sulphides from the fines and roasting to produce acid onsite. This will be evaluated in the pre-Feasibility Study.

25.4 Interpretation and Conclusion - QPs’ Comments

In all of the QPs’ opinion, HM is exploring a large volume porphyry copper deposit situated in an ideal location adjacent to modern infrastructure which has the potential to become a large copper resource. There already exists a significant body of technical data concerning the Haib mineralisation and the period between resource estimation, pre-feasibility and definitive feasibility studies could be relatively short.

In Damian Connelly’s opinion, the results from the PEA have been promising, and going forward he recommends that the Issuer conducts a Pre-Feasibility Study (PFS). To improve confidence in the PFS results, more detailed metallurgical testwork, including a pilot processing plant, will be required to validate the process options outlined in this report.

26. RECOMMENDATIONS

26.1 General

DSM has ownership of a significant, although highly challenging project in the Haib deposit which could rapidly progress to a PFS with a great deal of the investigative work already completed.

Teck Namibia correctly saw: -

- that the potential discovery of a satellite mineralized body could both increase the in-situ tonnage and provide a higher-grade zone that would help alleviate high initial CAPEX costs and,
- that the drill programme should also continue to investigate the potential higher-grade zones within the main Haib mineralized body.

These programmes have been continued for the last several years and were very successful in identifying satellite mineralized bodies to the Haib and redefining the mineralization within the Haib main mineralized body. Unfortunately, to date, the satellite body exploration programme has not developed significant additional higher-grade zones.

The Teck geological mapping of the higher-grade zones indicated that these were insufficiently defined by the vertical RTZ drilling since many geological features controlling the distribution of mineralisation are sub-vertical meaning that some of the more important / significant mineralized zones were under sampled. This suggests that there is an imperative to complete more infill drilling in the higher-grade zone identified by the new Resource modelling.

26.2 Recommended Exploration Programme

A number of recommendations have been identified by the authors, which will be progressively investigated and potentially implemented as the Project progresses.

DSM has used both the historical RTZ and Teck data and models to provide a new Resource Estimate and has commissioned a further study of processing methods to form the basis of this Amended Preliminary Economic Assessment. These will lead to further detailed studies to bring the project to the completion of a pre-feasibility study.

This programme was proposed and accepted by the Namibian Ministry of Mines and Energy and forms part of the documentation submitted in support of the renewal of the EPL for the period April 2017 to April 2019.

All phases of the programme will be results driven; for example, areas that may lack data in the 3-D model may require additional drilling and assaying with further resource estimation to drive decision making for mine planning and economic studies. The future budgets are therefore preliminary and may be changed at any stage, however the total actual expenditure during the renewal period must equal or exceed 80% of the total budgeted commitment in order for further renewals of the EPL to be granted.

26.3 Pre-Feasibility Study

26.3.1 Introduction

DSM holds a very large and detailed data base on the project including but not limited to: 66,000 meters of drilling with assay results and cores stored on site, various historical estimates, various metallurgical test work, various pits and mine modelling, geophysical surveys and many others. It is recommended to proceed with additional drilling and metallurgical test work to complement the data base and to proceed with a Pre-Feasibility Study. The PFS Implementation Plan contemplates a staged project delivery comprising:

26.3.2 Drilling

Drilling 4,000 meters in the higher grade pit #1 area is considered a priority in order to develop a measured resource over the area and delineate targets for future drilling to eventually develop a measured reserve within the mineralized area.

26.3.3 Computer modelling and mineral resource estimation

The results of the further drilling program added to the existing data will be used to conduct and complete a new resource estimate and a new pit and mine model that will be used in the PFS.

26.3.4 Metallurgical Testwork

To improve confidence in the PFS results more detailed metallurgical testwork will be required. Most work to date has focussed on the potential of processing options and is not sufficient to truly evaluate their feasibility with confidence.

26.3.4 Drill Core

Drill core should be used in the next stage of testwork. The use of drill core will minimise the risk of drilling methods significantly changing the properties of the test material, providing high quality sample for the tests described below:-.

26.3.5 Column Leach Tests

Column leach tests will be required for the PFS to determine several key heap leaching parameters with higher accuracy than those used for the scoping study. Previous testwork was designed to test the amenability of the ore to leaching by sulfuric acid. The testwork revealed that copper can be leached from the mineralized material, however the conditions did not accurately represent the conditions that will be experienced in a heap leach. In addition, the 2019/2020 testwork programme was carried out on samples of higher copper grade. The samples were coming from well preserved stockpile material that was extracted in the adit in the higher grade area. It is important to note that the sample head grade at 0.73% Cu is higher than the average grade of the resource estimation and it is not guaranteed that it is a representative sample of the overall deposit.

The results from a pilot scale heap leach operation will be required at a later stage of the project development to provide better sulfuric acid consumption and metal recovery data for the economic assessment.

Column leach tests are small scale laboratory tests designed to evaluate the amenability of an ore to heap leaching. Like a full-scale heap leach, the ore is agglomerated, the agglomerated ore is placed in a column (avoiding packing of material) and a solution is percolated through the column with intermittent monitoring to determine acid consumption figures. Two copper head grades will be evaluated in the PFS.

The PLS from the column leach tests can be used for solvent extraction testwork which will be required to determine the configuration of the copper solvent extraction circuit. Optimisation of leaching and stripping solutions is crucial to optimisation of the solvent extraction circuit.

Electrowinning tests can then be conducted on the strip liquor from solvent extraction in order to determine the cell operating conditions and the purity of the copper product to determine if changes are required to the solvent extraction configuration and operating conditions.

26.3.6 Variability Testwork

The 2019/2020 testwork performed on samples which is considered only representative for higher-grade (~1% Cu) zone in the Haib deposit. The average head grade of the sulfide mineralization across the Haib deposit is lower at ~0.31% Cu.

It is recommended that further drilling be conducted to collect sample from different locations of the Haib deposit so as to collect samples with different head grades. Variability testwork should be performed on the samples to confirm the results.

26.4 Engineering

Engineering design will be required at a sufficient level to evaluate the project within a ±25% level of accuracy. Factors such as heap leach design will be critical to the success of the project and the design needs to be established early in the PFS. The engineering design from this stage of the project should also have enough detail to move into the detailed design of the project.

26.5 PFS Cost Estimation

Table 26-1: Summary of Estimated Programme Costs.

This is currently (December 22nd 2020) equivalent to ***C$ 2,329,600 or N$23,296,000***

Item	Cost (US$)
Computer Modelling & Resource Estimation	80,000
Further Metallurgy & Process Technology & Economic Investigation	400,000
Drilling (4000 metres HQ diameter and assays)	750,000
Pre-Feasibility study report and engineering	350,000
Miscellaneous (supervision, accommodation, etc)	75,000
Contingency (10%)	165,000
Total	**US$ 1,820,000**

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