4 CHIBULUMA MINE

4.1 Introduction

[SR1.5A(i)]

Metorex has an 85% interest in Chibuluma, which has as its main operating asset the Chibuluma South mine. The Chibuluma East and Chibuluma West mines are now depleted, but Chibuluma remains liable for environmental rehabilitation. The remaining 15% interest is held by ZCCM-IH and the GRZ. The Chifupu Project, located approximately 1.7 km southwest of Chibuluma South mine, forms part of the Chibuluma South mine licence.

Chibuluma South mine is an underground, mechanised mine capable of treating 50 ktpm of RoM ore, which is located near Kalulushi in Zambia.

4.2 Location, Climate, Access and Infrastructure

[SR1.4A, SR1.5A(i), SR1.6, SV2.3]

The Chibuluma South mine is located at latitude 12°53'S and longitude 28°05'E, and approximately 15 km west of Kitwe. Kitwe is the second largest town on the Zambian Copperbelt and is approximately 300 km north of the capital city, Lusaka (Figure 4.1). The Chifupu deposit is located approximately 1.7 km southwest of the Chibuluma South mine.

The topography of the area is generally flat and lies at an altitude of 1 220 – 1 300 m above mean sea level. The Zambian Copperbelt is located in a sub-tropical zone characterised by distinct wet and dry seasons. Annual rainfall is approximately 1 200 mm and occurs during a wet season (summer) lasting from October to March with the heaviest rainfall occurring in December and January. Rainfall generally occurs as short thunderstorms any time during the day or night, and it is not uncommon to have 50 mm of rain in the space of a few hours.

The average air temperature remains fairly constant at between 17°C and 22°C throughout the year and there is no distinct winter and summer temperature regime. Average temperatures peak during September and October at 30°C. The coldest month is July with an average daily minimum temperature of 10°C.

The vegetation in the area is deciduous tropical woodland generally referred to as Miombo Woodland, characterised by woodland interspersed with broad grassy and seasonally waterlogged areas known as dambos in Zambia. Trees seldom grow to heights exceeding 20 m, with the majority less than 8 m high. In recent years, the area has been heavily impacted by charcoal burners.

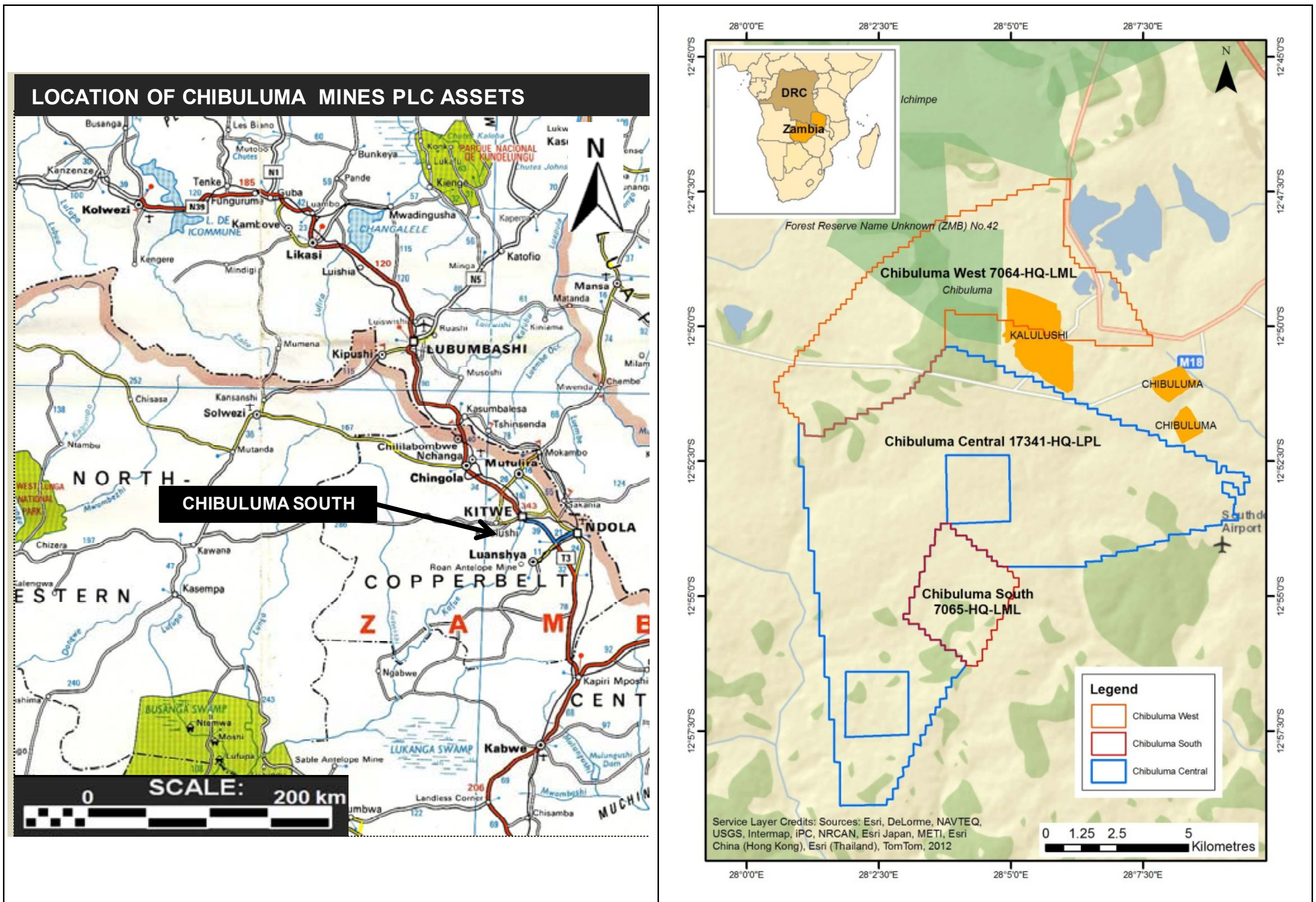
The town of Kalulushi was developed in the 1950s by Roan Selection Trust ("**RST**") to support the Chibuluma East and West mines. It is a mining town with approximately 3 300 houses with its own hospital and clinic, schools and recreational facilities. The town is accessed by a tarred road from Kitwe which was repaired and paid for by donor funding from China in 2007. The town is supplied with electricity by the ZESCO and fresh water from local drill holes and a pipeline from Kitwe by Nkana Water and Sewerage Company. The town has its own sewage works and internal water reticulation and is linked to the National Zamtel telephone network.

The South Downs airstrip is approximately 8 km from the Chibuluma South mine and is a tarred strip capable of handling light aircraft. The Copperbelt itself is well serviced by rail, road and air services with daily international flights from Johannesburg landing at Ndola International Airport, an hour's drive from Kitwe.

The T3 road to Lusaka is all tar and in sound condition. This road network also serves as the main logistics servitude for mines in the DRC. All major towns on the Copperbelt are served by rail links to Lusaka, Dar es Salaam (Tanzania) and South Africa but in general, this network is inefficient and rolling stock and locomotives are not in a satisfactory condition.

The Chibuluma South orebody lies 10 km to the south of Kalulushi, and the Chifupu deposit is located approximately 1.7 km to the southwest of the Chibuluma South mine. The Chibuluma East and West mines are located to the north of the town of Kalulushi.

The Chibuluma South mine is accessed via a service road off the South Downs access road. This road was upgraded in 2007 from gravel to a tarred surface. Concentrate and other heavy trucks are however routed via an alternate back road to avoid damage to the new tar road.



srk consulting	**Metorex** Locality of Chibuluma and extent of Mineral Rights	Project No. 453459

Figure 4.1: Locality of Chibuluma and extent of Mineral Rights

An 11.4 km power line was constructed by CEC in 2000 for the Chibuluma South mine and supplies power at 66 kV which is stepped down at the Mine to 11 kV.

4.3 Mining History

4.3.1 Historical Development of Chibuluma

[SR1.3, SR1.4, SR1.5A(ii), SV2.4]

The historical development of Chibuluma is summarised in Table 4.1.

Table 4.1: Chibuluma – Historical Development

Date	Activity	Comments
1939	RST discovers Chibuluma East ore body	No surface outcrop, or indication of mineralisation. First indications of mineralisation at 70 m below surface.
1940	RST discovers Chibuluma West orebody	
1955	First ore hoisted from Chibuluma East mine	Produced a Cu-Co concentrate which was treated at the Nkana smelter in Kitwe.
1963	First ore hoisted from Chibuluma West mine.	Produced a Cu-Co concentrate which was treated at the Nkana smelter in Kitwe.
1967	RST discovers the Chifupu deposit by auger and diamond drilling.	
1968	GRZ announces intention to nationalise the mines	
1969	RST discovers the Chibuluma South ore body as a strike extension of the small Chifupu deposit.	A total of 113 surface diamond drill holes were drilled in the area – 77 intersected the Chibuluma South ore body.
1970	GRZ had acquired 51% shareholding in the RST mines and formed Roan Consolidated Mines Limited	
1982	Full nationalisation occurred. Mining assets of RST and Nchanga Copper Mines Limited amalgamated to form Zambia Consolidated Copper Mines Limited ("**ZCCM**"), with GRZ holding 60.28% of ZCCM	
Mid 1990s	ZCCM effectively insolvent. GRZ forced by International Finance Corporation ("**IFC**") to privatise many of the companies that were nationalised in the 1970s.	
1996	Nkana Division of ZCCM-IH using a polygonal estimation method reported "mineral reserve" of 10.9 Mt at 4.3% Cu.	
Oct 1997	Metorex consortium acquired Chibuluma from ZCCM-IH, with ZCCM-IH/GRZ retaining a 15% interest.	
1998	Metorex re-coded drill hole data into a digital format for resource modelling purposes.	
1999	Metorex drilled three twin holes	Verified the thickness and grade of the ore body as defined by historical drilling.
2000	Digital Mining Solutions (Zambia) complete first digital resource model for Chibuluma South.	reported resource estimate of 9.2 Mt at 3.7% Cu.
May 2000	Internal feasibility study for Chibuluma South mine completed.	
June 2001	Open pit mining and processing of ores commenced. Treatment involved differential flotation and leach. Mining stopped due to poor leach recoveries.	Oxide zone extended to 60 m below surface.
Nov 2001	Mine placed on care and maintenance.	Slump in world Cu market.
Feb 2003	Refinancing agreement with Industrial Development Corporation of South Africa ("**IDC**")	
2005	Chibuluma West mine closed	
2007	Drilling at Chifupu completed – 15 holes totalling 1 082 m.	
2007	Chibuluma South mine reaches steady-state production as an underground mine.	IDC exits and Chibuluma South Mine Limited dissolved.
Dec 2008	Integrated Geological Solutions (Pty) Ltd ("**IGS**")	reported a resource estimate of 9.3 Mt at 3.6% Cu and 0.02% Co.
2010	Exploration drilling of 4 drill holes totalling 1 960 m completed on Chibuluma South mine and Chifupu prospect	
April 2010	Revisions to licence boundaries to conform to cadastral changes under the revised Mines and Minerals Development Act No 7 of 2008.	
Sept 2010	Re-evaluation to include new drill hole data and crosscut channel sample data since May 2010 estimates pre-mining resource of 9.8 Mt at 3.9% Cu.	
Jan 2013	Awarded the large prospecting licence for Chibuluma Central property	

4.3.2 Historical Operating Statistics

[SR1.3, SV2.17]

Brief historical operating statistics for Chibuluma South Mine are summarised in Table 4.2.

Table 4.2: Chibuluma South Mine – Historical Operating Statistics

Item	Units	2009/10 (1)	F2011	F2012	H2-F2103
Production					
RoM ore mined	(kt)	863.1	559.4	560.1	274.1
Plant feed	(kt)	853.7	559.8	556.8	274.0
Head grade - Cu	(%)	3.39%	3.46%	3.46%	3.25%
Plant recovery - Cu	(%)	94.8%	95.0%	96.5%	96.32%
Concentrate produced	(kt)	56.8	40.5	40.5	18.9
Concentrate grade	(% Cu)	48.3%	45.2%	45.9%	45.47%
Smelter recovery	(%)	95.7%	95.8%	96.3%	96.50%
Payable Cu (after smelting)	(kt)	26.1	17.5	17.9	8.3
Sales					
Sales - LME grade Cu	(kt)	26.2	17.5	17.9	8.3
Av. Price received - Cu	(USD/t)	6 907	8 844	7 943	7 586
Operating Costs					
On-mine costs	(USDm)	47.6	41.1	44.3	22.4
Salaries & wages	(USDm)	16.2	12.9	15.2	8.1
Mining Costs	(USDm)	7.5	6.6	8.6	3.9
Processing Costs	(USDm)	7.3	1.7	2.2	0.7
Engineering (including power)	(USDm)	12.8	15.9	14.6	8.2
SHEC	(USDm)	-	0.8	0.9	0.2
Administration costs	(USDm)	4.3	3.2	2.8	1.4
Stock movement	(USDm)	(0.5)	-	-	0.0
Off mine costs	(USDm)	24.7	16.5	15.3	7.3
Transport costs	(USDm)	14.6	0.6	0.7	0.4
Refining/smelting costs	(USDm)	10.1	15.9	14.6	6.9
Management fees	(USDm)	2.2	2.5	2.5	1.3
Hospital separation	(USDm)	-	-	-	0.9
Royalties	(USDm)	5.8	4.6	7.5	3.8
Unit Costs					
On-mine cost	(USD/t mined)	56.31	77.78	84.14	98.38
Operating cost per t Cu produced	(USD/t Cu produced)	2 841	3 694	3 887	3 749

1 represents the 18 months from July 2009 to December 2010

4.4 Title and Rights

4.4.1 Mineral Rights

[SR1.7A, SR5.1A, SV2.3]

Chibuluma operates in terms of two large scale mining licences ("**LML**"):

- 7064-HQ-LML (formerly LML 23) consisting of the defunct Chibuluma West and Chibuluma East mines; and
- 7065-HQ-LML (formerly LML 24) consisting of the existing Chibuluma South mine and the Chifupu deposit.

The mining title is held in accordance with the Development Agreement ("**DA**") signed between Chibuluma and ZCCM-IH in October 1997. At the time of the sale and transfer of LML 23 to Metorex, a price reduction was agreed between ZCCM-IH and the Metorex Consortium in exchange for the transferral of all environmental liabilities as at the point of sale in 1997, to Chibuluma for the Chibuluma West and East mines.

Both licences are subject to various conditions, which include adherence to the DA, an approved programme of work and pollution prevention, together with a programme of employment and training of Zambian citizens.

The details of the LMLs granted to Chibuluma are summarised in Table 4.3 (see also Figure 4.1).

Chibuluma has an Environmental Management Plan ("**EMP**") compiled in January 2004 and updated in terms of comments from the authorities in November 2004 and approved on 19 September 2006.

Chibuluma was awarded a large scale prospecting licence ("LPL") over an area of 93 km^2, which surrounds the Chibuluma South tenement and abuts against the Chibuluma West tenement along its north-western boundary (Figure 4.1). The prospecting rights to two small square tenements, situated north and south of the Chibuluma South tenement, within the Chibuluma Central Tenement, are held by a third party.

The Environmental Project Brief for the Chibuluma Central area still needs to be approved by the Zambian Environmental Management Agency ("**ZEMA**"),

Table 4.3: Chibuluma – Details of Mineral Licences

Licence	Type of title	Area (ha)	Valid From	Expiry Date	Commodity
Mining Licences					
7064-HQ-LML Chibuluma West	Large-scale Mining Licence	4 895	6 Oct 1997	5 Oct 2022	Cu, Co, base and precious metals,
7065-HQ-LML Chibuluma South	Large-scale Mining Licence	1 120	6 Oct 1997	5 Oct 2022	Cu, Co, base and precious metals,
Prospecting Licence					
HG-LPL Chibuluma Central	Large-scale Prospecting Licence	93 000	9 Jan 2013	8 Jan 2015	

4.4.2 Surface Rights

By virtue of its LML, Chibuluma is granted the exclusive right to use the surface within the LML, and to build installations and facilities required for mining exploitation.

4.4.3 Royalties

[SR5.7C(v)]

The royalty rate payable by Chibuluma to the Zambian Government was at a rate of 0.6% of gross revenue and the corporate tax rate was 30% of taxable income. The Government of Zambia announced in April 2008 an increase in the royalty rate to 3.0% and the introduction of a Windfall and/or Variable Tax from April 2008. However, the Zambian Chamber of Mines rejected the proposed increase in the royalty rate and the new tax rates. Following discussions between the Chamber and the Zambian Government, the Windfall tax was abandoned in April 2009, but the royalty rate and Variable tax formula remained. The royalty rate was further increased to 6% subsequent to the change in government in Zambia during 2011.

The increase in the royalty rate and the Variable tax rate has an adverse impact on the financial result of the Group's mining operation at Chibuluma.

4.5 Geology

[SR1.2, SR1.3, SR2.5A/B/C, SR4.1A(i), SV2.5]

4.5.1 Exploration History of the Project Area

Mineralisation within the Chibuluma concession was first discovered in 1939 (Chibuluma East ore body), followed by the discovery of the Chibuluma West ore body in 1940.

In 1967, RST discovered the Chifupu deposit through a combination of auger and diamond drilling. In 1969, RST discovered the Chibuluma South orebody as a strike extent of the Chifupu deposit.

Following privatisation in the mid-1990s, a Metorex-led consortium acquired Chibuluma from ZCCM-IH. Metorex carried out exploration campaigns involving three twin drill holes in 1999 and 15 holes at Chifupu in 2007.

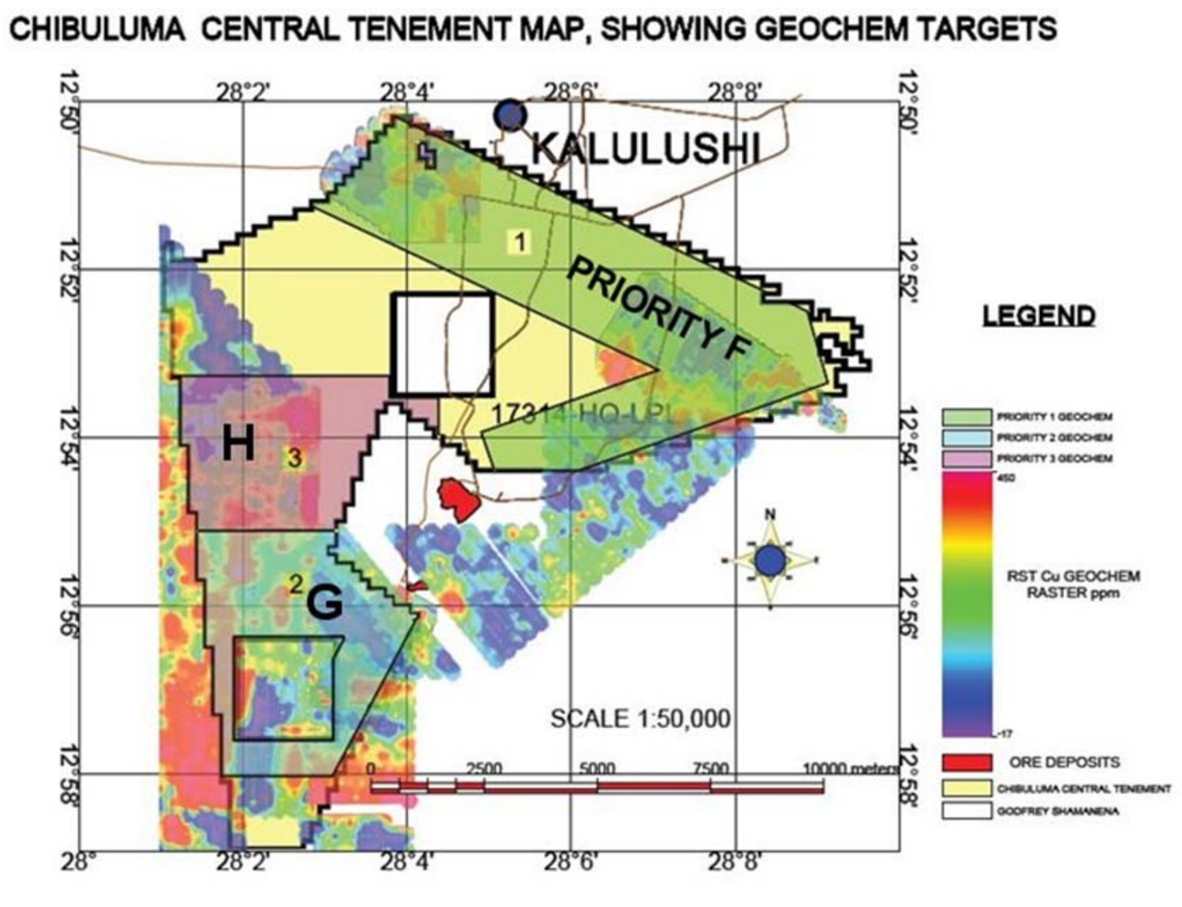
The Chibuluma Central tenement was previously explored by RST and Teal (now known as African Rainbow Minerals, "ARM"). Previous exploration consisted of surface geological mapping, trenching and sampling along the basement granite contact, soil geochemistry, airborne magnetic survey and several short drill holes along the basement granite contact and the Southdowns Syncline. No significant mineralisation was intersected in the drill holes. Processing of the soil sample data and interpretation of the historical airborne and surface geological mapping by the Chibuluma exploration department yielded three potential targets labelled F, G and H, which were prioritised as 1, 2 and 3, as shown in Figure 4.2. In October 2010, a low resolution airborne magnetic, electromagnetic and radiometric survey was flown over the area.

4.5.2 Regional Geology

This is more fully described in Section 3.5.2.

The Chibuluma deposits are SSC deposits located in the Zambian portion of the Central African Copperbelt. The Copperbelt forms one of the world's largest metallogenic provinces containing over a third of the world's cobalt mineral reserves and a tenth of the world's copper mineral reserves.

The copper-cobalt deposits of the Central African Copperbelt are hosted within a strongly deformed, arcuate belt of rocks that extends from north eastern Angola through southern DRC and into Zambia, referred to as the Lufilian Arc.



srk consulting	**Metorex** Chibuluma Central – historical soil geochemistry survey and geochem targets	Project No. 453459

Figure 4.2: Chibuluma Central – historical soil geochemistry survey and geochem targets

The Katangan Sequence is divided into three Supergroups (see Figure 4.3) separated by two marker conglomerates (from youngest to oldest):

- The Upper Kundelungu Supergroup (Ks);
- The Lower Kundelungu Supergroup (Ki); and
- The Roan Supergroup (R).

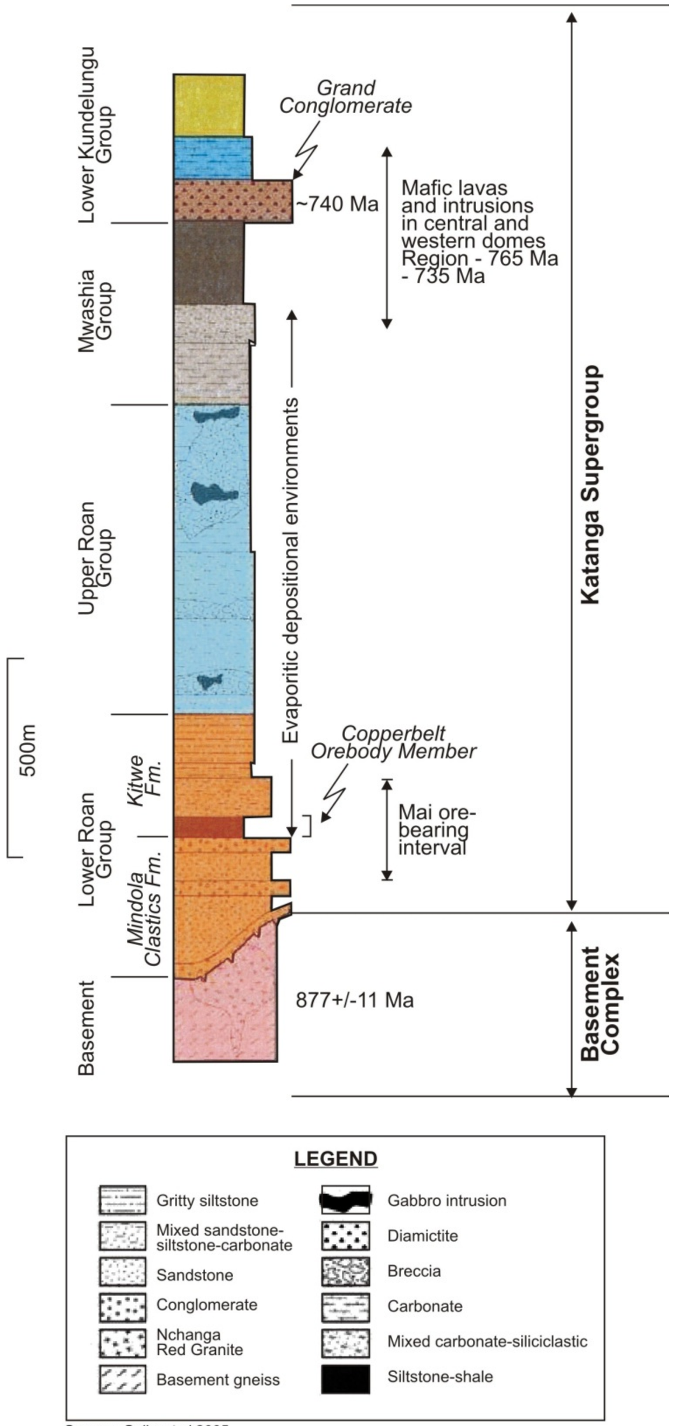
Mineralisation in both Zambia and the DRC is largely restricted to the Lower Roan or Mines Group, although vein style mineralisation is locally important higher in the succession (e.g. Kansanshi, Kipushi, Dikulushi).

Mineralisation in the Zambian deposits is dominantly sulphide, comprising chalcopyrite, bornite and chalcocite, variably accompanied by pyrite and pyrrhotite, carollite, covellite and diginite. Ore grades are commonly around 3% to 4% Cu and 0.1% to 0.2% Co.

There is generally a progressive transition from chalcocite to bornite to chalcopyrite to pyrite, vertically upward within the orebodies and laterally down dip. Due to the acidic nature of the silica rich host rocks on the Zambian

Copperbelt, oxidation and leaching of copper minerals is common to about 45 m to 60 m from surface, although it may be observed to depths of several hundred metres. The leached zone close to surface is commonly barren or very poorly mineralised. Supergene enrichment below the zone of leaching is highly variable with the main supergene minerals including malachite, chalcocite, cuprite, chysocolla and vermiculite.

The Zambian orebodies are thought to occupy a lower stratigraphic position than those of the DRC and mineralisation is generally not restricted to a particular lithological horizon so that several stacked orebodies may occur together.



Source: Selly, et.al.2005

srk consulting	**Metorex** Regional stratigraphic classification of the Katanga Supergroup in Zambia	Project No. 453459

Figure 4.3: Regional stratigraphic classification of the Katanga Supergroup in Zambia

4.5.3 Local Geology and Mineralisation (Chibuluma South West)

The Chibuluma South and West deposits are typical of the Zambian Copperbelt deposits and are geologically similar to the Chambishi and Mufulira mines. The Regional geology of Kalulushi District is shown in Figure 4.4.

As the Chibuluma West mine has been depleted, the following discussion will refer only to the Chibuluma South mine and satellite deposits.

The Ore Shale facies which hosts the mega deposits (e.g. Konkola, Nchanga and Nkana) of the Copperbelt is absent on the Chibuluma South property, and the host formation of the orebody is correlated with the footwall formations found beneath the Ore Shale. Consequently, the Chibuluma South orebody has been termed a "footwall orebody" in the context of the Zambian Copperbelt, forming small (<10 Mt), HG (~4% Cu) deposits within a coarse grained quartzite.

Mineralisation in the Chibuluma South orebody is predominantly Cu with very minor Co and is hosted in detrital conglomerates, sandstones and argillaceous siltstones of the Lower Roan Group (see Figure 4.5). The orebody is hosted by a competent quartzite horizon overlain by a sequence of argillites and dolomites of the Upper Roan Group. Mineralisation is hosted in a mineralised quartzite known locally as the Orebody Quartzite ("**OBQ**") with the unmineralised quartzite below the OBQ referred to as the Footwall Quartzite.

The Chibuluma South orebody occurs over a strike length of 300 m, dipping at approximately 38° towards the north-west and varies in thickness from a few metres to over 30 m in places (see Figure 4.6) for a typical section through the ore body). Drilling has defined the orebody to a maximum depth of 600 m where it pinches out against a basement high. While drilling has closed off the orebody at depth, it is feasible that the ore boby opens up down-dip of the basement high.

Mineralisation occurs as oxide to a depth of 60 m and as sulphides below the 60 m level. Malachite is the dominant oxide mineral while bornite, chalcopyrite and chalcocite constitute the sulphides. Chalcocite is found immediately below the oxide cap in the sulphide zone. Bornite dominates in the thickest and richest central portion of the orebody and is the predominant sulphide mineral with chalcocite below the 400 m level currently being developed by the Mine. Chalcopyrite accounts for approximately 20% of the sulphides and becomes more evident towards the fringes. Pyrite dominates in barren fringe areas.

Cobalt mineralisation in the Chibuluma South orebody is patchy and was only found in a few drill hole intersections.

The Chifupu deposit is similar to the Chibuluma South orebody and consists of two shallow dipping zones, each approximately 5 m in width, separated by a waste parting of 20 m to 30 m. A strike length of 150 m has been defined with a maximum depth of 300 m.

4.5.4 Exploration Programme and Budget

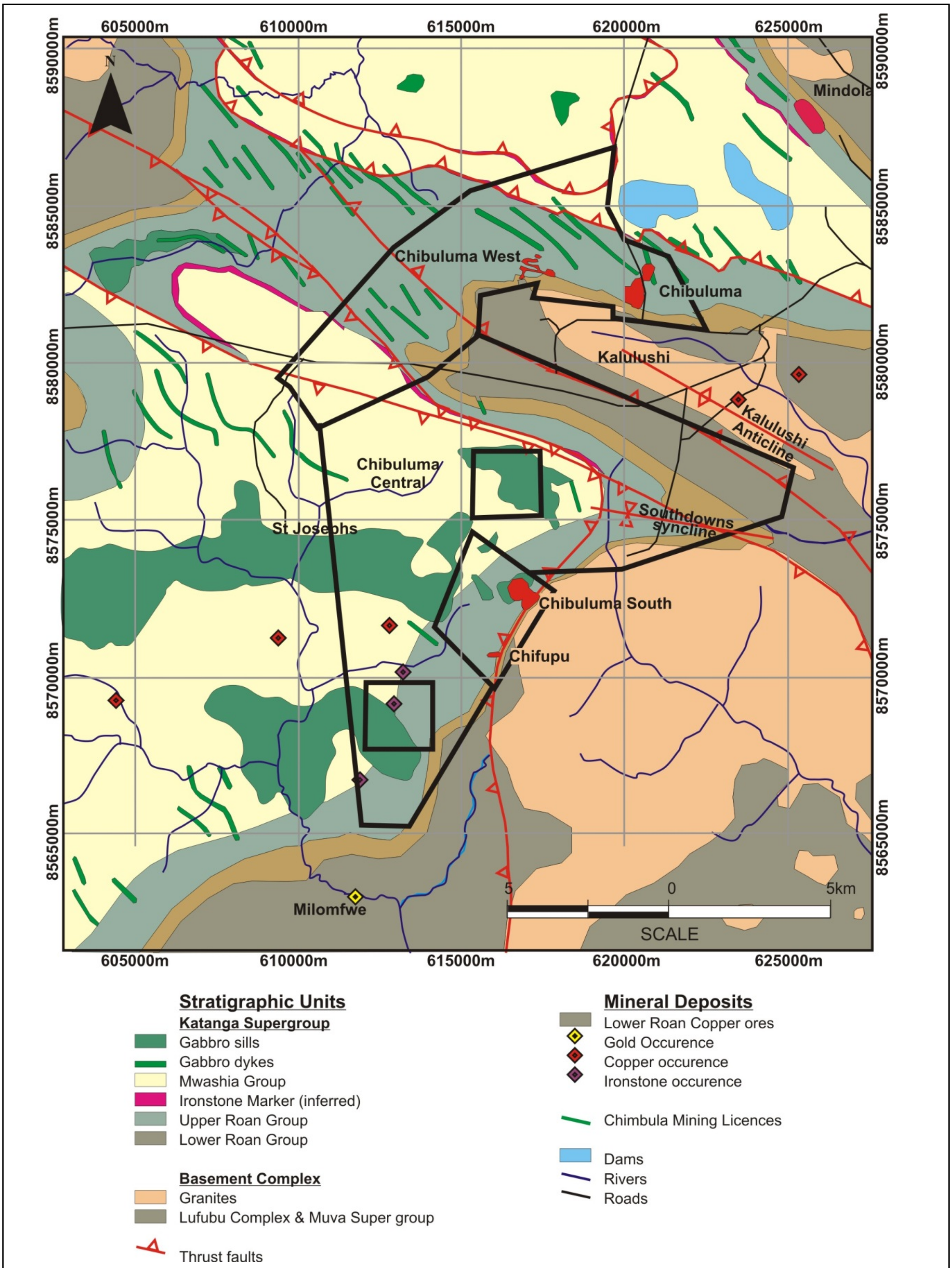
The intensity of surface exploration activities carried out in the 1960s preclude the likelihood of a near surface discovery, and future exploration activities on and adjacent to the licence area will focus on buried targets at depth associated with the identification of basement structures and redox trap sites. Metorex expects that exploration will be expensive due to the need for high resolution geophysics and deep diamond drilling. A high ratio of non-mineralised holes is expected in the early period while the exploration model is being refined.

By the end of December 2010, 1 960 m of exploration drilling, 1 497 line-km of airborne electromagnetics and 79 line-km of ground gravity surveys were conducted by various contractors. These works were undertaken as follow-up to a regional desk top study conducted in 2009 where a number of high potential target areas were identified.

The previous programme located on Chibuluma West licence gave disappointing results, so this has been downgraded. The number of drill holes allocated to Chibuluma West will be used to test the Chabara Gabbro Field and the Southdown thrust fault area during H2-F2013.

Metorex's plans for Chibuluma Central include compilation of a GIS database and GEMS 3D model of historical data, soil sampling, ground geophysics and drilling of anomalous areas.

Chibuluma's exploration budget for H2-F2013 to F2015 is set out in Table 4.4.



srk consulting	**Metorex** Regional geology of the Kalulushi district Including the Chibuluma South, Chibuluma West and Chibuluma Central licences	Project No. 453459

Figure 4.4: Regional geology of the Kalulushi district Including the Chibuluma South, Chibuluma West and Chibuluma Central licences

Table 4.4: Chibuluma – Exploration Budget H2-F2013 to F2015

Exploration	Units	H2-F2013	F2014	F2015
Chifupu	(USDm)	0.84		
Chibuluma West	(USDm)	1.32		
Chibuluma Central	(USDm)	0.35	1.00	1.00
New Projects	(USDm)	0.29	0.86	0.86
Total Exploration	**(USDm)**	**2.80**	**1.86**	**1.86**

1 Provision for the exploration at Chibuluma Central (see section 1.5.1) is included in these budgeted amounts.

The budget allocated for the work planned for H2-F2013 is considered to be appropriate.

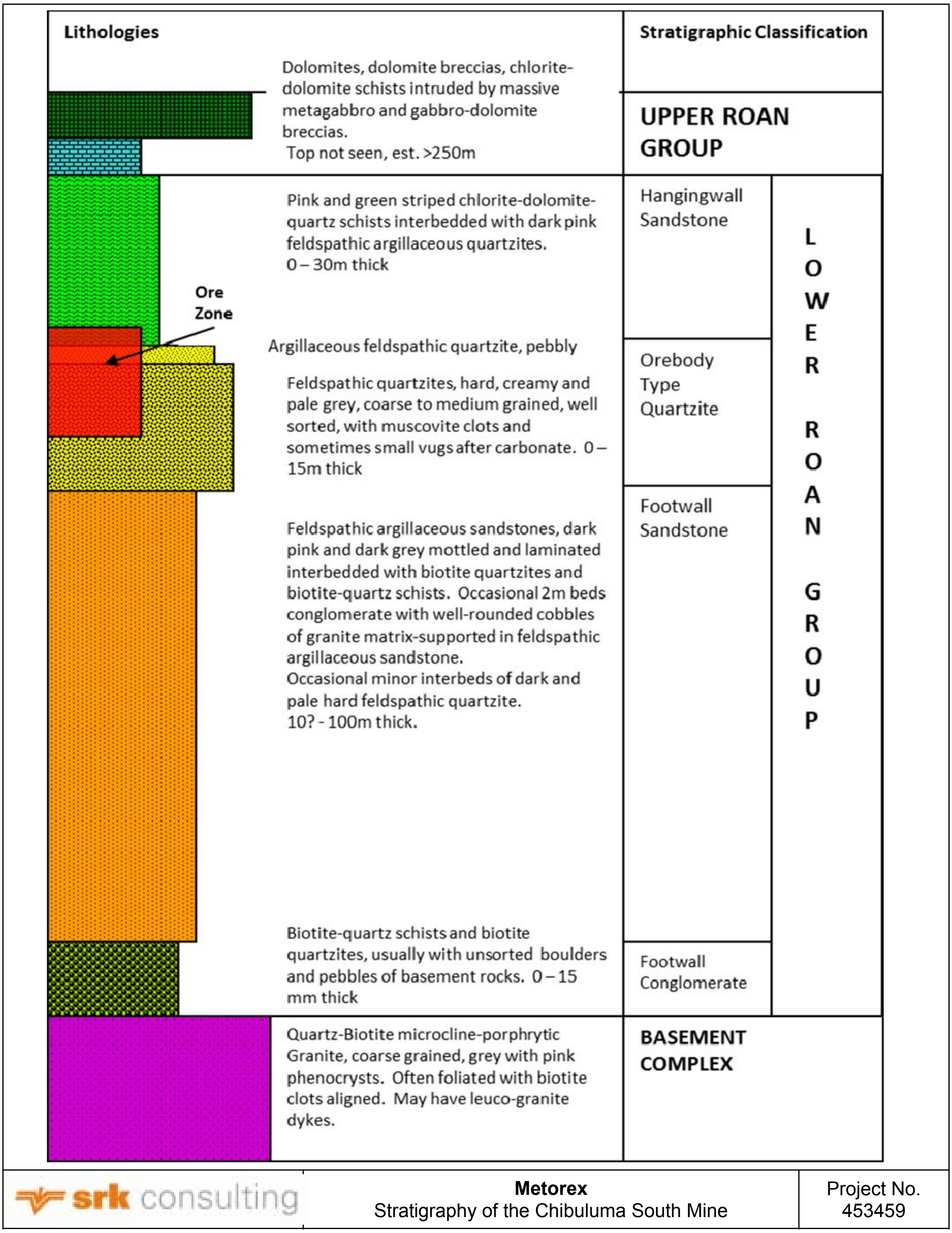
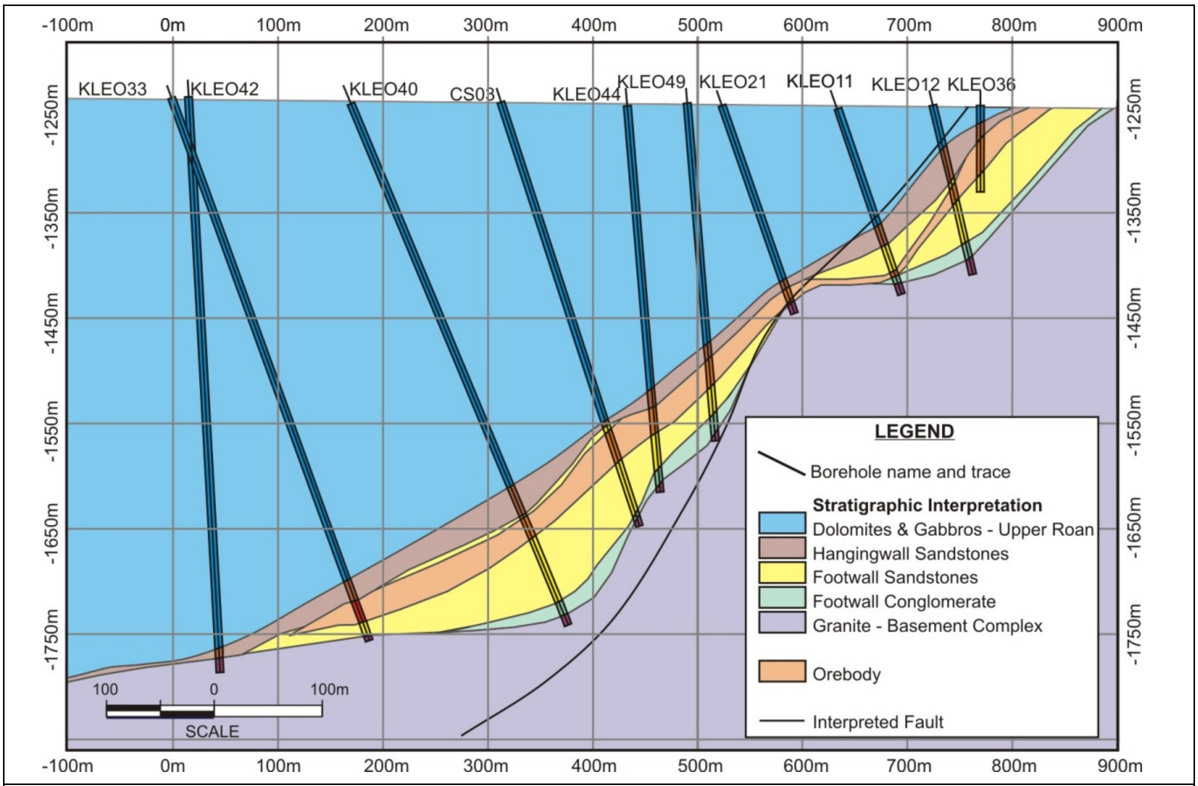
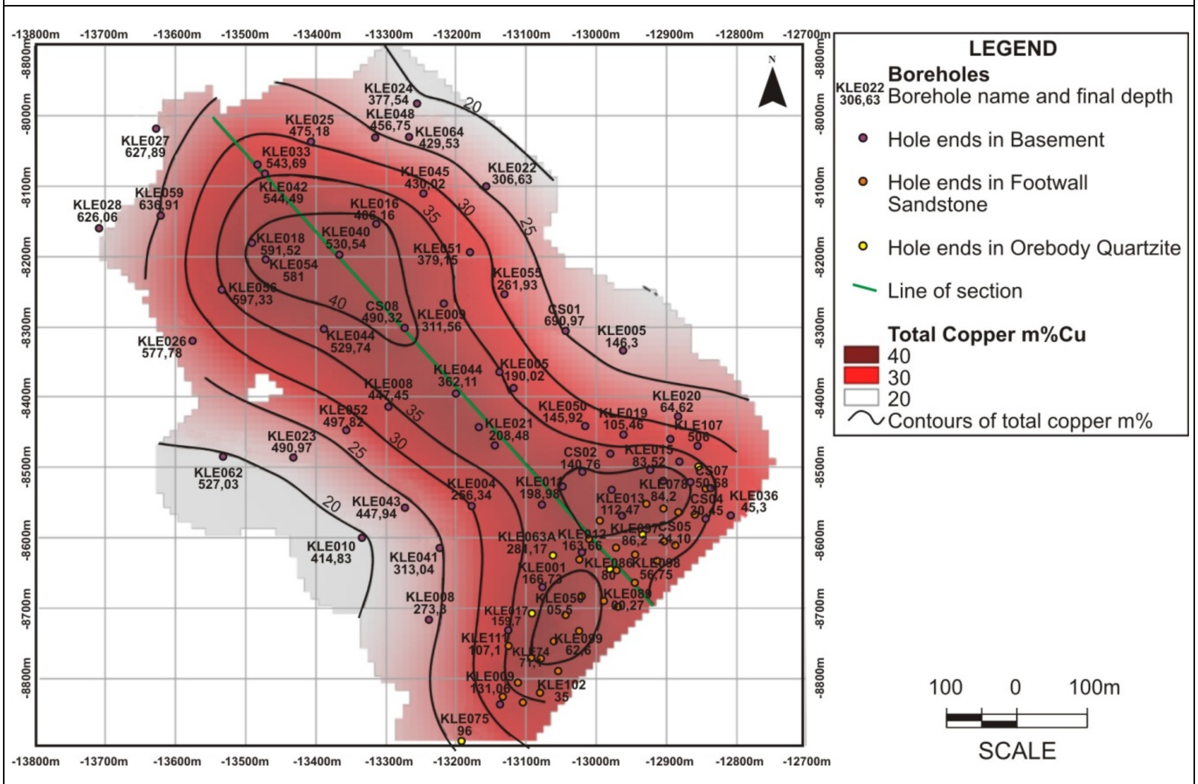


Figure 4.5: Stratigraphy of the Chibuluma South Mine





	Metorex Chibuluma South Mine – typical section (top) and surface drill hole location plan (bottom) (source: Arthurs, 2009)	Project No. 453459

Figure 4.6: Chibuluma South Mine – typical section (top) and surface drill hole location plan (bottom)

4.6 Mineral Resources and Mineral Reserves

[SR1.1A(iii), SR2.5A/B/C, SR7B, SR9A/B/C, SV2.6]

4.6.1 Data Quality and Quantity

[SR3.1, SR4.1]

The Chibuluma resource model is based largely on surface drill hole data collected between 1969 and 1975 by RST with limited data collected from underground drilling with the development of the underground mine. Additional information collected and used in the refinement of the resource model consists of underground mapping and channel sampling. This information is not included in the drill hole database.

About 100 drill holes, prefixed KLE, from the RST drilling were found to be proximate to Chibuluma South out of a combined database of 113 holes available within the area.

The current database contains 276 drill hole entries of which 97 are KLE holes from the RST drilling and the rest is made up of limited surface drilling and drill hole data collected from the underground developments together with channel sampling information. The count of holes is 138 prefixed KP, 7 prefixed CS, 33 prefixed CB and 1 prefixed UGCS.

There are limited down-the-hole surveys done on the RST holes with end-of holes varying from 35 m to 640 m and average 220 m. Also the underground holes are not routinely surveyed down-the-hole.

This has an impact on the spatial locations of the intersections of the mineralised zones and is reflected in the modelling discussed later in this section.

4.6.2 Verification of Historical Drilling

As a check on the integrity of the RST geological information, 8 of the original drill holes, (KLE 11, 16, 21, 51, 54, 61, 63 and 63a) were drawn from the Chamber of Mines core shed in Kalulushi and re-logged by a Chibuluma mine geologist shortly after acquisition by Metorex in 1997. The remaining half cores were selected to match as far as possible the original sampling widths, split into quarters and re-assayed at the ZCCM Technical Services Laboratory. The resulting grade distributions within the newly assayed cores were compared with the original grades. The grade distribution correlated extremely well with a +8 % grade variance in the re-assay.

Two holes were drilled by Metorex in 1998 to confirm previous intersections and local geology, and to provide material for metallurgical test work. Drill hole CS2 was drilled to twin KLE 2. Set up was adjacent to the collar and with the same inclination and azimuth. Drill hole CS3 served as an infill hole between original holes KLE 40 and 44. Holes were stopped in basement at depths of 140 m and 420 m respectively. Diamond drilling was carried out at NQ size (47.6 mm) and core was logged by mine geologists. Mineralised core was sampled at approximately 0.5 m intervals and assayed at the ZCCM Technical Services laboratory (now AH Knight Laboratories) in Kalulushi.

Both drill holes confirmed the depth and mineral distribution patterns indicated by earlier exploration drilling. Histograms of total copper in drill holes CS2 and KLE 2 are almost identical over core lengths of 16 m, with a grade of 3.6 % TCu in CS2 compared to 4.05 % TCu in KLE 2. However, drill hole CS2 has a further 6 m of mineralised core below this, half of which is low grade followed by 2.5 m with grades of up to 4.35 % TCu, implying additional mineable tonnage. Drill hole CS3 broadly confirmed the depth and distribution patterns of flanking drill holes KLE 40 and 44, and the grade of 3.34 % TCu over 29.3 m is similar to the overall grade of 3.38% TCu over 31.9 m of KLE 44.

The ZCCM Technical Services laboratory was not an accredited laboratory although it was used extensively by ZCCM prior to privatisation. There is limited information available as to the level of QA/QC carried out during this programme and whether any repeat samples were assayed by an independent referee. Until this can be verified in the form of a written document, it must be assumed that this was limited to the use of instrument calibration standards by the laboratory.

Whilst the new holes confirmed the presence of copper mineralisation as predicted in previous reports, they also highlighted the undulations of the footwall contact and the variation in mineral distribution across the orebody.

4.6.3 Sampling Method and Approach

[SR3.2, SR3.3]

There are no details on the sampling method and approach for the RST drilled holes.

4.6.4 Sample Analytical Methods

[SR3.3, SR3.4]

There are no details on the sample analytical methods adopted during the analyses of the RST drilled holes.

Analyses of the samples from verification work undertaken by Metorex in 1997 on the re-sampling the old core and the twin drilling of selected RST drill holes were done by AAS at the RST Research and Development Laboratory. The laboratory was not accredited during the period of the analyses.

The RST/ZCCM work was undertaken at the time when there was no emphasis on QA/QC and laboratory accreditation. This is included in the CPVR in the interests of transparency related to the historical activities.

The production reconciliation data (see Figure 4.8) provided by Metorex show good performance of the block model, which is based on these historical data supplemented with additional and more recent drilling.

4.6.5 Quality Assurance and Quality Control

[SR2.1, SR3.1, SR3.2, SR4.1]

No QA/QC procedures or results were available for the RST exploration drill holes.

No QA/QC information is available prior to 2009 for the surface and underground drilling and channel samples analysed at the company's laboratory at Chibuluma South mine. From January 2009 a total of 247 "blanks" have been inserted the sample stream as part of a limited QA/QC programme.

4.6.6 Geological Modelling

[SR4.1A(ii)(iv), SR4.1A/B, SR4.2A, SR4.2B]

The resource estimate for Chibuluma South Mine was conducted in-house using the Surpac version 6.1.3 geological and mine planning software package. The bench plans for the open pit and underground level plans to 350mL used in the 2008 estimate by IGS were used together with data from channel sampling and diamond drilling. The basement contact, orebody and the waste parting outlines used in the 2008 IGS estimate were updated with the new drill hole and channel sampling data. A combination of slices and drill hole/channel sampling intersections produced 3D wireframes. The orebody was projected up to and then truncated against the basement wireframe. The waste parting was modelled separately and projected through the orebody wireframe using the mapped horizontal slices as well as interpreted drill hole intersections at depth.

Where there is conflict in the contact position, channel sampling data was given precedence over underground drill hole data which was also given precedence over surface drill hole data. No changes to the basement surface were made. The orebody outline is based on an assay grade cut-off of 1% TCu.

A section through the orebody model is given in Figure 5.5. The orebody truncates against the basement in the north-east but moves away from the basement and eventually pinches out in the south west. The orebody model is well constrained in the areas close to the open pit, and in the mapping in the underground workings down to the 457m level. Below the current workings the orebody model is only defined by surface drill holes and while some variations in the exact geometry of the orebody are likely, they are not expected to be material.

The modelling of waste parting is done separately based on drill hole, channel sampling data and underground mapping.

4.6.7 Grade Estimation

[SR4.2]

An additional 4 219 samples were added to the Chibuluma database between December 2007 and November 2008, with the bulk of these samples representing underground channel samples. A total of 224 surface and underground drill holes and 9 channel crosscuts were used in the geological interpretation. Composites were selected within the modelled orebody envelope at a 1% TCu assay grade cut-off, and include surface, underground drill holes and channel samples.

For the purposes of geostatistical modelling and grade interpolation, all samples were composited to lengths of 1 m, with a minimum composite length of 0.75 m. A top-cut grade of 8.00 % TCu was applied. Sample statistics are presented in Table 4.5.

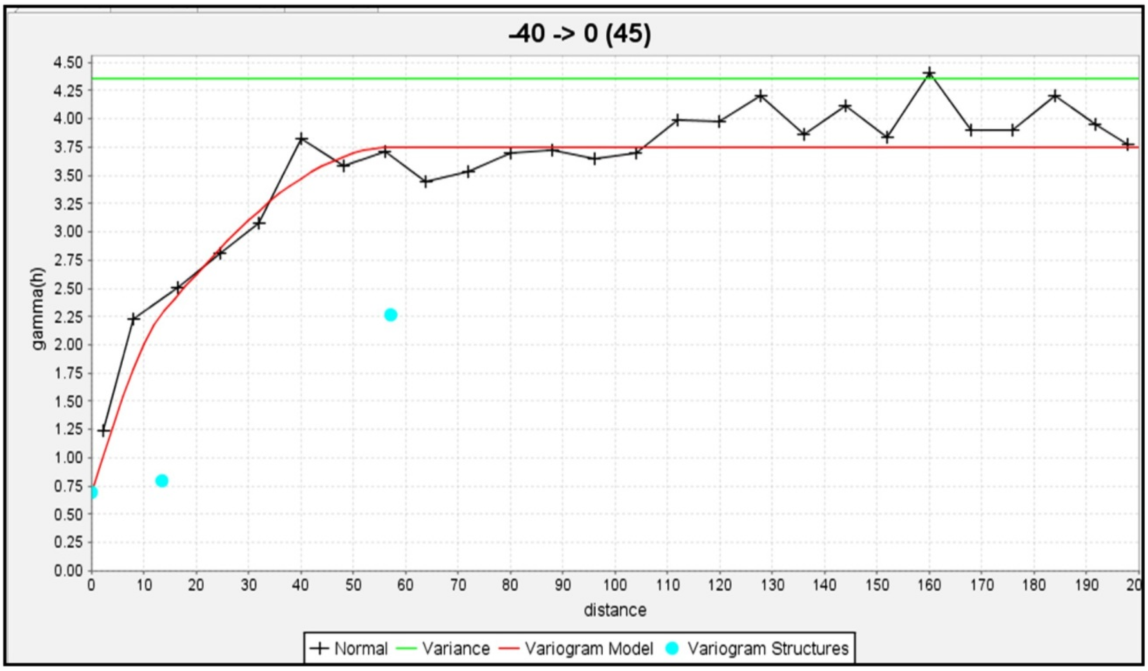
Table 4.5: Statistics of capped 1 m composites

Item	% TCu
Number of samples	2 789
Minimum value	0.01
Maximum value	8.00
25th Percentile	2.18
50th Percentile (median)	3.56
75th Percentile	5.23
Mean	**3.82**
Variance	4.36
Standard Deviation	2.09
Coefficient of variation	0.55

The sample data is too exhaustive to be included in the CPVR. The table of statistics is included to show the range of values intersected within the samples selected for resource estimation. In the case of Chibuluma, this is a mature operation that has a history of production and that mitigates the requirement for drillhole intersections to be included.

The copper distribution is slightly positively skewed with a mean grade of 3.82% TCu and a median grade of 3.56% TCu.

The data was assumed to be a normal distribution to improve the variogram modelling. The variogram was created normal to the plane of the orebody. The experimental variogram along 0° was chosen for spatial grade continuity analysis (Figure 4.7).



srk consulting | **Metorex** Chibuluma South Mine - %TCu variogram model in plane of mineralised zone | Project No. 453459

Figure 4.7: Chibuluma South Mine - %TCu variogram model in plane of mineralised zone

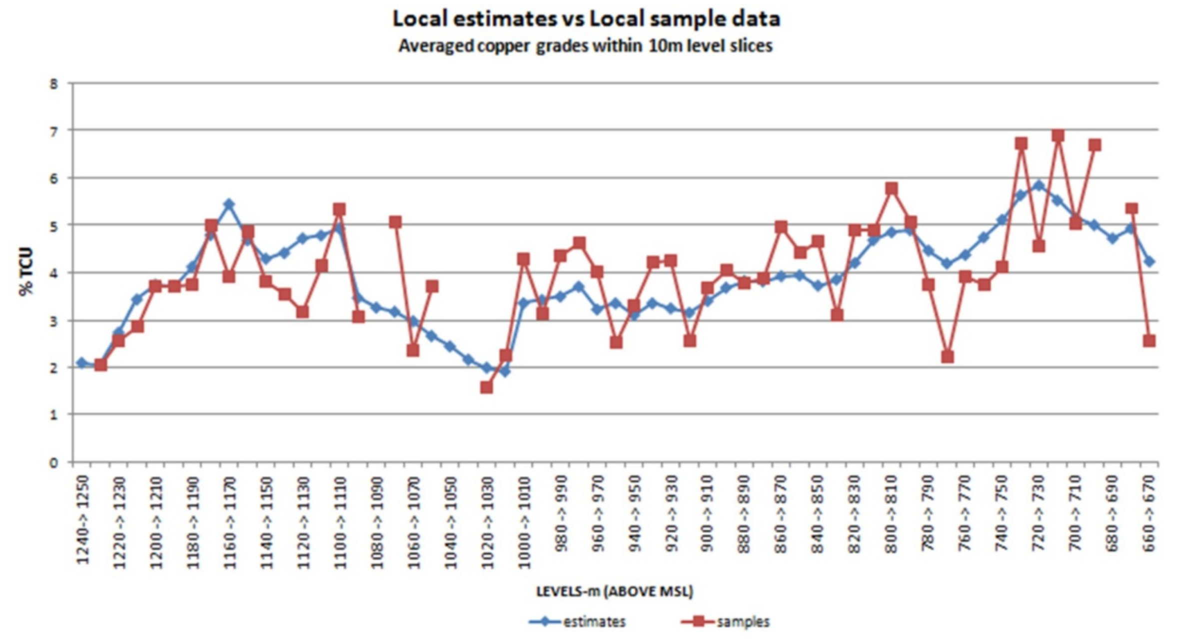
Parent blocks of dimensions 10 m x 5 m x 5 m in the X, Y and Z directions were filled inside the wireframe of the mineralised zone and the waste parting. The blocks were sub-celled for better control of the volumes at the contacts.

% TCu grades were estimated into the blocks using ordinary kriging and the capped composites within a search neighbourhood range of 300 m maximum, with a minimum of 2 and a maximum of 48 samples for estimating each block.

4.6.8 Validation of Estimates

The local estimate was visually validated by plotting 10 m vertical slices through the block model against the average of the composites within that slice (Figure 4.8).

It is noted that although the expected smoothening effect of kriging is observed, the locally variable grade distribution is reasonably well reproduced. A closer correlation exists where the number of samples is higher. There is no bias evident between the sample averages and the block model grades.



srk consulting	**Metorex** Chibuluma South Mine – swath validation of the %TCu estimates against the composites	Project No. 453459

Figure 4.8: Chibuluma South Mine - swath validation of the %TCu estimates against the composites

4.6.9 Resource Classification Matrix

[SR5.7B, SR7]

Metorex classified the Chibuluma South Mineral Resources into geological risk categories using the SAMREC Code definitions as a guideline. The Mineral Resources classification matrix was based on the range of the variogram models and the mining development, as set out in Table 4.6.

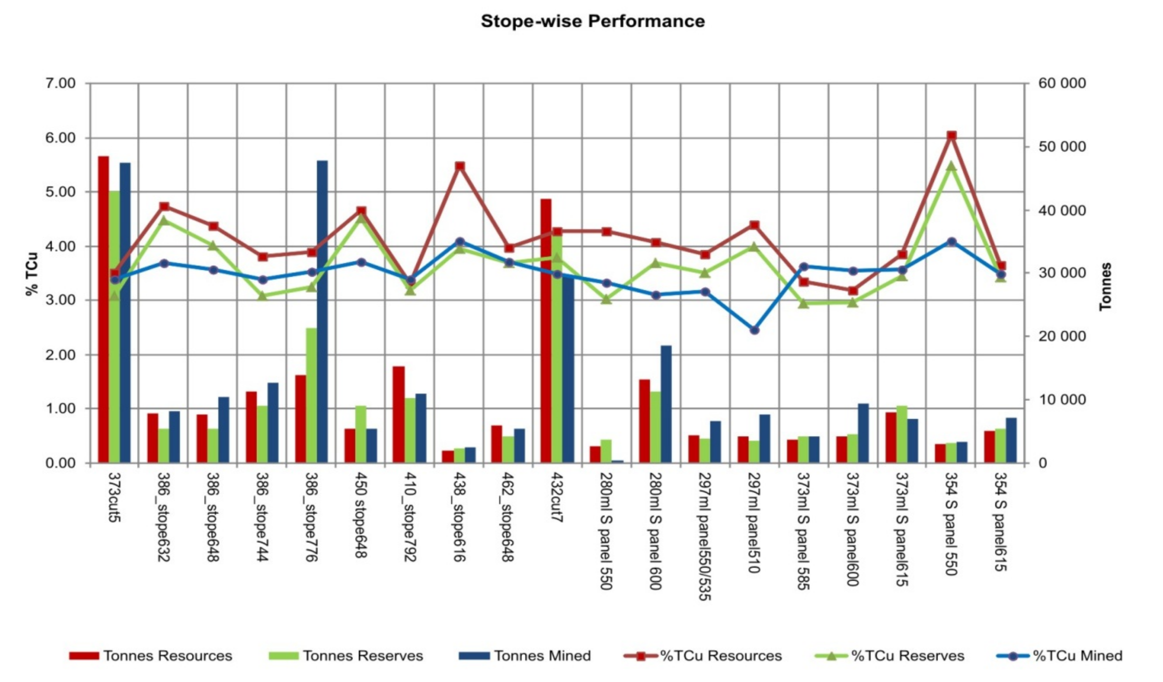
Table 4.6: Classification criteria adopted for Chibuluma South

Classification	Distance from block centre to sample point, metres	Qualifying criteria
Measured	0 - 40	Blocks within a distance of two thirds of the sill variance Additionally, blocks exposed by mining development are classified as Measured
Indicated	40 - 60	blocks within the range of the average variogram
Inferred	>60	blocks beyond the range of the variogram

Chibuluma South Mine stated that the resource estimates *for Chibuluma South Mine as a SAMREC compliant estimate must therefore be qualified on the basis of limited QA/QC data*. They further stated that "*In order to bring the resource estimate up to a fully SAMREC compliant standard, it is essential that the assay quality control programme recently instituted at Chibuluma South mine laboratory be strictly adhered to as a means of improving the confidence in all new assay results received*".

As a mitigation factor Chibuluma South considered the reconciliation of mineral resource estimates against mining tonnages and grades over the last 4 years as supportive of the estimates and providing confidence in the remaining resource estimates based on historical RST data (Figure 4.9).

Chibuluma South mine reconciliation data is based on exhausted stopes and compares the stope resources and reserves against the depleted stope tonnes and grade. The depleted tonnes are based on the truck tally by the mining department reconciled to milled tonnes.



srk consulting	Metorex Reconciliation of stope resource and reserves against depleted reserves	Project No. 453459

Figure 4.9: Reconciliation of stope resource and reserves against depleted reserves

4.6.10 SRK Comments

SRK visited Chibuluma South mine in October 2012, toured the underground operations and held discussions with the geological and mine planning personnel from the mine. SRK also reviewed the data and the models on which the resource and reserves are based and made the following observations.

There are data quality issues that impact on the quality of the model and the estimates and this is demonstrated in Figure 4.10, which are sections along the path of drill hole CB7713.

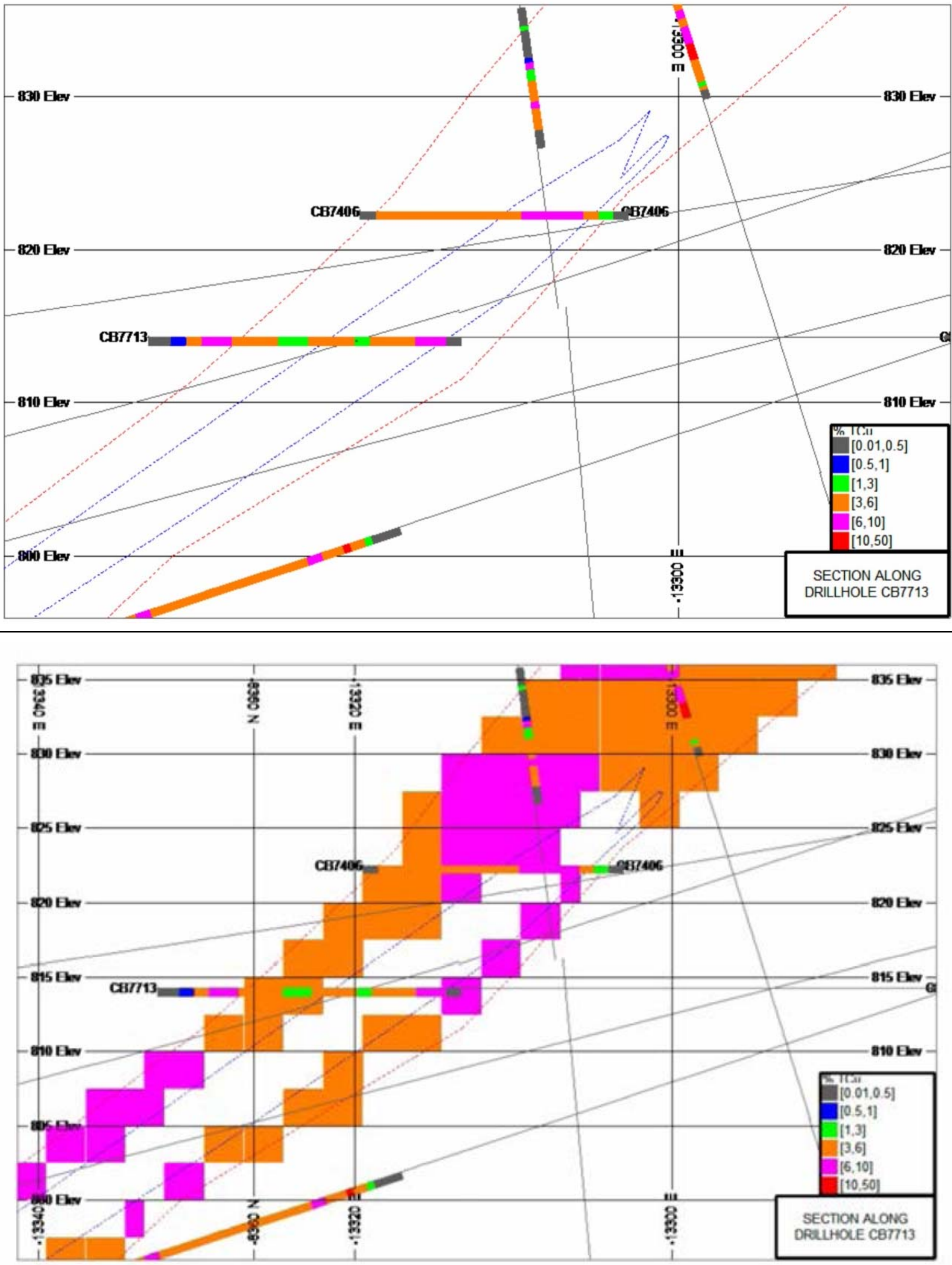
In the top diagram of Figure 4.10, the % TCu colour coded drill hole CB7713 is superimposed on the wireframes of the mineralised zones (red) and waste parting (in blue). The spatial location of the waste parting wireframe is inconsistent with the % TCu grades in the drill hole.

The bottom part of Figure 4.10 shows the block model estimates in the vicinity of the drill hole CB7713. Whereas the block estimates honour the wireframe, they do not honour the drill hole intercepts or the tenor of % TCu intersections in the spatial locations.

This was discussed with Chibuluma South mine who indicated that the spatial locations of the mineralised zones are, in most cases and where information is available, based on the underground mapping and channel sampling information rather than the drill hole intercepts. This is mainly because of the lack of or inadequate down-the-hole surveys. Further, Chibuluma South mine indicated that the coded mineralised zone in the drill hole is used in the estimation into a wireframe generated from contacts from the underground pickups.

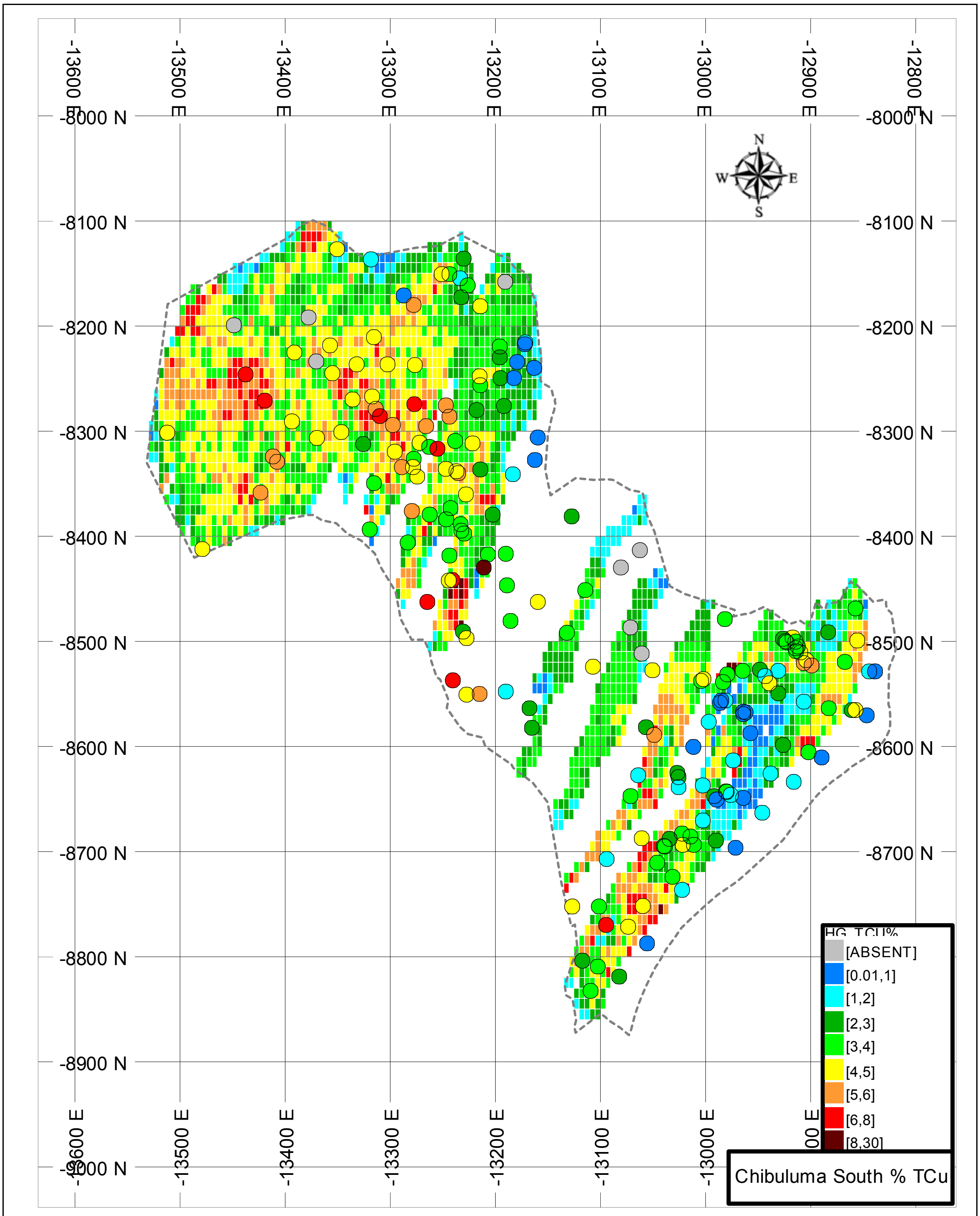
A consequence of this action is that some of the composites used in the estimation of the mineralised zones are spatially located outside the mineralised zone or within the waste parting. SRK considers this to be procedurally inaccurate and has the potential to result in inconsistent estimates. Metorex indicated that it accepts this on the basis that this was a work-around to compensate for the lack of accurate downhole survey for some of the historical drill holes.

Figure 4.11 shows the resource blocks within the LoM, colour coded with the average % TCu of a column of blocks within the mineralised zone represented by the block X and Y position. The average of the composite grades within the mineralised zone and within the superimposed drill holes is also colour coded on % TCu.



srk consulting	**Metorex** Section along drill hole CB7713 showing ore zone (red wireframe) and waste parting (blue wireframe) (top), and block estimates (bottom)	Project No. 453459

Figure 4.10: Chibuluma South - Section along drill hole CB7713 showing ore zone (red wireframe) and waste parting (blue wireframe) (top) and block estimates (bottom)



srk consulting	**Metorex** Resource blocks within LoM with average %TCu, compared drill hole composites	Project No. 453459

Figure 4.11: Chibuluma South - Resource blocks within LoM with average %TCu, compared drill hole composites

The following observations are made from the comparisons:

- There is concentration of drill hole data / channel samples in the centre of the LoM in the north-west (north of 8 400 m N) and also in the southern portion in the buttress with the open pit workings (south of 8 500 m N). The data density dissipates away from these nodes;

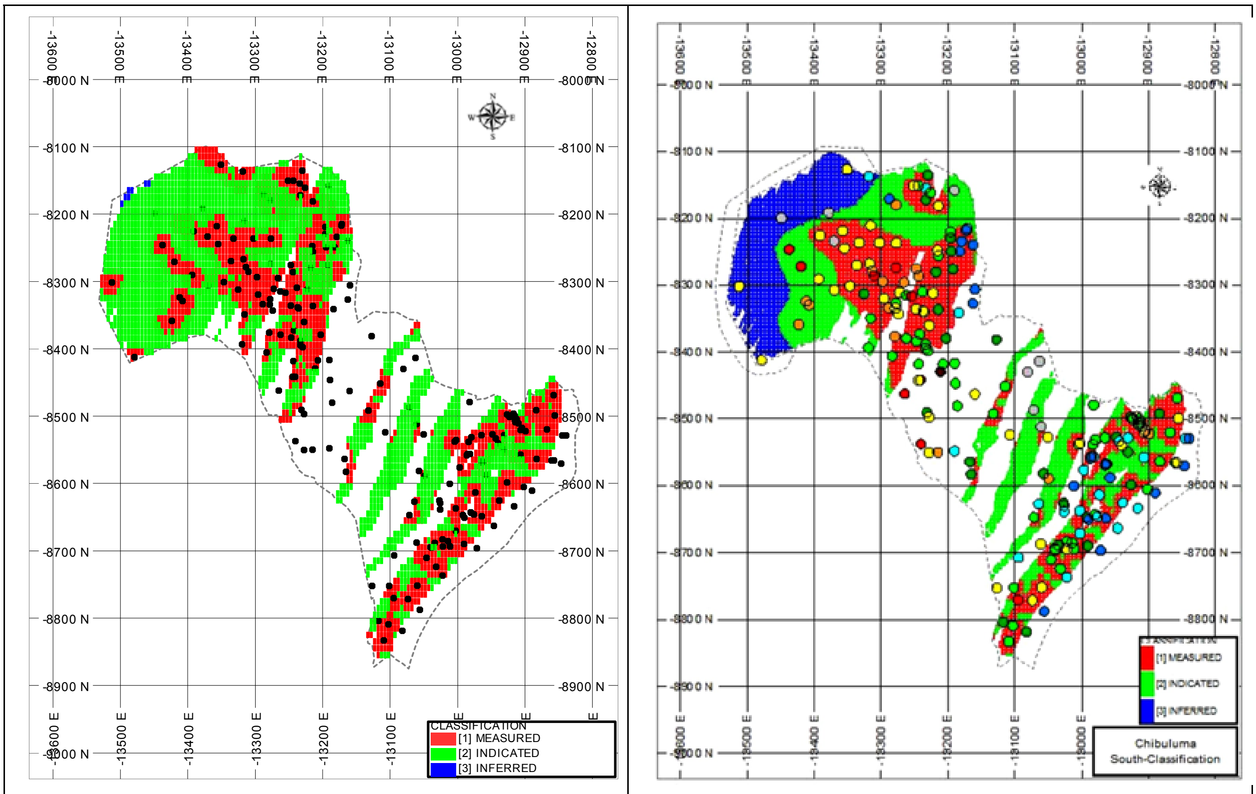
- In terms of grade distributions, generally the block estimates are consistent with the distribution of the composite grades in areas of high data density and less comparable in the fringe areas which appear to have been over-estimated;
- There are drill holes that are contained within the mineralised wireframe that do not contain copper mineralisation either as they were not sampled or are considered barren and not worthy of sampling.

From inspection of Figure 4.10, SRK observes that:

- Blocks are classified on the basis of proximity to a drill hole and annular rings are drawn around drill holes describing Measured, Indicated and Inferred as proportions of the variogram range.
- Isolated drill hole data points have annular rings of classification without accounting for proximity to other data points, geological continuity and grade domaining and continuity.

SRK is of the opinion that classification criteria should take into account the relationships between adjacent drill hole grade intersections, consistent with the SAMREC Code which requires that the locations are spaced closely enough to confirm geological and grade continuity. Isolated drill hole data points do not demonstrate continuity of any form and therefore cannot be used as a basis for classification.

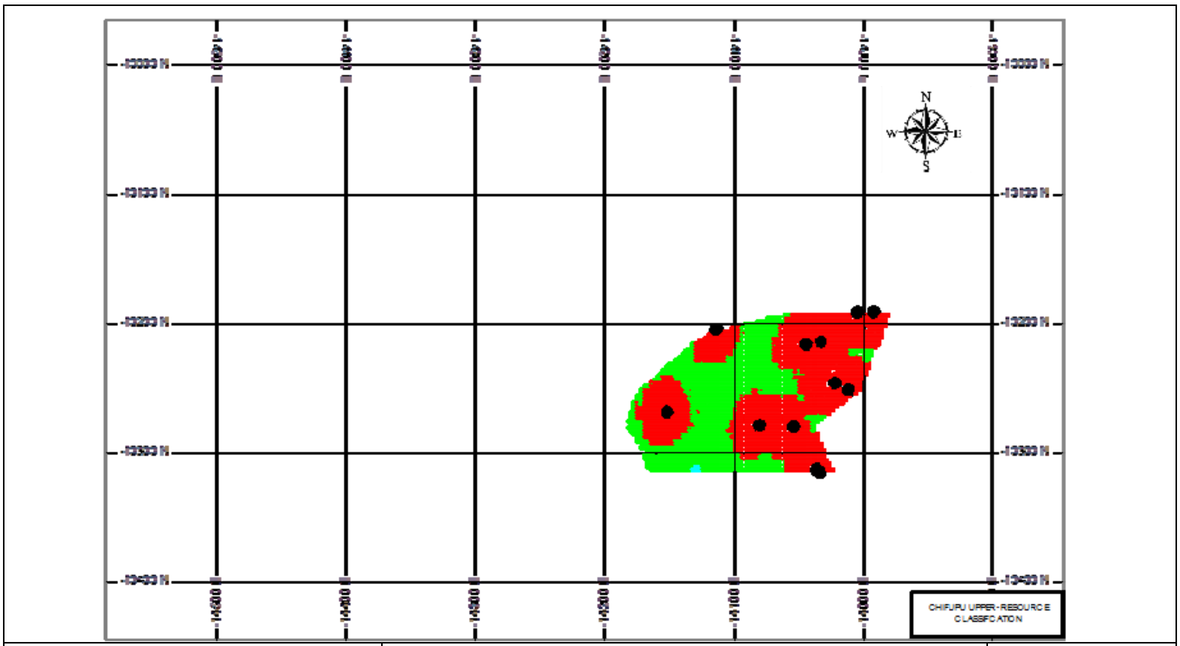
Figure 4.11 (left diagram) shows the classification of the Mineral Resource blocks for Chibuluma based on the criteria adopted by Metorex and discussed above. The classification criterion of drill hole proximity is acceptable where there is minimal variability in the grade. The classification should be based on drill locations that are spaced closely enough for geological and grade continuity to be interpreted (illustrated in Figure 4.12, right diagram). SRK's revised classification for Chibuluma is shown in the right hand diagram of Figure 4.12.



srk consulting	**Metorex** Distribution of resource estimates according to classification – Chibuluma's drill hole proximity (left) vs SRK's drill hole spacing (right)	Project No. 453459

Figure 4.12: Chibuluma – distribution of resource estimates according to classification - Chibuluma's drill hole proximity (left) vs SRK's drill hole spacing (right)

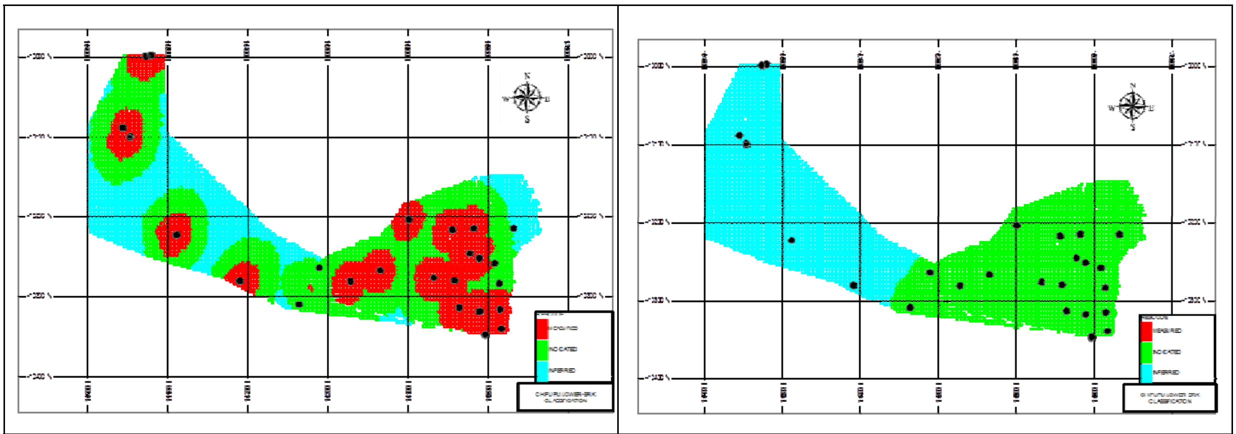
The distribution of resource estimates according to the Metorex classification matrix for Chifupu Upper is shown in Figure 4.13. SRK is of the opinion that the mineral resources for Chifupu Upper should be classified as Indicated.



srk consulting | **Metorex** Distribution of resource estimates according to classification – Chifupu Upper | Project No. 453459

Figure 4.13: Chibuluma – distribution of resource estimates according to classification – Chifupu Upper

Figure 4.14 (left diagram) shows the classification of the Mineral Resource blocks for Chifupu Lower based on the criteria adopted by Metorex (Table 4.7). The classification criterion of drill hole proximity is acceptable where there is minimal variability in the grade. The classification should be based on drill locations that are spaced closely enough for geological and grade continuity to be interpreted (illustrated in Figure 4.14, right diagram). SRK's revised classification for Chifupu Lower is shown in the right hand diagram of Figure 4.14.



srk consulting | **Metorex** Distribution of resource estimates according to classification – Chifupu's drill hole proximity (left) vs SRK's drill hole spacing (right) | Project No. 453459

Figure 4.14: Chifupu – distribution of resource estimates according to classification - Chibuluma's drill hole proximity (left) vs SRK's drill hole spacing (right)

4.6.11 Audited Mineral Resources and Mineral Reserves

SRK has reviewed the classification of the estimated blocks in the LoM, excluding those blocks in the pillars. SRK's audited classification and statement of Mineral Resources and Mineral Reserves for Chibuluma South including Chifupu at 30 June 2013 is presented in Table 4.7. The resource modelling is based on a >1% TCu grade envelope. This is essentially a natural/geological grade cut-off governed by the limit of mineralisation and the orebody is typically a much higher grade.

The Mineral Resources are quoted inclusive of the Mineral Reserves. The discussion on the conversion of resources to reserves and the mine modifying factors used in the conversion is given in Section 4.9.

Table 4.7: Chibuluma South including Chifupu – SRK Audited Mineral Resource and Mineral Reserve statement at 30 June 2013 at a 1% TCu cut-off

Classification	Mineral Resources Tonnes (Mt)	TCu grade (%)	Contained Cu (kt)	Classification	Mineral Reserves Tonnes (Mt)	TCu grade (%)	Contained Cu (kt)
Chibuluma				**Chibuluma**			
Underground				Underground			
Measured	0.8	4.06	32.5	Proved	0.5	3.83	17.6
Indicated	0.8	4.58	36.6	Probable	0.9	3.95	35.4
Inferred	0.7	4.55	31.9				
Buttress Pillars				**Buttress Pillars**			
Measured	0.8	3.91	31.3	Proved	1.0	2.70	26.0
Indicated	0.4	3.85	15.4	Probable			
Sub-Total Chibuluma	**3.5**	**4.22**	**147.7**	**Sub-Total Chibuluma**	**2.3**	**3.41**	**79.0**
Chifupu underground				**Chifupu underground**			
Measured				Proved			
Indicated	1.3	2.68	34.8	Probable	1.1	2.12	22.4
Inferred	0.9	2.41	21.7				
Sub-Total Chifupu	**2.2**	**2.57**	**56.5**	**Sub-Total Chifupu**	**1.1**	**2.12**	**22.4**
Total Chibuluma/Chifupu	**5.7**	**3.58**	**204.2**	**Total Chibuluma/Chifupu**	**3.4**	**3.01**	**101.4**

4.6.12 **Reconciliation of Mineral Resources and Mineral Reserves**

[SR8B(iv), SR8C(vi)]

The previous Mineral Resource and Mineral Reserve statement for Chibuluma was published by Metorex in its Annual Report for 2011. The Mineral Resources and Mineral Reserves at 31 December 2011 and at 30 June 2013 for Chibuluma are compared in Table 4.8.

Table 4.8: Chibuluma South including Chifupu – Mineral Resources and Mineral Reserves Reconciliation - 31 December 2011 to 30 June 2013

Item	At Jun 2013 Tonnes (Mt)	At Jun 2013 Contained Metal Cu (kt)	At Dec 2011 Tonnes (Mt)	At Dec 2011 Contained Metal Cu (kt)
Mineral Reserves				
Proved	1.3	39.2	1.7	61.0
Probable	2.1	62.2	1.2	46.0
Total Min. Reserves	3.4	101.4	2.9	107.0
Mineral Resources				
Measured	1.6	63.8	3.9	141.9
Indicated	2.5	86.8	2.3	87.1
Inferred	1.6	53.6	0.4	10.0
Total Min. Resources	5.7	204.2	6.6	239.0

The reliability of the geological data and resource estimates is reflected in the assigned classifications.

Historic performance and modifying factors for Chibuluma are set out in Section 4.9.

The changes in the Mineral Resourcesand Mineral Reserves for Chibuluma from 2011 to 2012 are attributed to:

- Mining depletion of 560 kt during F2012 and 274 kt in H1-F2013;
- Chifupu mine design and LoM plan completed and reserves added;
- SRK has modified the criteria applied in the classification of the resources.

It should be noted that there was some 1.2 Mt of material included in the LoM plan for Chibuluma, 0.7 Mt and 0.5 Mt from Chibuluma and Chifupu respectively, which have been removed from the Mineral Reserves as SRK had downgraded the resource classification of this material. This would extend the LoM for Chibuluma by approximately 2 years.

4.7 Rock Engineering

[SR5.4]

4.7.1 Geotechnical considerations

The general rock mass is highly weathered from surface to a depth of approximately 80 m. Above the orebody hangingwall, a competent amphibolite sill is present. The immediate hangingwall comprises calcareous sandstone to the north grading into a generally weaker argillite to the south. The orebody comprises quartzite, gritstone and conglomerate layers and, generally, is competent. The competent footwall consisting of siliceous and micaceous quartzites, grits and conglomerates hosts most of the development infrastructure.

The mining sequence is planned not to expose hanging wall argillite during ore body development. During stoping, the drill sequence is designed to leave a skin of ore, 0.5 m thick, against the argillite to maintain a competent hanging wall and reduce the risk of waste dilution.

Rock strength results obtained from laboratory testing are variable, but indicate that the orebody, footwall and basement rocks are generally strong with a uniaxial compressive strength of greater than 150 MPa. Three prominent, steep dipping joint sets (including the bedding) and a fourth random joint set have been identified. This structure creates a blocky rock mass and support systems have been designed using a combination of structural information and experience to reduce the potential for hanging wall and sidewall failures.

The near surface weathered zone forms an aquifer. Water occurs locally in the hangingwall (Upper Roan) and to a lesser extent in the fracture and joint systems of the immediate hangingwall, orebody and footwall quartzites. Dewatering has been undertaken by extending underground exploration holes into the hangingwall in areas where water has been encountered on an upper level. The majority of water encountered underground derives from short and long term drainage of backfilled stopes. The majority of water encountered underground derives from short and long term drainage of backfilled stopes.

Regional support for the Long Hole Stoping ("**LHS**") method consists of 4.5 m wide rib pillars, oriented along dip and spaced 11.5 m apart along strike (skin to skin spacing). Within any stope a pillar is over 11 m high with a height to width ratio of less than 0.4. After loading of ore, stopes are backfilled using cyclone classified tailings which provides lateral support to the pillars. The rib pillars are formed within each cut and superimposed on the previously formed pillars.

A critical element of the LHS method involves providing support to pillars by introducing backfill into stopes as soon as ore extraction has been completed. Cyclone Classified Tailings ("**CCT**") form the primary backfill product, which is reported to drain very efficiently and provide early support to the pillars. Bulkheads are constructed using an innovative geotextile bag system. CCT is supplemented by development waste when available.

Buttress pillars used previously in the cut and fill method will not be incorporated into the LHS method below 432mL.

The stope back within the 11.5 m wide rooms is supported with split sets to ensure the safety of personnel working in these excavations. No major rockfalls have been experienced, while this practice has been followed.

A number of rockfall incidents that have resulted in minor equipment damage and injury to two personnel, have been reported since January 2013. Currently Chibuluma has implemented a rockfall awareness campaign and is actively reviewing all support standards.

The LHS method is appropriate at the current depths, but may need to be modified for greater depth to cater for increased stress levels.

The portal for the primary access ramp has been constructed from the existing pit highwall, through highly weathered ground. This section of the ramp is well supported with steel sets, concreted timber shuttering and does not exhibit any significant deterioration. Mesh support has been installed on the highwall above the portal. Subsidence monitoring of the highwall above the portal is carried out. Split sets, which have been installed in the granitic footwall rocks of the 5 m-wide decline, generally are effective in controlling the blocky rock mass. The split set faceplates are monitored for signs of deterioration and indications of anomalous rock loading. There have been minor rock falls in the decline ramp primarily associated with weathered ground and faulting.

More recently a pattern of grouted rebar has been introduced in all long term excavations. Providing the quality of the grouting is controlled, this system will be more effective than split set support in the long term. The need for quality control has been identified and is being addressed.

Support and layout designs have been carried out by AMC in April 2006, June 2007 and December 2008. The 2006 design incorporates a wedge analysis for development excavations at various orientations, stope stability analysis using the Matthews/Potvin Stability Graph method and an empirical pillar analysis. SRK concurred with the conclusions and recommendations drawn from this analysis in an Independent Engineer's Report dated 8 November 2007. The design covers the current shallow portion of the orebody adequately. Support standards were drawn up taking into consideration the recommendations from the report. Additional support is installed on an ad-hoc basis where necessitated by local variations in ground conditions.

An in-house rock engineering service is available at Chibuluma South mine. Strata control functions are addressed on an on-going basis by in-house strata control and production staff, while rock engineering services are provided on a regular basis by external rock engineering consultants. This level of rock engineering services and input to mine planning and operation is considered adequate for this operation.

The 2008 report completed by AMC covers the re-evaluation of anticipated mining induced stresses using numerical modelling as well as physical rock mechanics aspects observed underground. The conclusions led to the revision of support recommendations and advice on optimising future mine planning.

The mining induced stresses used the 2008 report were calculated using the Examin Tab, a RocScience computer modelling program. The Hoek-Brown failure criterion was used for pillar evaluation. The analysis showed an increase in pillar stress as mining progressed and when panels between buttress pillars are completely mined out. The model assumed 4 m pillars and 14 m stopes. The current support standard for panels was also evaluated using the Phase2D RocScience program. This support incorporates 2.4 m split-sets at 1.5 by 1.5 m grid pattern as primary support and later with 6 m Swellex and 9 m hydrabolts at 1.5 m and 4.5 m on either side of the centre line of intersections.

It is presumed that the change to the LHS system will largely eliminate the risk associated with highly stressed buttress pillars. Closure of mining faces against the 432mL buttress pillar and abutments will however remain a risk.

No modelling of the revised LHS layout has been undertaken. In SRK's opinion, this exercise should be carried out to assist with understanding the interaction between mining faces, abutments and the 432mL buttress pillar and to identify any areas which may require additional support or a variation to the routine layout.

Development of the decline shaft system to access the Chifupu deposit has commenced with excavation of the box cut. A design for side and back wall slopes has been prepared and compared with slopes existing in the South Mine box cut.

Geological exploration has indicated that strata within the ore body sequence are similar to those encountered at South Mine. It can reasonably be expected that, for application of LHS, mining conditions will be similar to those experienced at South Mine.

4.7.2 SRK Comments

[SR6C]

The LHS method is appropriate at the current depths, but may need minor modifications at greater depth to cater for increased stress levels. Modelling of the revised LHS layout should be undertaken to examine the interaction between mining faces, abutments and buttress pillars and identify where support layouts may need to be changed.

The level of rock engineering services and input to mine planning and operation is considered by SRK to be adequate for Chibuluma.

SRK concludes that the LHS method is feasible in the prevailing mining environment. Detailed planning is essential to ensure that production and backfilling targets are achieved as the LHS method is implemented on a wider scale.

4.8 Hydrogeology and Hydrology

[SR5.4]

The comments which follow are based on a review of a CPR compiled by Metorex in 2010 and any additional hydrogeological data that may have been collected since that report. This review also aims to identify the most significant risks to ground and surface water, given the available data. No site visit was conducted as part of the hydrogeological review.

4.8.1 Baseline description

Surface Water

For Chibuluma South raw water is obtained from water pumped to surface and potable water is abstracted from the Kalulushi Stream.

Groundwater

- **Hydrogeological Units** – Besides stating that "the near surface weathered zone forms an aquifer" and "water occurs locally in the hybrid rocks and sporadic dolomites in the hangwall (Upper Roan) and to a lesser extent in the fracture and joint systems of the immediate hangingwall, orebody and footwall quartzites", no detailed description is given of the hydrogeological units.
- **Groundwater Use** - As far as could be ascertained from available data, no hydrocensus has been conducted around the Mine to capture information on existing drill holes, springs, dugwells, etc. The radius of the hydrocensus should be determined from the predicted radius of influence of both mine dewatering (water level drawdown) and groundwater contamination. Similarly, no numerical or hydrochemical modelling has been done to determine the predicted cone of dewatering or potential impact of contaminated groundwater (if any) on surrounding communities.
- **Groundwater levels and flow directions** - No groundwater contour map that indicates the groundwater flow directions could be found in the data provided to SRK.
- **Recharge** - No data available.
- **Water use and supply** - Chibuluma has built a water tank at a local village (Chief Nkana's village), and installed drill holes and hand pumps at the school and in the nearly communities.

  The report further states that the process plant and underground section uses 4 000 m^3 of water per day, which is supplied from a stream 3 km from the mine. Service water for the process plant is available from the clear water dam on surface (supplied from the underground section).

Water Quality

A report by Metorex, dated January 2010 notes the following:

- Mining activities at Chibuluma South have the potential of polluting ground water;
- Pollutants released on surface can impact on groundwater.
- Monitoring boreholes have been positioned both upstream and downstream of the site in order to monitor pollutants spreading from the site. Ground water monitoring at the mine is a commitment in the Chibuluma South Mine Environmental Management Plan of April 2009;
- Monitoring of the ground water should, ideally, continue even after closure of the mine.

AMC issued a report in 2012, in which sampling of standing pools in the stockpile area and different depths in Shaft 3 and 4 were done. Based on this work they state that the Co-concentrate is the obvious source of pollution of surface water, the underlying soils and most probably the underlying groundwater aquifer. AMC has therefore identified the stockpile area as a source of historical pollution. They note that all contaminated soil or waste rock samples have significant potential to generate acidic drainage with no or a very low neutralisation potential and the storage and release of acidity by secondary minerals can cause acid drainage to continue even after sulphides are depleted. The status of the groundwater in the area was not determined, but AMC expected that any receptor of seepage would be impacted upon. In their conclusions they predicted that the site would be unfit for residential or commercial use as it might pose serious health risks to humans even if the surface contamination is removed.

In March 2013 eight water samples were collected by Metorex and sent to Alfred H Knight laboratory for analysis. No comparisons against any standards were shown on the laboratory results. Since this is a once off sample run and is not linked to any assessment of possible receptors it should not be used as an indication of potential risks and liabilities.

4.8.2 Groundwater Model

There is no evidence of conceptual and/or numerical groundwater models for the mine.

Surface water and groundwater monitoring have been identified by Metorex as necessary and which must be implemented. Although water samples are being collected by Metorex, no information was supplied to SRK to confirm whether a formal groundwater and surface water programme has been developed.

4.8.3 Legal Framework

The following licences related to water and waste, as required by Section 3.1.3 of the environmental authorisation, are in place:

- The Waste Management (licensing of Transporters of Waste and Waste Disposal Site) Regulations, 1993;
- The Hazardous Waste Management Regulations, Statutory Instrument No 125 of 2001;
- Pollution Control Regulations, 1994 (Pesticides and Toxic Substances); and
- The Water Pollution (Effluent and Waste Water) Regulations 1993 - license to discharge effluent (Regulation 5).

4.8.4 Risks to Surface and Groundwater

Chibuluma has water monitoring drill holes and monitors groundwater quality on a monthly basis. This is done internally, and no external report could be made available at the time of the site visit and assessment of trends could not be done. SRK understands external checking of monitoring and assessment of trends is now to be implemented, and included as a module in the mine's Environmental Management System. In addition, Metorex reports that external consultants have been commissioned to investigate the potential for Acid Mine Drainage ("**AMD**") and initial results indicate that there is a potential for AMD but that, post closure, the impact of this could be negated by rapid inflows of water.

Groundwater contamination at Chibuluma West can be expected, given soil contamination and seepage from the tailings dam that has been detected. The extent of this has not been quantified but ground water monitoring is taking place. Due to the nature of the sulphide ore mined, AMD can be expected.

Five monitoring drill holes were drilled upstream and downstream of the tailings dam at Chibuluma South. Concern was raised over possible groundwater contamination that may affect Kaputula Village, which is located approximately 500 m from the tailings dam. According to Metorex, arrangements are in place for people potentially affected by this to be moved.

Dewatering of the underground operations is being done at present. There is no indication in the information provided what the impact this may have on drawdown and other water users.

4.9 Mining Engineering

[SR5.4]

4.9.1 Introduction

Chibuluma

Chibuluma South mine commenced underground mining operations in 2005. The mine reached a production rate of 40 ktpm by June 2007 and has been operating since then at a production rate of between 45 ktpm and 50 ktpm. The mine is designed for use of trackless mechanised equipment for development, stoping and rock handling including hauling ore to surface. Equipment sizing is matched to the development dimensions. The ADT and Load Haul and Dump ("**LHD**") units are diesel powered, while the drill rigs are electro-hydraulically powered.

Secondary mining equipment includes the following items:

- Long hole hydro-power drill rig for drop raising of vertical development ends; and
- Mobile hydraulic rock breaker.

Pumping of dirty water to surface is via four Warman dirty water pumps with two dedicated pump columns. Underground ventilation is affected by three main axial fans located on surface.

Ongoing LoM planning is carried out as part of an annual planning cycle. Short term planning is carried out on-mine and monitored to ensure adherence to a strict mining echelon. On site discussions revealed that planning meetings are held monthly with planning and production staff in attendance. The mine plan is generated by the planning department and is then agreed to and signed by all present. SRK considers this to be a sound process.

LoM planning is based on a detailed 3-dimensional mine design with Gantt chart schedule. Chibuluma South mine uses Gemcom Surpac Version 6.1.3 software for all geological modelling and mine design, and the Minesched module for scheduling requirements.

Chifupu

The Chifupu deposit is located about 1.7 km south of Chibuluma. The deposit consists of two orebodies separated by a 23 m thick waste parting or barren quartzite. The ore bodies dip at approximately 40° with average thicknesses of 9 m and 15 m for the footwall and hangingwall ore bodies respectively.

The Chibuluma Mine Planning Department completed a feasibility study on the deposit in order for production from there to supplement tonnage from Chibuluma as Chibuluma nears the end of its life, currently planned for 2021, when the crown pillar is extracted. Development of a decline at Chifupu is planned to commence in the fourth quarter of 2013, with stoping commencing in 2015.

Sound Mining Solution (Pty) Ltd ("**SMS**") reviewed the Chifupu feasibility study (a copy of which was provided to SRK) and submitted a report entitled "*Chifupu Project Review*" to Metorex in June 2012. SRK has considered two subsequent reports, "*Chifupu Project - Technical Review Report"*, SMS Report SMS/081/13, March 2013 and "*Chifupu Project - Board Document Notes",* March 2013*"* in the compilation of this CPVR.

4.9.2 Access

Chibuluma

The Chibuluma mine is accessed via a single decline from the old pit. Figure 4.15 shows a view of the open pit and decline ramp portal from the base of the pit.

Chifupu

Chifupu is planned to be accessed by a single decline ramp from surface, development of the boxcut for the decline portal has already commenced. SRK understands that a trade-off study demonstrated the merits of this approach relative to utilising the existing underground infrastructure at Chibuluma. SRK was not provided with a copy of this study.

4.9.3 Mining method

Chibuluma

The Cu sulphide orebody dips at an average 38° and varies in thickness from a few metres to over 30 m, with a strike length generally over 200 m. Underground mining started at 70 m below surface, beneath the oxides and transitional zone. A crown pillar has been left between the open pit and underground excavations. Current development and stoping operations are taking place between 348 mL in the upper block and 516 mL in the lower block. Ramp development currently is at 550 mL.

The orebody closes off against a basement abutment at depths between 600 m and 650 m.

A Cut and Fill mining method has been applied to extract the majority of the orebody. LHS has been used in areas where the orebody is narrow or to extract the 7.5 m high buttress pillars where Cut and Fill mining approaches a mined out level above. These LHS stopes are also filled. A Post Pillar Cut and Fill ("**PPCF**") method was introduced into the 398 m L block in April 2009.

Chibuluma intends to extend the use of the LHS method to the majority of the orebody for the remaining LoM.

LHS spans are designed at 11.5 m and stopes are separated by 5.5 m pillars. The vertical stope height is 11.7 m. This approach is expected to reduce the ore reserve by 2% but to increase copper production by 11% as dilution from backfill and waste development is reduced substantially.

srk consulting	**Metorex** Chibuluma South Mine – the Chibuluma South pit showing the ramp decline portal	Project No. 453459

Figure 4.15: Chibuluma South Mine – the Chibuluma South pit showing the ramp decline portal

SRK reviewed a comprehensive report detailing the LHS method prepared by Chibuluma, which included recommendations to further increase confidence in the method as follows:

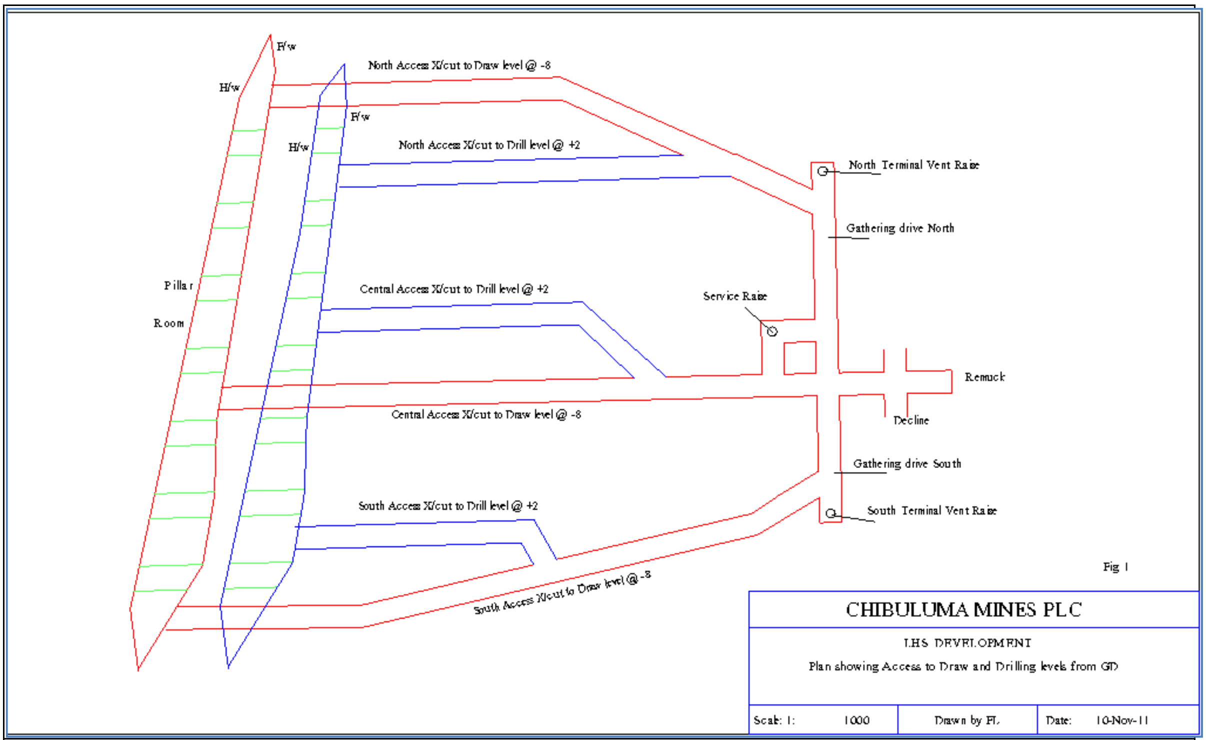
- additional numerical modelling of the layout and mining sequence to investigate stress changes on the centre access cross cuts;
- careful consideration of backfill sequencing and reticulation system requirements;
- further review of stope drilling layouts and blast designs to confirm their practicality and to minimise blast induced damage to rib pillars and stope backs.

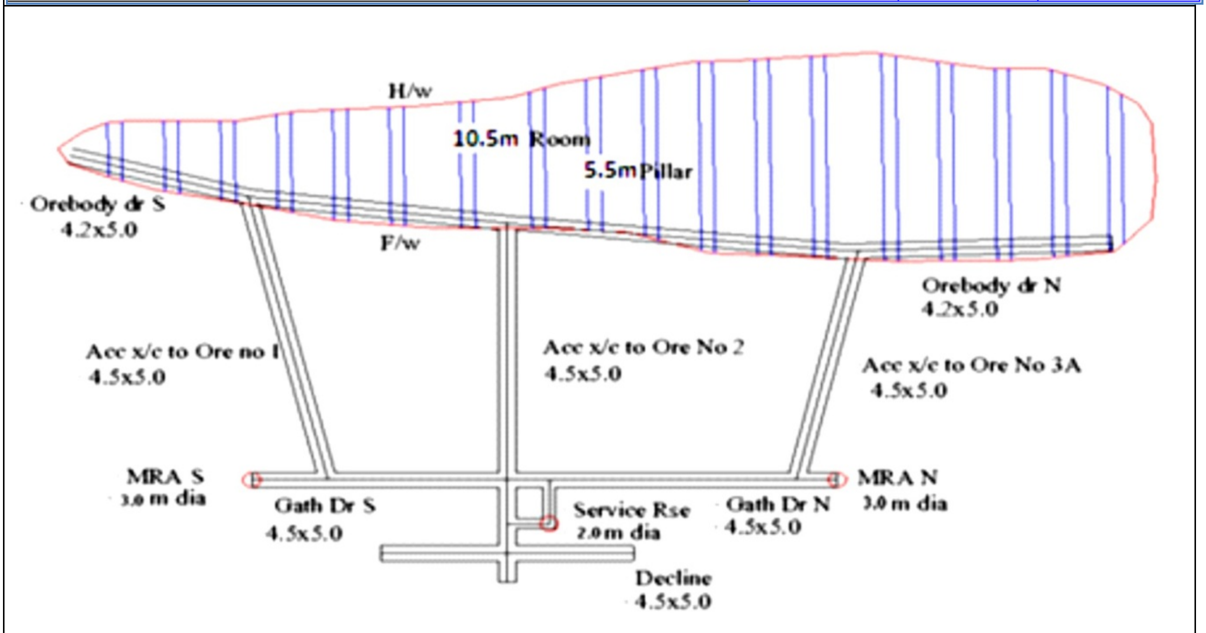
SRK concludes that the LHS method has been trialled sufficiently and is feasible in the prevailing mining environment. Detailed planning is essential to ensure that production targets are achieved as the LHS method is implemented on a wider scale.

The PPCF method was selected on account of depth and resultant stress, width of orebody, availability of mining faces, pillar width-height ratio and extraction factor. The design for the method is 10.5 m wide rooms and 5.5 m pillars, and 5 m wide drives through pillars.

The orebody is mined in 40 m vertical sections as soon as they become available. Mining takes place from the bottom up, while development is from the top down.

Typical LHS and PPCF layouts are compared in plan (Figure 4.16) and section (Figure 4.17).





srk consulting	**Metorex** Chibuluma South Mine – conceptual plans for development and stoping designs – LHS (top) and PCCF (bottom)	Project No. 453459

Figure 4.16: Chibuluma South Mine – conceptual plans for development and stoping designs – LHS (top) and PPCF (bottom)

Chifupu

Because of the geometry and other physical characteristics of the Chifupu orebodies being broadly similar to Chibuluma, the cut and fill mining method proposed for Chifupu is the same as is practised at Chibuluma, with stopes being mined from the bottom towards the top of the orebody. The method is well understood at the mine so skills and equipment transfer could be utilised fairly easily. SMS noted, however, that more than one mining method may be appropriate, mainly because of the changing shape and width.

SRK understands that the mine has introduced a central access which entails starting stoping from the extreme fringes and retreating to the centre, thus improving the flexibility of the design.

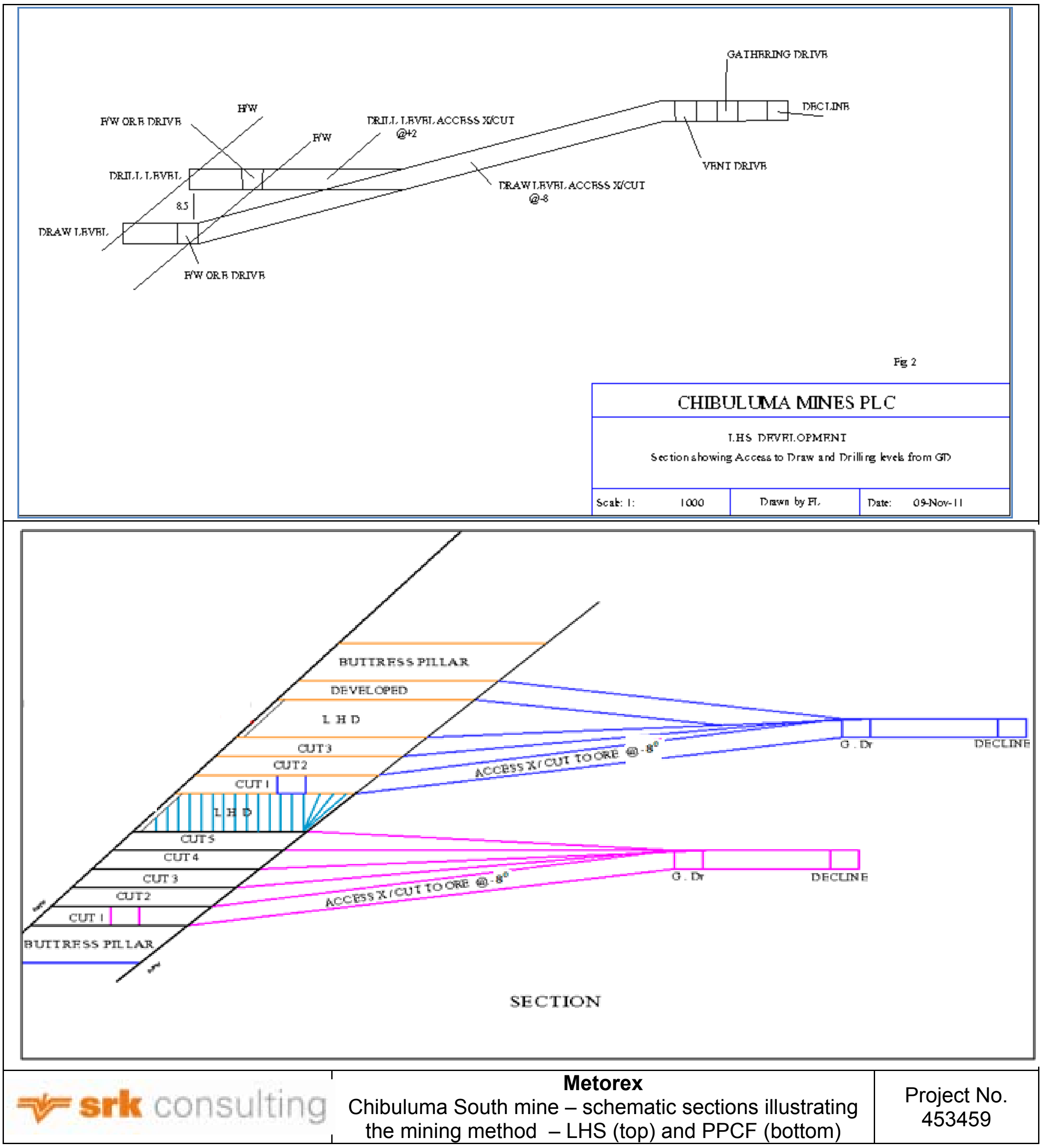
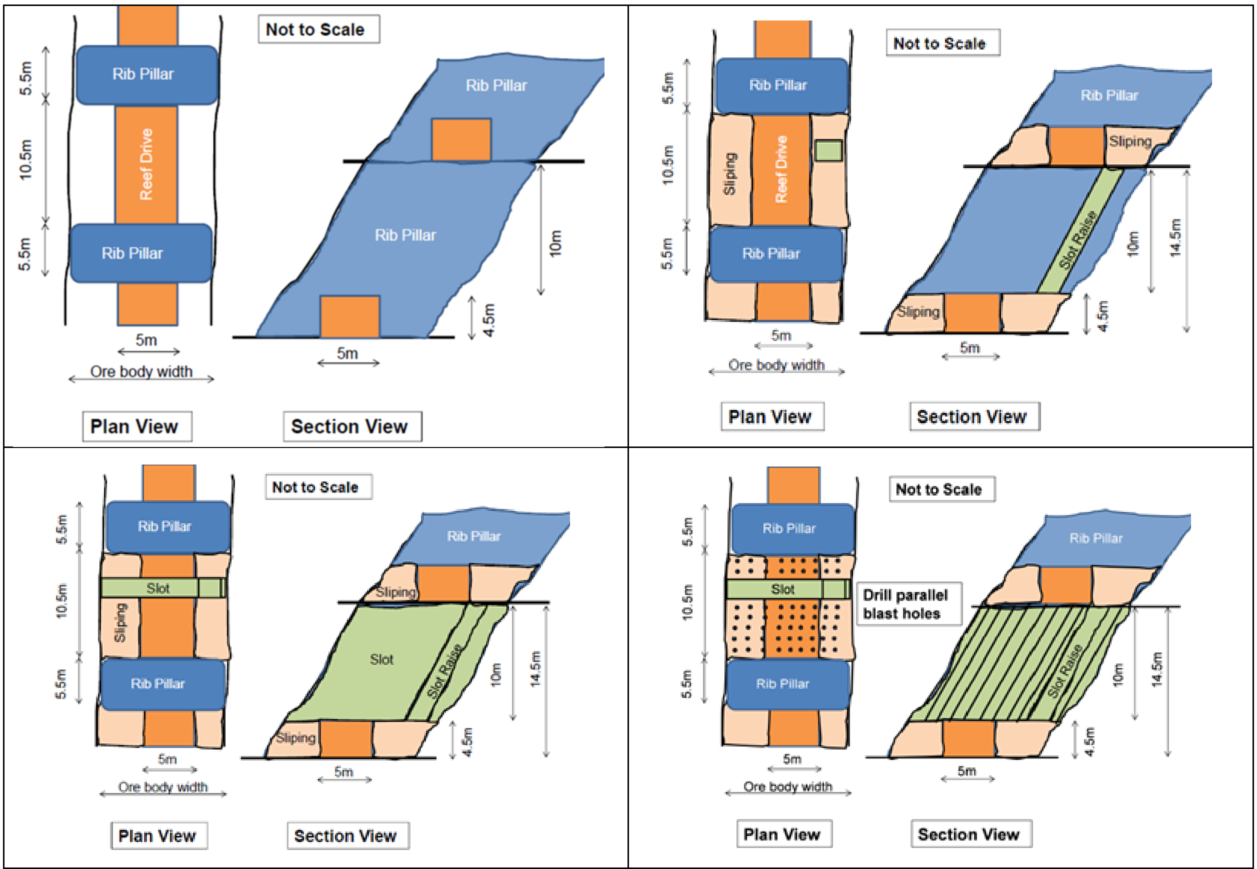


Figure 4.17: Chibuluma South Mine – Schematic sections illustrating the mining method – LHS (Top) and PPCF (Bottom)

Comment was made on the location of the main buttress pillar in a narrow HG portion the Chifupu orebody. In the redesign, the location of the pillar has now been moved from the 235 m L to a lower grade area on 227 m L.

The stope design is based on geotechnical parameters and the current operating experience at Chibuluma South Mine. The LHS method was selected due to its cost effectiveness and high levels of equipment productivity and is best described by means of illustrations.

Developing the reef drive on strike is the first stage of the mining process. Figure 4.17 illustrates the mining process starting from the development stage with the reef drive passing through the centre of the orebody. The reef drive has dimensions of 5 m wide and 4.5 m in height. Rib pillars are left in-situ every 10.5 m along strike. The rib pillars are 5.5 m in width according to geotechnical recommendations. The height of the stopes is 14.5 m. The next stage of the mining process includes sliping the stope at the height of the reef drive, to the width of the orebody. After the slot raise is developed, the slot is removed across the width of the orebody. The slot creates the free breaking face to mine the stope between the rib pillars. The final process includes the drilling and blasting, followed by loading.



srk consulting	**Metorex** Chibuluma South mine mining process: top left- stope development phase, top right-reef drive sliping phase, bottom left- slot removal phase and bottom right-drilling and blasting phase	Project No. 453459

Figure 4.18: Chibuluma South Mine – Schematic sections illustrating the mining process – top left-stope development phase, top right-reef drive sliping phase, bottom left- slot removal phase and bottom right-drilling and blasting phase

4.9.4 Service infrastructure (ventilation, rock hoisting, men and material access)

Chibuluma

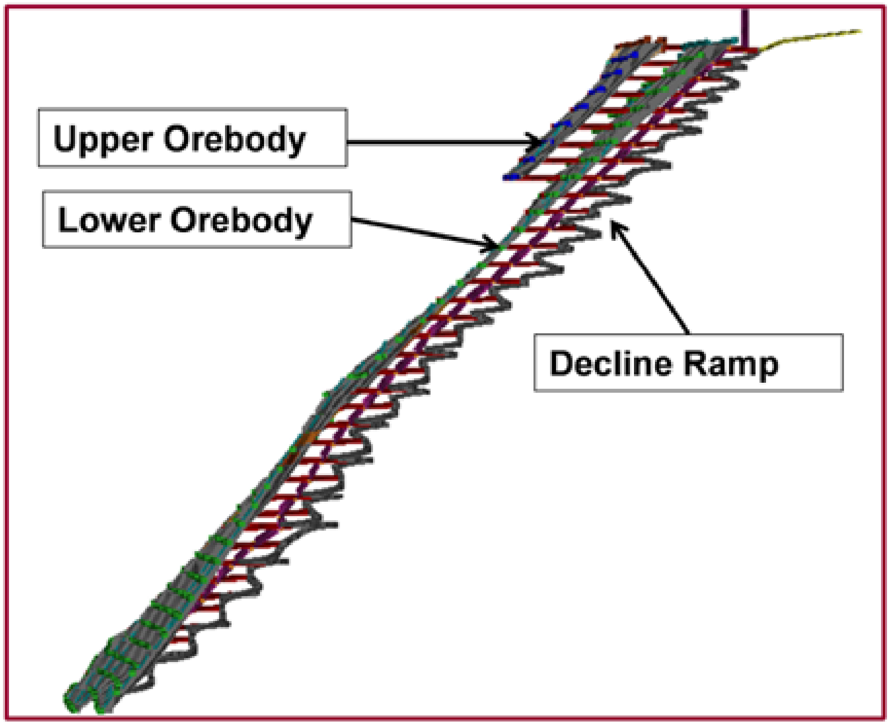
Access to the mine for men, material and utilities is through the decline ramp positioned from the bottom of the open pit as depicted in Figure 4.19.

Fresh air is downcast through the ramp and directed to all underground workings. A series of raises are mined in the footwall connecting between levels and finally to the 3.5 m diameter ventilation shaft bored from 113 m level to the open pit where three surface exhaust fans are located. The designed capacity of each surface fan is about 68 m^3/sec, at a static pressure of 2 kPa.

Currently, an average of 198 m^3/sec of fresh air is drawn into the mine using three surface fans at a static pressure of 1.9 kPa.

Chifupu

The decline ramp from surface (see Figure 4.19) will act as the main air intake airway for the underground mine. SMS considered that the exhaust raise, at 3 m x 3 m, was potentially too small in cross-section to cater for the mine's requirements. SRK understands that the excavation has now been increased to 4 m x 4 m, while internal raises are 3 m x 3 m. SRK understands further that a series of additional raises has also been added on the other side of the main access from decline to increase the exhaust capacity.



srk consulting	**Metorex** Chibuluma South mine – section view of proposed Chifupu mine design	Project No. 453459

Figure 4.19: Chibuluma South Mine – section view of proposed Chifupu mine design

The Chibuluma South Mine only has one decline ramp from surface and is meeting its production targets. The Chifupu Project has therefore been planned along similar principles and will have a lower production requirement compared to Chibuluma South Mine. The single decline ramp for the Chifupu Project is therefore considered adequate.

SMS also noted that the main ramp be moved closer to the orebody in order to reduce the amount of waste development. While SRK has not seen the design, SRK understands that the ramp is now 45 m to 55 m away from the orebody.

4.9.5 Modifying factors and mining efficiencies

Chibuluma

Historical performance has been used to determine dilution factors. The dilution for F2010 and for F2011 was 16% and for the first five months of 2012 has been 12%.

Dilution in the H1-F2013 was 23% relative to a budget of 21%. The high dilution is largely a function of weak ground in the hangingwall on the southern extension of the orebody, mucking of waste-rock/backfill during production and the waste parting. Support and close monitoring of the filling sequences is anticipated to bring the dilution down in the LoM. According to the LoM production schedule, dilution is planned to rise to 28% for 2014 and remains in the 24% to 30% range for the rest of the LoM, an approach that SRK considers to be appropriate.

The modifying factors applied to convert mineral resources to mineral reserves are 28% dilution factor and 88% extraction factor.

Chifupu

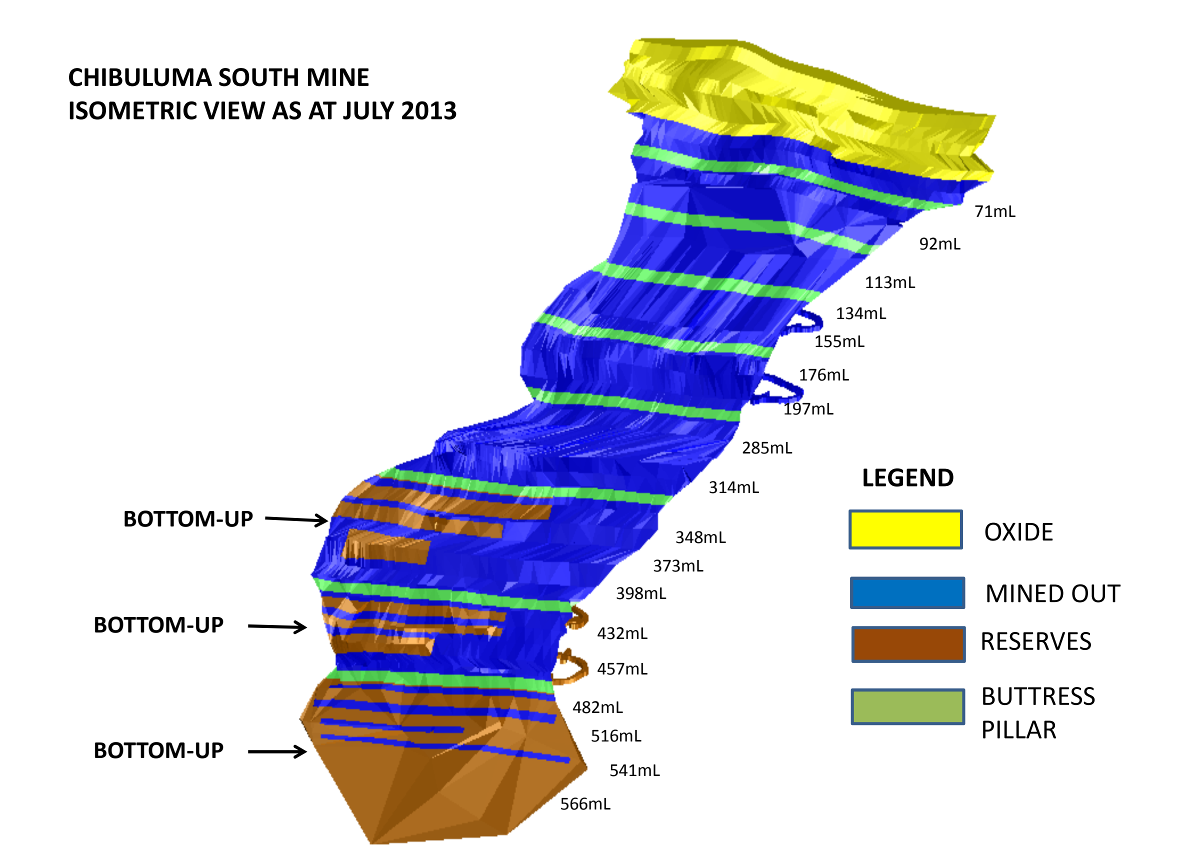
The modifying factors applied to convert mineral resources to mineral reserves are 21% dilution factor and 88% extraction factor.

4.9.6 Development and production schedule

Chibuluma

The decline ramp is planned to advance at 40 m per month. Intermittent pumping and ground problems are currently being experienced and may impact on this advance rate. The ramp is currently on the 541 m L and is being advanced to the 566 m L (Figure 4.20).

A production rate of about 50 ktpm is planned from two mining blocks at any one time. Each block is scheduled at 25 ktpm. Currently production arises from the 398 m and 457 m L blocks. The upper 314 m L block is being exhausted and the 457 m L block is its replacement. The mine staff realised that to maintain production at this level requires higher availability and utilization of the equipment than was being previously achieved and for this reason the mine recently upgraded its haul fleet from 30 t to 40 t capacity units.



srk consulting	**Metorex** Chibuluma South Mine – schematic section illustrating the Cut and Fill mining method	Project No. 453459

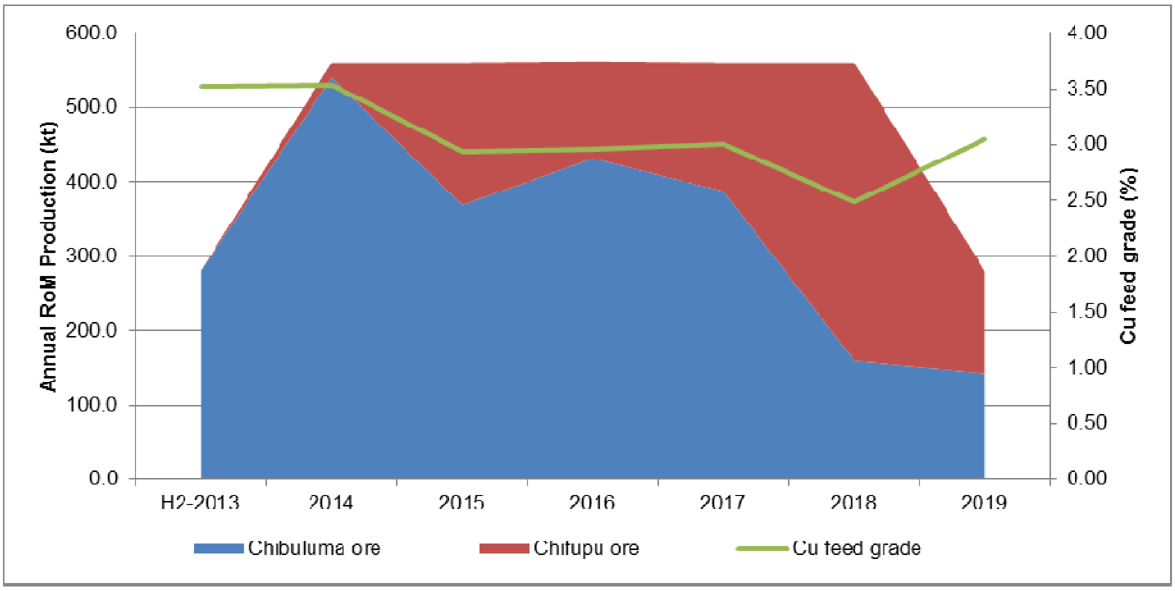
Figure 4.20: Chibuluma South Mine – schematic section illustrating the Cut and Fill mining method

Chifupu

The Chifupu development schedule calls for the development of 210 m during the first 12 months of development. At this point development will be at a depth of 66 m below surface (40 m deep boxcut plus 26 m vertical advance in decline). The RAW is positioned at 70 m below surface, and from that point onwards, the development advances at 90 to 110 m per month with two-end availability (RAW and the decline). SRK considers this reasonable.

Ore development at Chifupu is planned to commence in September 2014, with production from stopes slated to begin in 2016. Total tonnage from Chifupu peaks at 401 ktpa in 2018 (328 ktpa ex stoping).

The combined production schedule for Chibuluma and Chifupu is set out graphically in Figure 4.21. Total production from the two mines is shown to cease in 2019. It should be noted that there was some 1.2 Mt of material included in the LoM plan, 0.7 Mt and 0.5 Mt from Chibuluma and Chifupu respectively, which was removed from the Mineral Reserves as SRK had downgraded the resource classification of this material. This would extend the LoM for Chibuluma by approximately 2 years.



srk consulting	**Metorex** Chibuluma South Mine – combined production schedule for Chibuluma and Chifupu	Project No. 453459

Figure 4.21: Chibuluma South Mine – combined production schedule for Chibuluma and Chifupu

The Proved and Probable Mineral Reserves of 3.4 Mt at 3.01% Cu support a 6.5-year LoM plan at a steady-state production rate of 560 ktpa.

4.9.7 Manpower

The Chibuluma manpower complement associated with mining activities consists of management and supervision to direct and control the mining activities, production personnel, technical support services and engineering support personnel. The total complement is approximately 227 people.

4.9.8 Capital and Operating Costs

Chibuluma has provided a breakdown of the mining capital expenditure from F2013 to F2015 as set out in Table 4.9. The capital for the decline and underground development at Chifupu in preparation for mining is included.

Table 4.9: Chibuluma – Mining Capital Expenditure – H2-F2013 to F2015

Mining	Units	H2-F2013	F2014	F2015
Development	(USDm)	1.97	2.85	2.85
Raise development	(USDm)	0.02		
U/G electrical	(USDm)	0.19	0.19	0.14
Power generation	(USDm)		0.01	
Mining equipment (mechanized)	(USDm)	3.90	8.63	5.18
Other mining projects	(USDm)	0.37	2.41	0.40
Chifupu Cu project	(USDm)	2.47	3.84	7.79
Total Mining	**(USDm)**	**8.92**	**17.93**	**16.36**

The unit mining costs per tonne of RoM ore (excluding manpower) at Chibuluma forecast for H2-F2013 and remainder of LoM are respectively:

- Mining including Technical Services USD13.34/t USD13.73/t;
- Mining engineering USD15.79/t USD15.75/t;
- Transport of Chifupu ore (estimated) USD2.50/t.

The budgeted mining cost for F2013 showed a 3.1% overall increase relative to the forecast mining cost for, F2012, which is seen to be reasonable. The budgeted mining operating costs for H2-F2013 to F2015 are set out in Table 4.10.

Table 4.10: Chibuluma – Mining Operating Cost – H2-F2013 to F2015

Mining Costs	Units	H2-F2013	F2014	F2015
Production	(USDm)	3.7	7.4	7.4
Technical Services	(USDm)	0.0	0.3	0.3
Mechanical Engineering	(USDm)	0.0	0.1	0.5
Ore transport (Chifupu)	(USDm)	4.4	8.8	8.8
Salaries & wages	(USDm)	3.5	6.9	6.9
Total Mining Opex	**(USDm)**	**11.7**	**23.5**	**23.9**
Unit mining cost	USD/t RoM	41.66	41.91	42.67

4.9.9 SRK Comments

Ongoing LoM planning is carried out as part of an annual planning cycle. The short term mine plan is generated by the planning department on the mine and is then agreed to and signed by all planning and production staff in attendance at a monthly meeting. SRK considers this to be a sound process.

SRK concludes that the LHS method has been trialled sufficiently and is feasible in the prevailing mining environment. Detailed planning is essential to ensure that production targets are achieved as the LHS method is implemented on a wider scale.

The Chifupu development schedule calls for the development of 210 m during the first 12 months of development. At this point development will be at a depth of 66 m below surface (40 m deep boxcut plus 26 m vertical advance in decline). The RAW is positioned at 70 m below surface, and from that point onwards, the development advances at 90 to 110 m per month with two-end availability (RAW and the decline). SRK considers this reasonable.

4.10 Mineral Processing

[SR5.5]

4.10.1 Introduction

The Chibuluma concentrator was commissioned in 2000. Originally copper oxide and copper sulphide ores were treated. The % copper recovery and silica content of the copper oxide ore made it uneconomical to treat and currently only copper sulphide ore is treated.

The concentrator is currently receiving ore from the Chibuluma South section. The ore supply from the Chibuluma West section ceased in April 2005. The concentrator rated capacity is 48 ktpm. The average treatment rates for F2012 and H1-F2013 were 46.4 ktpm and 45.7 ktpm respectively, at average grades of 3.46% and 3.25% Cu and overall Cu recoveries of 96.5% and 96.3% resepctively. The budget for H2-F2013 allows for an average grade of 3.52% Cu and a 96.0% Cu recovery. The ore reserve report states an average of 3.04% Cu for LoM, which reflects the influence of the lower grade Chifupu ores.

4.10.2 Metallurgical Testwork

The bulk of the total Cu is derived from bornite while contributions from chalcocite and chalcopyrite are subordinate. Bismuthunite occurs as an intergrowth with bornite and increases with depth. Bismuth in the Cu concentrate attracts a smelter penalty at levels greater than 300 ppm. Currently, bismuth levels in the concentrate are at 1 000 ppm to 1 200 ppm. This mineralogical relationship is unique to Chibuluma South in the context of other Zambian Copperbelt mines.

Carollite and native Cu are minor contributors to the total Cu while the contribution from Co oxides in the form of malachite or chrysocolla remains negligible. The gangue mineralogy is composed of mostly quartz and feldspars with comparatively minor micas and carbonates. Other gangue constituents are negligible.

Laboratory test work indicates that the concentrator should expect recovery for Chifupuu ores. This is in line with current performance at Chibuluma South mine, and the LoM recovery rate.

Additional metallurgical testwork on 6 drill core samples showed that the Cu recovery for Chifupu ore would be 93% (versus 96% of Chibuluma), but yield a lower concentrate grade. The mineralogical analysis revealed that:

- The copper sulphides, which account for the acid insoluble copper, were represented by major chalcopyrite, subordinate bornite and minor to negligible chalcocite and carrolite,
- The copper "oxides" which were responsible for the acid soluble copper, were negligible,
- The pyrite and pyrrhotite content was negligible,
- The gangue mineralogy was similar in all the samples with the major gangue constituents, being quartz/feldspars. Micas and carbonates were minor while other constituents were negligible.

This mineralogy confirms that this material can be successfully processed by the current Chibuluma flow sheet.

4.10.3 Process Description

The simplified process plant flow sheet for Chibuluma is described in the following section and shown in Figure 4.22.

The ore from the South section is stockpiled on a ramp with a capacity of 20 kt. The ore with a size grading of -700 mm is fed by front-end loader directly into a jaw crusher. The product from the jaw crusher is –100 mm and is further crushed by the Hazemac impact crusher to a size of 60% -13.5 mm. This product is then deposited on a 6 kt tonne capacity stockpile. This crusher increased the concentrator capacity from 42 ktpm to 48 ktpm. The crusher can be operated in or out of circuit.

A series of conveyors feed a secondary cone crusher (which acts as a standby unit for the Hazemac impact crusher) via a vibrating scalping screen. The scalping screen undersize and the secondary crusher products are fed to a sizing screen which is in closed circuit with a tertiary cone crusher.

The product from the sizing screen is 85% –13.5 mm and is deposited on a 3 kt capacity stockpile. A conveyor fitted with a weightometer feeds a 20 t mill feed bin and two mill feeder conveyor belts fitted with weightometers feed the two ball mills at a similar rate. A cyclone is in closed circuit with each mill. The cyclone overflow is 52-55% -75 µm and feeds directly into the first rougher flotation cell. The flotation chemicals (collectors), Sodium Normal Propyl Xanthate ("**SNPX**") and Potassium Amyl Xanthate ("**PAX**"), and the frother Beta-froth are added. A combination of rougher, middling, scavenger and cleaner flotation cells produce a Cu concentrate with a grade of 46.0% Cu.

The concentrated is de-watered in a thickener and pumped to a filter press. The overflow from the thickener is recycled to the process water tank. Water from the tailings dam is also returned to the process water tank. The fresh water make-up comes from a local stream located 3 km from the processing facility. The concentrate with a moisture content of 10% is deposited on a stockpile. Trucks take the concentrate to the Chambishi Copper Smelter ("**CCS**").

The tailings from the plant go through a backfill plant with a cyclone arrangement. The cyclone underflow (20% -75 µm) is re-deposited underground with the overflow (60% -75 µm) to the tailings dam.

The single largest constraint in the process plant is the milling capacity with the two ball mills running at approximately 20% over their designed capacity. The milling plant utilisation runs at 95% with availability at 90%, giving overall plant running time of 85.5%.

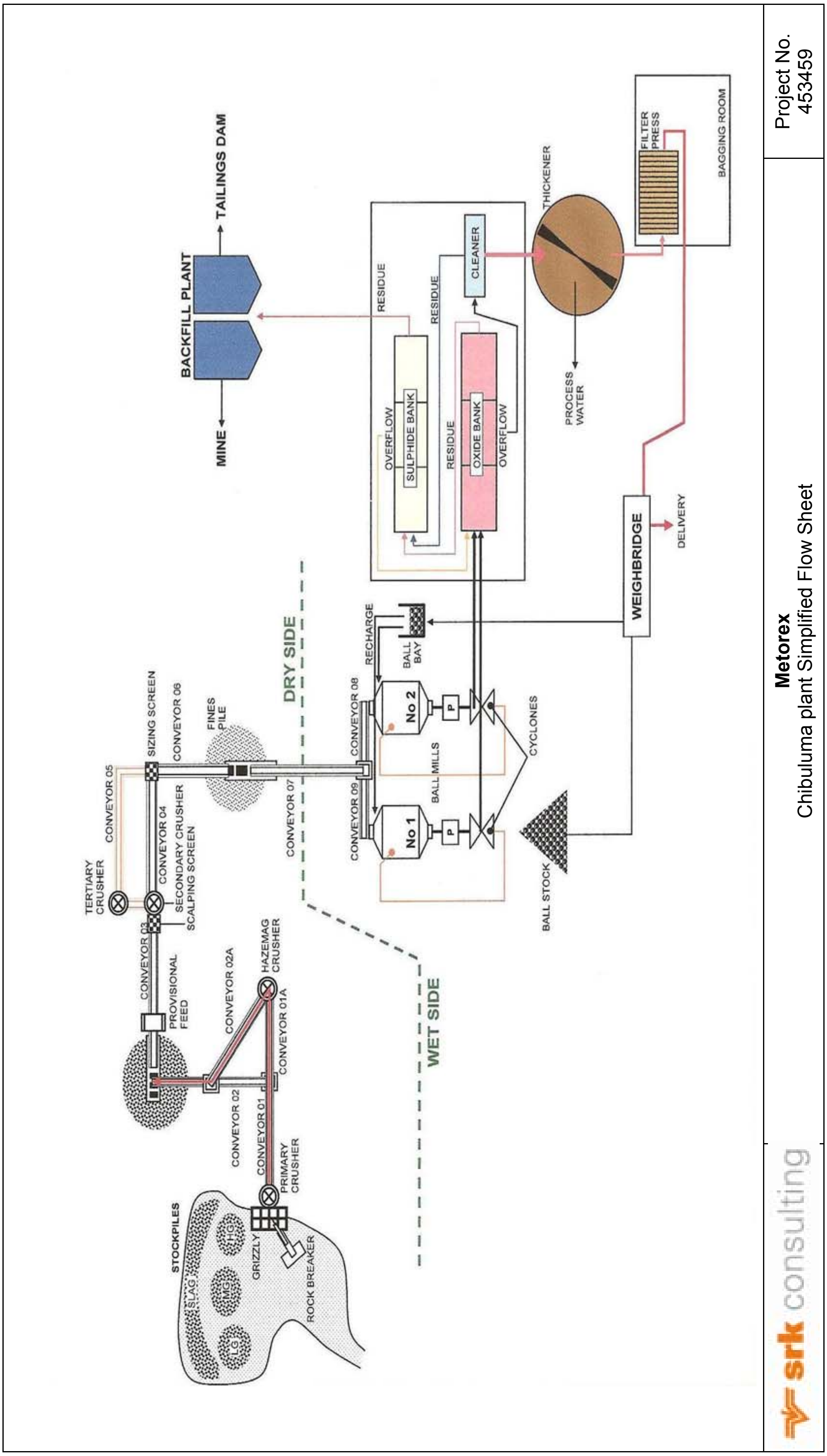


Figure 4.22: Chibuluma Plant Simplified Flow Sheet

4.10.4 Metallurgical Balance

The metallurgical balance was sourced from the F2013 Budget presentation and 18-month working capital forecast. The budgeted figures for H2-F2013 to F2015 are compared to the actual results for F2010 to F2012 and H1-F2013, as set out in Table 4.11.

Table 4.11: Chibuluma – Historic and Budget Metallurgical Balance

Item	Units	F2010 Actual	F2011 Actual	F2012 Actual	H1-F2013 Actual	H2-F2013 Budget	F2014 Budget	F2015 Budget
Ore feed – Chibuluma	(ktpa)	552.1	559.8	556.8	274.0	281.2	540.1	369.3
Ore feed - Chifupu	(ktpa)				0.0	0.0	20.8	191.6
	(ktpm)	46.0	46.7	46.4	45.7	46.7	46.7	46.7
Feed Grade	(% Cu)	3.46%	3.46%	3.46%	3.25%	3.52%	3.54%	2.94%
Plant recovery – Cu	(%)	94.3%	95.0%	96.5%	96.3%	96.0%	95.9%%	95.0%
Recovered Cu conc.	(ktpa)	36.8	40.7	40.6	18.9	20.9	41.6	34.6
Cu in Concentrate	(% Cu)	48.9%	45.2%	45.9%	45.5%	45.8%	45.8%	45.8%
Smelter recovery	(%)	95.6%	95.8%	96.3%	96.5%	96.5%	96.5%	96.5%
Payable Cu produced	(ktpa)	17.1	17.5	17.9	8.3	9.2	18.4	15.3

Based on past performance, the Concentrator should be able to handle the budgeted tonnage for H2-F2013 to F2015 (see Figure 4.22). The forecast plant feed grade is in line with historical results, except for the reduced figure in F2015 which arises from the inclusion of ore from Chifupu.

The copper recovery is set in the budget at 96.0% and 93% for Chibuluma and Chifupu ores respectively (Figure 4.23). During F2012 and H1-F2013, this recovery was achieved and with the spare flotation cells available, the concentrator should be able to maintain this recovery. The target % Cu in concentrate for H2-F2013 to F2015 has been regularly exceeded in the past, so this should be readily achievable.

Penalties are payable to CCS, where the concentrate is smelted under a toll treatment agreement, on % insoluble components, % moisture and % bismuth. The % Bi is the main factor responsible for penalties. The Bi penalty is dependent on the Bi level at the time, but is on average USD16/dmt of concentrate

Manual samples are taken for the metallurgical accounting samples. Automatic sample cutters have been included in the capital budget for F2013.

The analytical work is performed by on site with an Atomic Absorption Spectrophotometer and an electrolytic analyser is used for the concentrate copper grade determinations. Monthly composite exchange assays are done with Alfred Knight and SGS Laboratories.

The accounting is done by means of tonnes of feed recorded on the feed conveyors, a spear sample of the cyclone overflow and Cu content of the concentrate. The concentrate is weighed out of the concentrator. The mass and % moisture recorded by the smelter is taken as the accounting data. The mass and % moisture recorded by the smelter is taken as the accounting data.

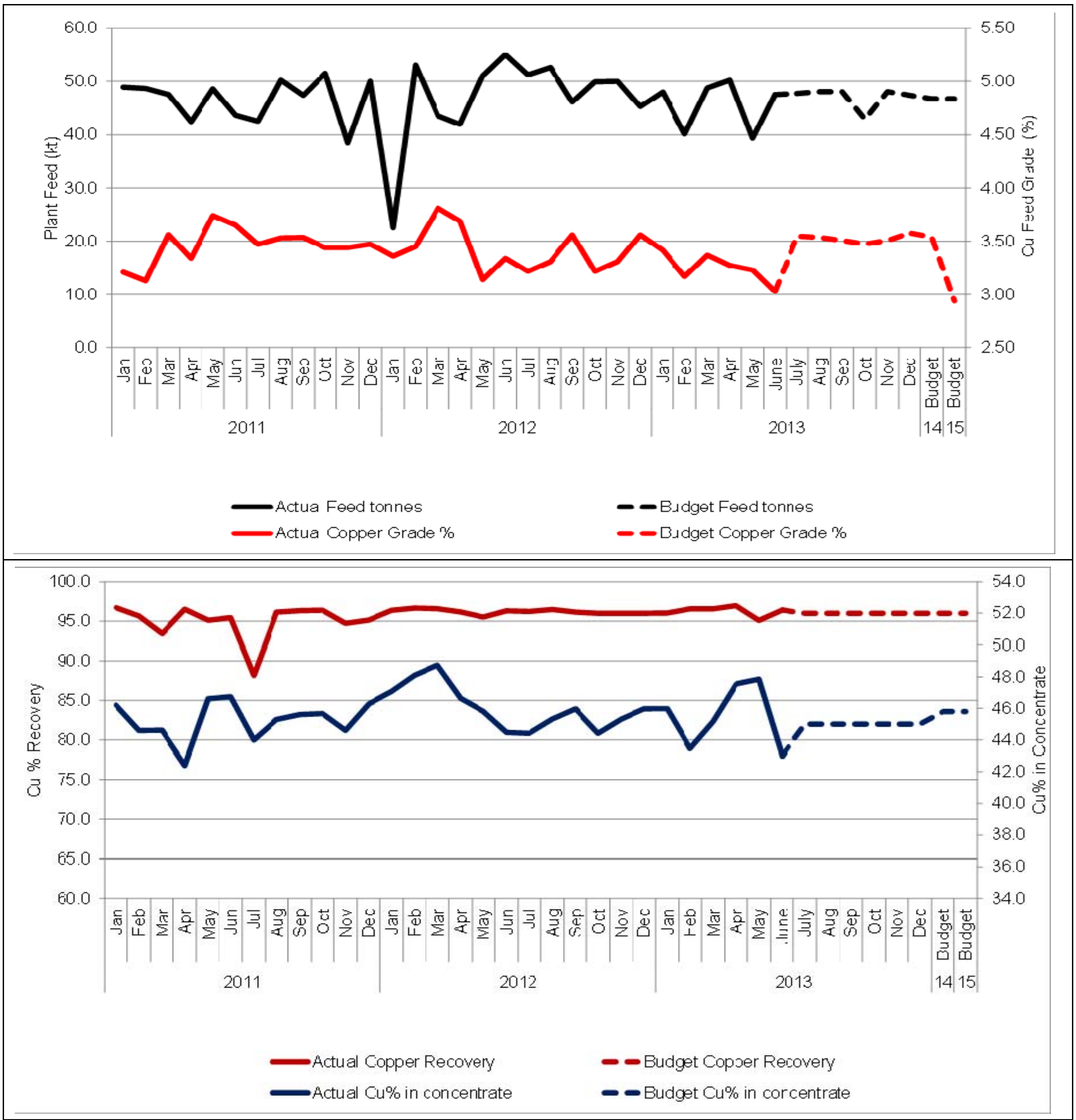
SRK suggests that Chibuluma expand the metallurgical balance and calculate a % Plant Call Factor and an un-accounted Cu content.

4.10.5 Costs

Capital Cost Budget

The capital cost budget at Chibuluma for H2-F2013 to F2015 is set out in Table 4.12. This includes capital carried over from F2012.

SRK is satisfied that the capital budget reflects all the major items required to sustain the metallurgical operation.



srk consulting	**Metorex** Chibuluma – Historic and Budget - Ore feed and Cu Head grade (top) and Cu recovery and Cu grade in concentrate (bottom)	Project No. 453459

Figure 4.23: Chibuluma – Historic and Budget - Ore feed and Cu Head grade (top) and Cu recovery and Cu grade in concentrate (bottom)

Table 4.12: Chibuluma Plant Capital Cost Estimate

Processing Plant	Units	H2-F2013	F2014	F2015
Concrete Thickener Road	(USDm)		0.06	
Procurement of Pump Floatation	(USDm)		0.02	0.02
Tails Dam HDPE	(USDm)		0.03	
Procurement of Automatic Samplers	(USDm)			0.04
Replacement of cyclone Outer Casings	(USDm)		0.05	
Optimization & Sustaining of recovery	(USDm)	0.03	0.08	0.05
Analytical Equipment	(USDm)		0.03	0.03
TSF resettlement	(USDm)	0.10	0.55	
Total plant capex	**(USDm)**	**0.13**	**0.81**	**0.14**

Operating Cost

The unit plant operating cost per tonne of plant feed at Chibuluma forecast for H2-F2013 and remainder of LoM are respectively:

- Process plant operations USD2.80/t USD2.88/t;
- Metallurgical engineering USD8.95/t USD9.53/t.

The budget plant operating cost for F2013 showed an increase of 6.2% relative to the actual cost for F2012, which is seen to be reasonable. The budgeted plant operating costs for H2-F2013 to F2015 are set out in Table 4.13.

Table 4.13: Chibuluma Plant Operating Cost Estimate

Process Plant/Metallurgy		H2-F2013	F2014	F2015
Production	(USDm)	0.8	1.3	1.3
Backfill plant	(USDm)	0.0	0.1	0.1
Mobile equipment maintenance	(USDm)	0.3	0.5	0.5
Engineering	(USDm)	2.2	5.3	5.3
TSF	(USDm)	0.0	0.1	0.1
Salaries & wages	(USDm)	1.4	2.6	2.6
Total Plant opex	**(USDm)**	**4.8**	**10.0**	**10.0**
Unit plant cost	(USD/t feed)	16.88	17.84	17.84

Off-mine / Realisation Costs

The off mine / realisation costs comprise transport, smelting, refining, realisation charge and penalties. The transport and smelting costs are applied to the concentrate tonnage. The refining cost and realisation charge is calculated on the payable copper after smelting. The penalty is a percentage applied to the gross sales revenue and is dependent on certain impurities and moisture content of the concentrate sent to the refinery.

The off-mine / realisation costs for Chibuluma for H2-F2013 to F2017 are shown in Table 4.14.

Table 4.14: Chibuluma Mine – Off-mine / realisation costs for H2-F2013 to F2017

Item	Units	H2-F2013	F2014	F2015	F2016	F2017
Transport costs	(USDm)	0.4	0.9	0.7	0.7	0.7
Smelting/refining/realisation costs	(USDm)	7.5	14.9	12.4	12.5	12.6
Penalties	(USDm)	0.4	0.8	0.6	0.6	0.6
Total off-mine/realisation costs	(USDm)	8.3	16.5	13.7	13.9	14.0

4.10.6 SRK Comments

- Development of the Chifupu copper sulphide deposit will supply additional ore, extending the LoM of Chibuluma;
- The metallurgical balance can be accepted, as it is in line with actual results of the past few years. The major assumptions are:
  - The feed grade must be realised.
  - The recoveries of 96% and 93% for Chibuluma and Chifupu ores resepectively should be feasible with the additional flotation cells introduced into the circuit as envisaged.
- The operating and capital cost estimates for the plant look realistic in view of past performance and envisaged enhancements to the operating process. Allowances are made for critical spares.
- The risks identified are:
  - Metorex indicated that the Chifupu ore has more chalcopyrite compared to the Chibuluma South orebody, but this has been factored into the Chifupu evaluation;
  - Engineering maintenance competency- The maintenance system is being developed on the Delta platform and critical and strategic spares are available on site;;
  - The concentrator crushing circuit is a single line plant. A breakdown of any of the major equipment pieces can stop the whole plant. The two stockpiles in the plant provide some buffer. Metorex

confirmed that it will give attention to improve the availability of critical equipment such as the crushers and conveyors;

- The stockpiles are a source of dust. Metorex has confirmed that dust suppression measures will be implemented as required;
- Increasing the back fill production to meet the mining requirements.

4.11 Tailings Storage Facilities

[SR5.6]

4.11.1 Vegetation and Rehabilitation

No untoward phenomena were seen with regard to the physical condition of the Chibuluma Tailings Dam. No toe-line seepage, cracking, bulging, sagging due to differential settlement or wet spots were observed. The outer side slopes of the starter wall and the rising tailings outer wall have been mulched in areas, grass sods and tree planted with limited success, bearing in mind the site inspection took place at the end of the dry season and as the vegetation is not irrigated. With the onset of the summer rains the vegetation coverage might improve.

During the previous 2 years, outer catchment paddocks were installed around the entire perimeter of the facility to minimise side slope erosion migrating into the surrounding environs, which were built using labour intensive methods with labour being sourced from the neighbouring communities.

4.11.2 Geometry

The top operational surface area of the tailings dam is approximately 15 ha, has a current maximum height of approximately 22 m and is operated using a day wall paddock and basin configuration. Underground backfill is currently being practised, that results currently in 70% to 75% of the 48 ktpm of tailings produced reporting to the tailings dam facility. Approximately 43% of the tailings deposited on the tailings dam has a -75µm grading. In the LoM plan, it suggests that 50% of the total tailings stream will report as underground backfill. SRK has assessed the LoM tailings dam storage requirements on both the 30% and 50% backfill requirements. The pool is operated within the confines of a pool wall and wing walls. The pool was relatively large in relation to the available basin. Freeboard was adequate and the condition and operation of the catwalk structure and decant structure meets industry requirements. The dam has adequate freeboard and the majority of the day walls were dry, indicating good deposition strategy.

4.11.3 Seepage

Even though no toe-line seepage was observed, the historical minutes indicate that seepage has been observed in the past necessitating the installation of sub-surface seepage collection drains to the western and most recently to the south western flank. Subsurface drains and piezometers are read on a monthly basis and results uploaded into the SSMS's standard risk management system. Generally the tailings dam facility is in good condition. Nevertheless, continual good operational and monitoring procedures must be maintained at all times.

4.11.4 Pumping and Distribution System

The tailings pumping and distribution system is adequate with no constraints.

4.11.5 Return Water

The Tailings Dam complex does not contain an adequately sized RWD complex. All supernatant water, storm water and collected seepage water either report into an unlined silt trap dam, which is highly silted and covered with reeds, or directly into the small HDPE lined RWD. Both the silt trap and the HDPE lined RWD are desilted on a regular basis and evidence of this is present adjacent to the dams. Overflow water from the silt trap dam, when operational, gravitates directly into a small HDPE lined dam from where the recovered water is pumped back to the plant. Observations made during the site inspection confirmed that the HDPE lined dam has some degree of tailings siltation, while the penstock outfall pipe discharge point located immediately upstream of both dams was almost completely submerged as a result of the high water level in the HDPE lined return water dam.

One of the contributing factors to why the HDPE lined RWD is subjected to siltation is due to the development of informal fines (tailings) storage containment facilities to the south of the tailings dam and the installation of a storm water cut-off drain to the outside of the overburden dumps which capture and transport all side slope erosion into the return water dam complex. It is reported that the informal fines (tailings) storage facilities contain HG material that will be ultimately processed through the plant. However these facilities consist of pushed up, possibly uncompacted, containment walls, no under-drainage system nor formal decanting water system or formal protected spillways, therefore any major storm event could, and has, resulted in the breaching of the perimeter wall/s that in turn allows uncontrolled release of fines/tailings into the silt trap dam and the HDPE lined water dam. Any major storm event will, and has, resulted in dirty water being released into the clean water dambo located to the south of the HDPE lined dam and silt trap dam. During the inspection at the end of the dry season, the HDPE lined return water dam was overflowing, via a V notch weir, into the dambo at an estimated rate of 50 litres/second with virtually no freeboard on the return water dam. The overflow water was not clear indicating some sedimentation, however, historical documentation reviewed stated "*Effluent from the return water dam is tested monthly and complies with Zambian discharge standards - constant PH of 7 is required*". Underground water and return water exceed the plant requirements and continued overflow into the clean water dambo will continue.

4.11.6 Capacity and Rate of Rise

Based on the expected LoM tonnage, assuming that between 30% and 50% of the tailings stream will be used for mine backfill, the existing Tailings Dam has the capacity to cater for a worst case scenario of 70% of the expected LoM tonnage reporting to the tailings dam based on a target dry density of 1.6 t/m^3. It is therefore imperative that all future operations ensure that a minimum of 30% of all tailings produced reports as underground backfill. The tailings dam is not expected to rise more than 18.0 m over the projected LoM above the current top surface elevation. The termination rate of rise would be approximately 2.15 m/annum and the termination day wall to basin ratio would be in the order of 1:5.5, all of which is acceptable. As the dam approached termination elevation the management of the tailings dam will become more difficult and additional supervision and stability investigations will be required.

4.11.7 Capital and Operating costs

The capex that should be allowed for the desilting of the HDPE lined water dam, repairs to the HDPE lining, the construction of additional sub-surface seepage collection drain and if required buttressing the side slopes of the tailings dam towards the end of life of the facility is USD1.0 million.

The tailings depositional operating costs, including the internal tailings dam operators would be approximately USD0.15/t - USD0.20/t. This would equate to an annual opex of USD0.1 million.

4.11.8 SRK Comments

SRK has reviewed the current Chibuluma Mine tailings disposal system and is of the opinion that there is sufficient capacity on the Chibuluma tailings dam to accommodate the 4.83 Mt of tailings from the Chibuluma Mine Concentrator for the projected 9 years LoM.

The tailings dam is currently being operated by apparently competent mine personnel and is reviewed annually by the external designer.

No inspections were made of the old historical (Chibuluma North) tailings dam located approximately 10 km north of the Chibuluma South tailings dam.

4.12 Infrastructure and Engineering

[SR5.6]

The general layout of the surface infrastructure is shown in Figure 4.24.

4.12.1 Bulk Services

Electrical Supply

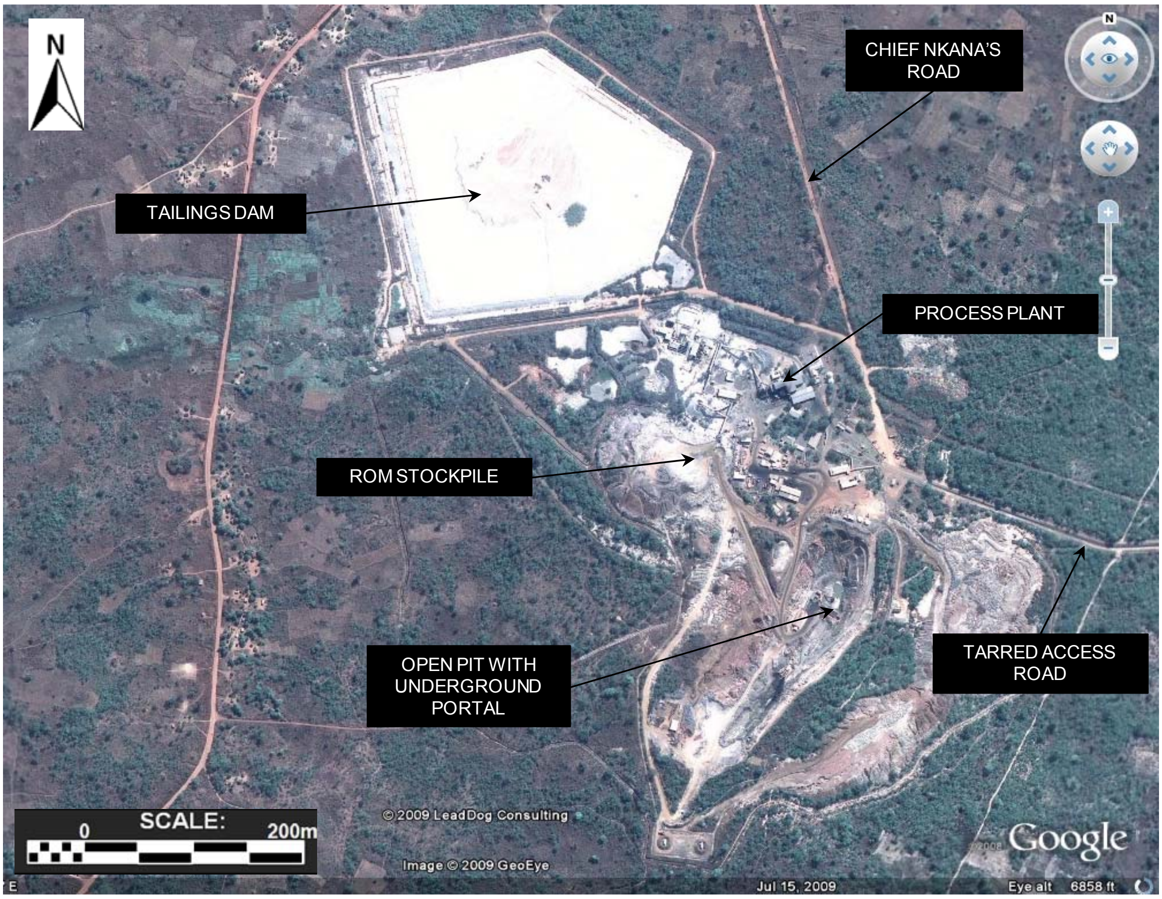
CEC installed an 11.5 km 66 kV overhead transmission line to Chibuluma in 2000. The mine steps this supply down to 11 kV at its

main consumer substation. The power supply from CEC and ZESCO has recently been upgraded and is a stable, reliable supply to the operations.

Chibuluma South mine has an adequate power supply to ensure continuous operations. In addition to an 11 kV CEC grid connection supplying up to 5 MW power to the mine, the mine has recently procured two backup diesel generators capable of producing 2 MW which is sufficient to provide emergency power for underground ventilation fans and pumping. In the event of a power failure, the crushing and milling sections are not normally operated. The present site maximum demand, obtained from recent CEC monthly electrical bills, is 3.36 MW, relative to the Nominated Maximum demand which is declared at 3.5 MW. This is close to incurring under-declaration penalties from CEC, and will need to be closely monitored in future.

The mine has a power factor of 0.85, which is low compared to a world class set up and should be 0.97 to 1.0. The engineering team is planning to improve on this with installing power factor control equipment in the future. The new main pump station due to be commissioned on 483 Level will add around 370 kW to the existing site load. This coupled with 4 new final tailings pumps, new surface buildings, new Telecoms room, new ladies change house and new tyre workshops is likely to result in Maximum demand being exceeded and penalties being charged by CEC.

SRK understands that an amendment to the power supply agreement with CEC was signed which extended the term of the agreement by ten years from October 2012 to October 2022. Chibuluma should consider negotiating an increased declared maximum demand to 5 MW, especially in light of the planned electrical load increase outlined above.



srk consulting	**Metorex** Chibuluma South Mine – surface infrastructure layout	Project No. 453459

Figure 4.24: Chibuluma South Mine – surface infrastructure layout

Electrical infrastructure

The main sub-stations on surface and underground are well designed and constructed, with all main (HT) switching sub-stations switched remotely on surface from outside the sub-stations, which takes away the risks associated with switching activities. SRK endorses this initiative, as it shows that the engineering management team is serious about safety to its workers.

The equipment generally consists of Steelcor supplied vacuum breaker switch-gear, ring main units and 630 kVA mini-substations. The only exception to this standard is a set of old "Yorkshire" vacuum breakers, which have become obsolete with spares no longer available for ongoing maintenance. The engineering department plans to replace this in the near future.

The transformer oils are sampled and tested for insulation properties and water content on a 6 monthly basis, for all surface and underground transformers. Also, this is further enhanced with 6 monthly injection tests on all the HT switchgear on site.

The mine has upgraded its surface and underground electrical infrastructure over the last 2 to 3 years.

Bulk water supply

The process plant and underground section uses 4 000 m^3 of water per day. This is supplied from the Kalulushi stream 3 km from the mine which in the 9 years of operation at Chibuluma South has always delivered. Four reservoir tanks with a total capacity of 600 m^3 have recently been installed on the mine to mitigate pump failure or downtime related to pipeline maintenance. Service water for the process plant is also available from the clear water dam on surface (supplied from the underground section) should it be required. The surface dam is also supplemented with additional water from the tailings dam return and 3 drill holes on the site.

The surface treatment plant has recently been upgraded and potable water was available to the work force from 18 October 2012.

The engineering team has recently purchased HDPE cutting and welding equipment and trained operators to make up piping on site. This ensures that pipes and fittings are available when required at a much cheaper price.

4.12.2 Underground pumping system

The mine dewaters up the decline in staged pumping to the plant surface water storage dams. Each pump station is equipped with four Warman PCH 150 centrifugal pumps fitted with 185 kW drive motors. Initially the dirty water sumps were horizontal, and due the high volumes of suspended solids reporting to the sumps, resulting in the fines building up in the sumps. The maintenance teams struggled to keep the sump fines build up away from the pump suction pipes, which resulted in poor pumping performance and premature pump failures of bearing housings due to high levels of cavitation. The mine engineers redesigned the sumps, recently commissioning a series of 29 m long, 6 m diameter vertical sumps, that are agitated to reduce fines build up in the base of the sumps, the pumping operations have been drastically improved by the introduction of the vertical sumps-which has increased pumping volumes due to improved pump suction pressures and better pump availabilities due to the improved suction heads and no cavitation due to pump blockages on the suction side.

4.12.3 Backfill system

A cut and backfill mining method is used to extract the bulk of the ore-body, with mining taking place in vertical 40 m sections which are mined from the bottom upwards. To achieve this and ensure flexibility of mining operations, the mine operates a backfill plant that uses classified tailings as the fill material. The average daily placement of backfill has improved significantly to around 900 tpd due mainly to the employment of an experienced backfill specialist. The daily placement rates prior to engaging the backfill specialist were in the region of 250 - 400 tpd.

The main operational challenge presently is the premature wearing out of the delivery columns from the plant on surface to the underground sections. The pipes are installed at various degrees of inclination, with horizontal sections on the working levels. The changes in inclination are seen as a major contributor to pipe failures. In September 2012, the mine replaced 42 6-m long pipe sections of 75 mm bore piping, at a cost of around USD2 500.

Work is underway, to find an alternative pipe to the HDPE used presently. SRK advised that Chibuluma should consult with Patterson and Cooke, based in Cape Town, South Africa, to gain guidance on alternative pipes. They are the leaders in flow testing and specifying pipes that will guarantee laminar flow in the distribution lines.

The backfill specialist is also planning to send backfill directly to the working levels via a vertical drill hole, which will significantly shorten the delivery columns and the number of changes in line inclination. SRK supports this initiative.

4.12.4 Underground mobile equipment

The mine owns and operates its own fleet of underground equipment, comprising:

- Toro 6m³ front end loaders ("**FELs**") 5;
- EJC 533 truck 1;
- Toro 40 t ADT 7;
- single boom drill rig 5;
- long hole drill 2.

As a general comment, the equipment appeared to be well maintained with very little, if any, damage seen to the machinery. The stopes did have a lot of pooled water present on all the working levels from its backfilling operations, and recent torque convertor and transmission failures on loaders and trucks were as a result of water ingress into the units. The water on the roadways will adversely affect the tyre life on machinery. SRK suggests that a better road drainage system is implemented and operated in the main haulages and panel access roadways.

The mine has both surface and underground workshops fully equipped to support the maintenance effort on the mobile plant. The underground workshops are for minor repairs and are supplemented with a fully equipped hose repair bay. The hose crimping equipment and associated consignment stock for hoses and fittings is managed by a hose supply company. Monthly stock checks confirm the monthly usage and agreed on by the mine and the contractor, prior to the monthly invoice being sent through to the mine. This system undoubtedly reduces equipment downtime waiting for a replacement hose to be delivered from surface. In addition to this, the hose specification and length can be exactly copied, ensuring that the 'as built' hose routing is not altered with incorrectly sized hoses.

All machine services are carried out on surface, with 125 hour, 500 hour and 1 000 hour services carried out in the surface workshops. All main component replacements are carried out in the surface workshops.

The main production machines receive a full overhaul after 17 000 hours of operation. This allows a second operating life for the production machines of 14 000 hours, after which time the machine is sold to third parties.

4.12.5 Planned maintenance systems

Planned maintenance ("**PM**") runs a detailed time-based preventative maintenance plan, based on the experience of running and maintaining the equipment at Chibuluma. The Delta system is used here, but is suffers with the lack of reporting on engineering aspects outlined for Ruashi (see Section 4.12.4). Historical reporting of work done on equipment by work centre is presently not possible.

The engineering department does report on individual equipment costs. This information is used to run a very detailed operational replacement indicator ("**ORI**") whereby the operating hours since commissioning and the monthly operating costs are combined to indicate the optimum operating hours (Life of equipment) for each piece of main underground production equipment. The ORIs for the entire fleet are used to drive the 4 year capital replacement strategy. Asset management of equipment and major component tracking is used, but needs improving. In terms of utilising the Delta CMMS, Chibuluma is well advanced when compared to Ruashi.

An indicator of how effective the scheduled PM plans are - is the equipment availability. The processing plant availability is between 85% and 96%. The production equipment availability for drills, loaders and dump trucks are consistently above the planned budget of 80% which is a very good performance when benchmarked with other mechanised mines.

4.12.6 Capital and Operating Costs

The engineering and administration capital budget for Chibuluma for H2-F2013 to F2015 is set out in Table 4.15.

Table 4.15: Chibuluma Mine – Engineering and Administration Capital for H2-F2013 to F2015

Engineering	Units	H2-F2013	F2014	F2015
Engineering				
Workshop equipment	(USDm)		0.06	0.04
Concentrator engineering	(USDm)		0.19	0.07
Ball mill	(USDm)			0.30
Roads	(USDm)	0.12	0.18	0.18
Total engineering	**(USDm)**	**0.12**	**0.43**	**0.59**
Administration				
IT, systems, equipment	(USDm)	0.05	0.15	0.11
Surface vehicles	(USDm)		0.22	0.15
SHEC	(USDm)	0.09	0.31	0.02
Total administration	**(USDm)**	**0.14**	**0.68**	**0.27**

The unit surface engineering cost at Chibuluma is budgeted at USD1.34/t plant feed, which is line with the actual cost for F2012. Engineering costs associated with mining and the processing plant are handled in the respective sections above.

The budgeted administration and infrastructure costs for Chibuluma for H2-F2013 to F2015 are shown in Table 4.16.

Table 4.16: Chibuluma Mine – operating costs – administration and infrastructure (F2013)

Item	Units	H2-F2013	F2014	F2015
Salaries and wages [(1)]	(USDm)	8.1	16.3	16.3
Administration / HR / security	(USDm)	1.9	4.0	4.0
Power	(USDm)	1.0	2.1	2.1
SHEC	(USDm)	0.1	0.3	0.3
Management fees	(USDm)	1.2	2.5	2.5
Mine hospital	(USDm)	0.0	0.0	0.0
Total admin costs	**(USDm)**	**11.2**	**22.6**	**22.6**

1 includes the salaries and wages for mining and plant

4.12.7 SRK Comments

The present site maximum demand, obtained from recent CEC monthly electrical bills, is 3.36 MW, relative to the Nominated Maximum demand which is declared at 3.5 MW. This is close to incurring under-declaration penalties from CEC, and will need to be closely monitored in future.

The mine has a power factor of 0.85, which is low compared to a world class set up and should be 0.97 to 1.0. The engineering team is planning to improve on this by installing power factor control equipment in the future. Metorex advised that the power situation is closely monitored on a daily basis to ensure the peak demand limit is not exceeded.

Chibuluma is planning to send backfill directly to the working levels via a vertical drill hole, which will significantly shorten the delivery columns and the number of changes in line inclination. SRK supports this initiative.

As a general comment, the equipment appeared to be well maintained with very little, if any, damage seen to the machinery. The stopes did have a lot of pooled water present on all the working levels, and recent torque convertor and transmission failures on loaders and trucks were as a result of water ingress into the units. The water on the roadways will adversely affect the tyre life on machinery. SRK suggests that a better road drainage system is implemented and operated in the main haulages and panel access roadways.

4.13 Logistics

[SR5.6]

Currently all the Cu concentrate produced at the Chibuluma South Mine is sold on a custom basis to the CCS operators. Chibuluma South Mine negotiates an annual road transport contract with a third party who is responsible for providing the vehicles and the security guards to guard the daily shipments.

It was reported that no major problems have been encountered with the road transport of the Cu concentrate to the CCS, with the exceptions of the odd breakdown or flat tyres. The independent contractor has sufficient roadworthy transport vehicles, as the current contractor also provides a similar service to other mines in the Zambian Copperbelt area.

The approximate road haulage distance, one way, between the Chibuluma South Mine and the Chambishi Smelter is 50 km and with approximately 3 500 tpm of 47% Cu concentrate containing a moisture content of 9%, the transport costs would equate to around USD100 000 per month. This method of transportation does not pose any risk to the Chibuluma South Mine.

As part of the concentrate purchase agreement of the Chibuluma South Mine Cu concentrate, the Chambishi smelter operator is responsible for the disposal of the tailings residue for the smelter operation.

4.14 Human Resources

[SR5.3, SR5.4C, SR5.5C]

4.14.1 Operating Structure

The year-end audit pack for Chibuluma showed that there were 615 permanent employees in service at December 2012. In addition, there were 207 casual and contract workers engaged at Chibuluma Mine.

The distribution of the permanent employees within the different departments is shown in Table 4.17.

4.14.2 Mine Complement

The budgeted mine complement for F2013 to F2015 is set out in Table 4.17. This shows that Chibuluma plans to reduce the number of casual and contract workers relative to that employed during F2012.

The distribution of the permanent employees within the different departments is shown in Table 4.17.

Chibuluma transferred the mine hospital and all staff to the Zambian government during H1-F2013, hence the reduction in hospital staff in F2014 as shown in Table 4.16.

4.14.3 Productivity Assumptions

The productivity statistics for Chibuluma are estimated at 62 tonnes processed per TEC per month and 2.0 tonnes of copper cathode per TEC per month (see Table 4.17).

Table 4.17: Chibuluma Mine – Mine complement for F2013 to F2015

Department		F2013	F2014	F2015
Mining		245	245	245
Processing		77	77	77
Engineering		145	145	145
Administration		50	50	50
SHEC		30	30	30
Hospital		23	0	0
Trainees		8	8	8
Exploration/projects		38	38	38
Permanent Employees		616	593	593
Casuals/contractors		168	161	161
Total mine establishment		**784**	**754**	**754**
Productivity indices:				
RoM ore	t/TEC/month	59.6	62.0	62.0
Cu produced	t/TEC/month	1.9	2.0	1.7

4.14.4 Termination Benefits

Information provided to SRK suggests that the termination benefit payable in Zambia is determined as two months' salary for every year of service. SRK queried this with Metorex as this seems to be excessive, but no confirmation has been received whether this is indeed the case. Metorex advised that the calculation will be reviewed on an annual basis to ensure that adequate provision and funding is in place.

Metorex advised that its estimated termination benefit at closure was around USD7.0 million. This is much less than the annual salary bill at Chibuluma. Accordingly, SRK has set the termination benefit at closure to be equal to the annual cost for salaries and wages.

4.14.5 SRK Comments

SRK has reviewed the methodology used by Metorex to estimate the termination benefit at Chibuluma. SRK notes that the calculations assume employees reaching the age of 55 years retire and no termination benefit becomes necessary. The calculations further assume that these retirees are replaced by contract workers for which no termination liability exists. This is contrary to Metorex's stated aim of maintaining its skills base for longer, during which time it is hoped that additional resources can be located and proved (refer Section 8.2).

SRK has set the termination benefit at closure to be equal to the annual cost of salaries and wages, which is greater than the figure estimated by Metorex. The risk that this may be understated is therefore considered to be low.

4.15 Occupational Health and Safety

The discussion on SHEC Policy and group-wide safety statistics is set out in Sections 3.15.1 and 3.15.2 above.

4.15.1 Quarterly SHEC Reports

Safety

To gauge how successfully the SHEC policy and systems have been implemented, the safety performance statistics for Chibuluma for F2010 to F2012 are shown in Table 4.18.

SRK reviewed the Q3 and Q4 quarterly SHEC reports of F2012 and the following points were noted:

- There were 6 non lost time injuries and 4 lost time injuries for the last six months of F2012. Although this is an improvement over the previous year, SRK feels that the level of accidents of this nature is still too high, given the scale of the operation;
- The Lost time accidents are of concern, with three of the four lost time accidents occurring underground under unsupported ground. In these accidents, employees and contractors broke critical basic mine rules, which tends to suggest that workers are not working safely. The incidents were fully investigated by management and necessary corrective actions reinforced. Metorex advised SRK that the government inspector was satisfied with the standard of safety at Chibuluma.

Table 4.18: Chibuluma Mine – Safety Indicator Statistics F2010 to H1-F2013

Safety indicator	Total F2010	Total F2011	Total F2012	Total H1-F2013
PTO	318	1 730	2 349	1494
NLTI	15	10	12	6
LTI	8	9	4	4
TRI	23	19	16	10
RI	5	7	3	2
LD	71	562	57	59
F	0	0	0	0
LTIFR (No/mmh)	3.7	4.2	2.2	4.4

Legend to safety indicator descriptions:

PTO planned task observations carried out;
NLTI non-lost time injuries (accidents);
LTI lost time injuries;
TRI total recordable injuries;
RI reportable injuries (>14 days off work);
LD lost days due to accidents, not able to return to work
F fatality

The number of planned task observations carried out in the work place by supervisors and managers has increased. However, the number of lost time accidents and lost days due to accidents has unfortunately increased. Three of the four lost time injuries in 2013 were a result of fall of ground incidents underground. This problem is receiving priority attention and special interventions have been implemented to prevent a continuance of this negative trend.

The safety statistics in F2012 had improved and reflected the efforts on the part of the supervisors and managers. However, there has been a negative trend in safety statistics in H1-F2013, with efforts underway to bring about improvements in safety performance.

SRK recommends that management concentrate their efforts on employees' behavioural aspects towards safety and health in the work place. This needs to include more safety awareness and risk awareness in the work place. This particular aspect could in future be set up as part of the work based auditing and planned task observation processes currently carried out by management and supervisors.

SRK has been appraised by Metorex that policies and management systems to educate employees on workplace health and safety have been put in place.

Health

The sick leave days reported have remained steady when compared to F2012. However, the VCT and malaria cases have increased in H1-F2013 (Table 4.19).

Table 4.19: Chibuluma Mine – Health Indicator Statistics 2011 to H1-F2013

Safety indicator	Total F2011	F2012					H1-F2013		
		Q1	Q2	Q3	Q4	Total	Q1	Q2	Total
Medical Examinations	4 821	1 354	887	1 170	1 229	4 640	1728	1453	3181
Sick Leave Days	1 293	323	255	212	300	1 090	319	232	551
New TB cases	1	2	0	1	1	4	1	1	2
New HIV/Aids cases	35	3	7	3	0	13	0	1	1
VCT	452	4	75	106	0	185	172	3	175
Malaria cases	121	41	18	0	14	73	23	22	55

Environment

Metorex reported that the increase in Level 1 environmental incidents year on year from F2011 to F2012 was due to improved identification of incidents and reporting.

Community

There had been an increase in community incidents at Chibuluma during F2012 related to illegal tree-cutting.

4.15.2 Site visit observations

Generally, the mine equipment appeared to be well maintained, with few safety issues seen during the visit. The following are seen as safety risks:

- The main operational challenge presently is the premature wearing out of the delivery columns from the backfill plant on surface to the underground sections. The pipes are installed at various degrees of inclination, with horizontal sections on the working levels. The changes in inclination are seen as a major contributor to pipe failures. In September 2012, the mine replaced 42 x 6 m long pipe sections of 75 mm bore piping, at a cost of around USD2 500/month. Work is presently underway, to find an alternative pipe to the HDPE pipes used. The failure of backfill underground can create dangerous conditions in travelling ways and access ways. The mine's backfill specialist is also planning to send backfill directly to the working levels via a vertical drill hole, which will significantly shorten the delivery columns and the number of changes in line inclination. SRK supports this initiative.
- As a general comment, the equipment appeared to be well maintained with very little, if any, damage seen to the machinery. The stopes did have a lot of pooled water present on all the working levels that can result in tyre life, due to cutting and sidewall damage. SRK suggests that a better drainage system is implemented and operated in the main haulages and panel access roadways.
- All electrical sub-stations are switched remotely on surface. This is a commendable approach and demonstrates a commitment from management with regards to safety of persons.

4.15.3 SRK Comments

SRK recommends that management continues to concentrate its efforts on employees' behavioural aspects towards safety and health in the work place. This needs to include more safety awareness and risk awareness in the work place. Metorex advised that policies and procedures are in place to educate employees on workplace health and safety and monitor compliance.

The level of total reportable injuries has increased in 2013 and needs to be targeted as part of a safety drive, to ensure that the rest of this year does not see the same levels of reportable injuries.

With health, the sick leave days reported have remained steady when compared to F2012. However, the VCT and malaria cases have increased in H1-F2013.

4.16 Environmental

[SR5.2B/C]

4.16.1 Regional Setting

Chibuluma South is situated in a rural area with 86 households comprising over 400 people living on the lease area while Chibuluma West and East is adjacent to the town of Kalalushi with industrial activities in the area. The mine employs some 600 people full time as well as 200 contractors. All staff lives in Kalalushi.

4.16.2 Project Description

Chibuluma South

The pit at Chibuluma South is 30 m deep, about 550 m long and 210 m wide at its maximum. The open pit sump acts as a sedimentation pond which settles solids from slope runoff during the rainy season. Clear water is pumped to the surface settling pond for further settling and used as raw water in the plant. Excess water is discharged to the natural environment. Storm water cut-off drains and bund walls have been constructed around the open pit perimeter to prevent surface run-off flowing into the pit.

Tailings is disposed of on a ring dyke tailings dam which has a footprint area of some 25 ha.

Potable water for Chibuluma South is abstracted from the Kalulushi stream. Water from the RWD at the tailings dam is returned to the process water system or discharged into the Nseleki stream. The EMP makes provision for the treatment of this water if necessary.

Chibuluma West

De-commissioned infrastructure which has been addressed in a Closure Plan for Chibuluma West includes 2 tailings dams, a waste rock dump, old stockpile areas and Kalalushi Business Park. The latter incorporates redundant mine infrastructure that has been purchased for the development of the business park.

The total tailings dam footprint area is some 55 ha of which more than 40 ha is not vegetated. The height of the larger of the two dams is 7 m and the EMP identifies ponding water on the dam as a risk to its stability. Storm water runoff control measures therefore have to be planned and implemented, in addition to rehabilitation measures which will be required for air pollution control.

The rock dump footprint area is approximately 2.5 ha while old low grade stockpiles cover an area of some 13 ha and the plant area requiring rehabilitation covers an area of nearly 6 ha. Apart from these areas, the EMP states that soil contamination affecting certain other areas has been remediated but the closure plan provides for soil contamination studies in other areas, notably the old stockpile area and the area within the Kalalushi Business Park.

4.16.3 Potentially Material Environmental risks

Metorex acknowledges that rehabilitation costs could increase if ground water pollution problems are encountered. The possibility that water treatment following mine closure may be required therefore represents a significant potentially material liability. The significance of this potential risk has been reduced by the proactive financial provision, by Metorex on a group wide basis, for possible post closure water treatment.

4.16.4 General Observation Regarding Environmental Management

According to the 2012 SHEC report, sulfides in waste rock and in-situ rock in the underground workings pose a risk of AMD. An existing water treatment plant at Chibuluma West 7 Shaft area is being rehabilitated to treat water from 5 Shaft. Metorex advised that Nkana Water (state owned water utility) will manage this treatment plant with the intention of using the water for domestic use and distribution. Low pH water in 4 Shaft is noted as a concern. Effluent quality leaving the mine at the control point is monitored but a more intense monitoring programme would provide a better understanding of impacts on the mine site. Metorex indicated that the extent of the pollution and treatment methods are being evaluated by AMC.

Observations during the site visit confirmed that there is a positive water balance and that discharges to the stream are common if not continuous. In addition to water abstracted from the river, process water is recycled as much as possible and water is made underground. Because of the excess water, use is made of settling dams which receive this water prior to its release but these are unlined dams of insufficient capacity. Local people use water flowing out of the RWD for the irrigation of vegetables.

It is reported on the mine that no problems with salinity or heavy metals content are experienced for water discharged from the mine. Results made all refer to the water quality at the mines effluent discharge control point, the Emerald Road Bridge. Compliance at this point will not necessarily address possible liabilities associated with other discharges, such as the overflow at the RWD.

Storm water management systems require, and are receiving attention.

Re-vegetation of the tailings dam at Chibuluma South is continuing. It was observed during the site visit that the need for this has been recognized and acted upon by the mine. While this is generally a routine matter, it has some significance in that dust is an issue that has been raised by stakeholders in the vicinity of the tailings dam. It is not expected to have a significant impact on the overall environmental liability in the light of the approved RAP and the fact that land has been made available by a local chief.

4.16.5 Potentially Material Social Risks

No potentially material risks were identified in this review.

4.16.6 General Observations Regarding Social Considerations

People living in close proximity to the TSF at Chibuluma South have expressed concern regarding impacts, including air quality and possible AMD. A RAP has been approved for the resettlement of these people and a local chief has made alternative land available for the purpose. Metorex reports that the mine has embarked on the RAP process. There are 80 households involved who reside in close proximity to the tailings dam. A budget of US$1 million has been set aside for this purpose. The suitability of this land for agriculture is being determined. Indications are therefore that this issue can be satisfactorily addressed. No other social issues have been identified.

Metorex reports that there are currently no land claims over Metorex mining properties.

Legal Compliance

A draft EIA for Chibuluma South has been submitted to the Zambian Environmental Management Authority ("**ZEMA**") for consideration. It is unlikely that there will be any problems associated with permission to mine. Environmental licences for 2012 had been issued by ZEMA.

The RAP for Chibuluma South with respect to the community in proximity to the tailings dam is approved.

It is SRK's view that provided the mine adheres to the remedial measures and obligations of the EIA, there should be no reason that would prevent the MR from being renewed. This does not constitute a legal review and SRK does not make any claim or state any opinion as to the ability of the mine to obtain or renew the necessary permits. It must also be noted that this opinion by SRK does not imply that the mine is in strict compliance with all the requirements of the EIA or other permits.

The EIS for Chifupu was approved in June 2013

4.16.7 Mine Closure Planning and Cost Estimate

[SR5.2C]

Mine closure costs have been estimated by AMC for both Chibuluma West (including Chibuluma East) and Chibuluma South. SRK used AMC's itemised cost estimates to develop spreadsheets in order to make certain adjustments to the estimates, which are discussed separately below. AMC deducted amounts of USD119 000 and USD264 000 from the gross closure cost estimate for Chibuluma South and West respectively, as a reduction to reflect work already completed. While this work is clearly of some benefit and the mine SHEC department is clearly committed to the rehabilitation work, onsite observations did not indicate that all work carried out was of a sufficient standard to provide comfort that the rehabilitation achieved would be maintenance free and hence possibly need to be redone on closure. It is SRK's view therefore, that it would be prudent not to apply this correction and the figures quoted below are the gross cost estimates.

Other differences between the AMC cost estimate and the reworked calculations are attributable to the following:

- Differences between the unit costs for re-vegetation of the tailings dams and waste rock dumps as calculated by AMC and SRK.
- Inflation at 5%.
- The re-vegetation costs for the tailings dams and waste rock dumps are based on labour intensive hand planting, without the use of topsoil. Consideration of the provision for topsoil at Ruashi suggests that this requirement could increase the re-vegetation cost by up to 60%. At Chibuluma the haulage costs are likely to be less than that but a provision of 50% of the re-vegetation costs has been allowed for.
- The contingency has been increased from 10% used by AMC to 20% to be consistent with that applied for Ruashi.

A provision of 30% of the total to cover EPCM costs which were not included in the AMC estimate.

Chibuluma South

The total closure cost estimate by AMC in 2011 amounted to some USD1.9 million. The closure cost estimate obtained by reworking the AMC estimate as described above is USD4.1 million.

Chibuluma West

The total cost estimate by AMC in 2011 amounted to some USD1.3 million. The closure cost estimate obtained by reworking the AMC estimate and taking into account the differences noted above is USD2.9 million. This figure includes a 10% contingency, which is also included in the AMC report.

Chibuluma East

No cost estimate has been seen for Chibuluma East. Based on the finding that the legal opinion obtained in this respect has been shown to be incorrect, a provision of USD1 million is proposed to address this deficiency. SRK did not visit Chibuluma East and has no way of calculating a more accurate estimate.

Total cost and residual risk

The possibility that on-going water treatment may be required in the post closure scenario and that closure liabilities at Chibuluma East may be greater that the provision suggested, remain a risk. Omissions identified by SRK in the report are regarded as possibilities and not certainties. Of these, in terms of environmental risk, ongoing water treatment following closure is regarded as potentially material. Neither the likelihood nor the quantum associated with this risk can be ascertained at this stage. The mine is actively assessing the situation regarding ground water contamination and has implemented measures for its control in the operational phase.

Metorex has a group-wide provision for post-closure water treatment of around USD5 million. In SRK's experience, this figure is likely to be considerably more. In the absence of any proper evaluation of the extent (quantities) and severity (pH or TDS) of water to be treated, SRK has in agreement with Metorex increased this provision for post closure water treatment to USD25 million for the group for evaluation purposes, of which USD5 Million is allocated to Chibuluma.

SRK's total closure cost estimate for Chibuluma, is therefore USD13.0 million.

4.17 Material Contracts

4.17.1 Concentrate Sale Agreement

[SR5.8]

Chibuluma sells all its copper concentrate to CCS. The agreement covers the period from 21 December 2012 to 20 December 2013 and can be extended by mutual agreement.

Chibuluma is required to provide quarterly forecasts of concentrate tonnes to CCS and to endeavour to deliver concentrate evenly on a monthly basis.

The concentrates should be free of deleterious impurities that would prevent CCS from employing its smelting and refining process. Maximum acceptable contents in the sulphide flotation concentrate are specified for moisture content, insoluble (SiO_2 and Al_2O_3) As, Bi and Se. Penalty charges are levied on each daily lot of concentrate where the content of As, Pb, Zn, Bi, Hg, Se and moisture exceeds prescribed values.

The price paid for the final copper content after smelting and refining is a percentage of the LME Grade A settlement price as published in the London Metal Bulletin (published by Metal Bulletin Journals Ltd), less treatment and refining charges according to the 2013 Annual Benchmark between concentrate producers and custom smelting companies in Japan. Chibuluma receives credit for final agreed Au and Ag content subject to certain deductions and realisation charges.

Payment for the contained copper is made in Zambian Kwacha, with Standard Chartered Bank's 5-day average buying and selling exchange rate used to convert USD invoice value into Zambia Kwacha.

4.17.2 Power Supply

[SR5.7, SR5.8]

SRK understands that an amendment to the power supply agreement with CEC was signed which extended the term of the agreement by ten years from October 2012 to October 2022. Chibuluma should consider negotiating an increased declared maximum demand to 5 MW, especially in light of the planned electrical load increase outlined above.

4.18 Financial Model

The key TEPs from the Chibuluma FM are summarised in this section.

4.18.1 Financial / Economic Criteria

Incorporated into the Chibuluma FM are the following financial / economic criteria:

- The final deliveries in terms of a hedging contract were made in F2012. There are no hedging contracts in place for F2013;
- Capital allowances for tax purposes were recently changed so that capital expenditure in any given year can be offset against income at 25% per year for that plus the following three years;
- Metallurgical recovery for Cu for Chibuluma ore is set at 96.0% for H2-F2013, in line with the actual for F2012 and H1-F2013, and kept at this level for the LoM. A 93% Cu recovery is applied for Chifupu ore;
- The concentrate grade was set at 45.8% Cu in F2013, in line with the actual for F2012, and kept at this level for the LoM;
- A cost of USD2.50/t RoM allowed to transport the Chifupu ore to the Chibuluma processing facility;
- Company tax is a variable rate determined according to the formula Y=30%+[a-(ab/c)], where a=15%, b=8% and c=% ratio of assessable income to sales.

4.18.2 Changes to Metorex's model

SRK has incorporated certain adjustments into the Chibuluma LoM FM, as follows:

- Removed the RoM production from Chibuluma and Chifupu for F2020 to F2022, plus adjusted the tonnage and pro-rata contained copper in F2019 to match the aggregate Mineral Reserves reported in Table 4.7;
- Adjusted the process recovery on a weighted tonnage basis to incorporate the lower recovery for Chifupu ore;
- The annual safety and training budget was increased to USD0.31 million per annum, which was in line with the actual cost for H1-F2013;
- In F2019, which is when production ceases in the adjusted LoM plan for Chibuluma, maintained the following costs:
    - Security at full cost for the whole year, to prevent theft of any items;
    - Management fees for 6/12th of the whole year's cost (due to equivalent of six month's production);
    - All other costs (administration, power, human resources, environment, community, IT, sundry) set at 8/12th of the annual cost, to cater for downsizing, demolition, closure/rehabilitation activities;
    - Removed the operational capital of USD5.0 million per annum in each of F2018 to F2021, but maintained the sustaining capital of USD1.5 million in F2018.

4.18.3 Financial model summary

The key TEPs for the revised LoM FM for Chibuluma are summarised in Table 4.20.

The production schedule is as provided by Metorex and audited by SRK.

The process recoveries are supported by historical performance, metallurgical testwork and plant upgrade projects.

The cost components for Chibuluma are based on the strategic business plans and detailed one-year budgets as compiled by Metorex. SRK has reviewed these costs for reasonableness in relation to the actual costs incurred in F2012 and H1-F2013. Where deemed necessary, SRK has adjusted the forecast costs as used in the financial models.

The capital expenditures are as per the detailed budgets and forecasts supplied by Metorex and reviewed by SRK. Based on its review, SRK has added capital amounts as deemed necessary.

SRK reviewed the terms of the off-take agreement and confirmed these were correctly incorporated into the Chibuluma LoM FM.

Table 4.20: Chibuluma Mine – summary of post-tax pre-finance cash flow model

Item	Units	Totals / Average	H2-F2013	F2014	F2015	F2016	F2017	F2018	F2019
Production									
ROM mined	(kt)	3 367.4	281.2	560.9	560.9	562.5	560.9	560.9	280.0
Chibuluma South	(kt)	2 312.4	281.2	540.1	369.3	431.7	387.6	159.7	142.7
Chifupu	(kt)	1 055.0	0.0	20.8	191.6	130.7	173.3	401.2	137.3
Ore milled	(kt)	3 367.4	281.2	560.9	560.9	562.5	560.9	560.9	280.0
Cu feed grade	(%)	3.01%	3.52%	3.54%	2.94%	2.97%	3.00%	2.48%	2.73%
Total contained Cu	(kt)	101.4	9.9	19.8	16.5	16.7	16.8	13.9	7.6
Processing									
Metallurgical recovery Cu	(%)		96.0%	95.9%	95.0%	95.3%	95.1%	93.9%	94.5%
Payable Cu	(%)		96.5%	96.5%	96.5%	96.5%	96.5%	96.5%	96.5%
Payable Cu	(kt)	93.1	9.2	18.4	15.1	15.3	15.4	12.6	7.0
Commodity sales									
Cu sales - LME grade	(kt)	93.1	9.2	18.4	15.1	15.3	15.4	12.6	7.0
Commodity prices									
Average Cu LME	(USD/t)	8 171	8 171	8 171	8 171	8 171	8 171	8 171	8 171
Revenue Real	**(USDm)**	**767.2**	75.3	150.1	123.5	125.4	126.2	103.1	63.6
Copper sales	(USDm)	767.2	75.3	150.1	123.5	125.4	126.2	103.1	63.6
Operating expenditure	**(USDm)**	**(465.5)**	(37.5)	(75.5)	(71.4)	(71.6)	(71.8)	(73.9)	(63.9)
Mining (excl salaries)	(USDm)	**(99.2)**	(8.2)	(16.5)	(16.5)	(16.6)	(16.5)	(16.5)	(8.3)
Transport costs - Chifupu ore	(USDm)	**(2.6)**	0.0	(0.1)	(0.5)	(0.3)	(0.4)	(1.0)	(0.3)
Processing (excluding salaries)	(USDm)	**(41.6)**	(3.3)	(7.0)	(7.0)	(7.0)	(7.0)	(7.0)	(3.5)
Surface engineering, incl power	(USDm)	**(17.2)**	(1.4)	(2.8)	(2.8)	(2.8)	(2.8)	(2.8)	(1.7)
Administration (incl salaries)	(USDm)	**(128.8)**	(10.4)	(20.9)	(20.9)	(20.9)	(20.9)	(20.9)	(14.0)
Environmental / closure	(USDm)	**(9.6)**	(0.1)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(8.2)
Post-closure water trreatment	(USDm)	**(5.0)**							(5.0)
Management fees	(USDm)	**(14.9)**	(1.2)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(1.2)
Realisation / off-mine costs	(USDm)	**(84.4)**	(8.3)	(16.5)	(13.6)	(13.8)	(13.9)	(11.3)	(7.0)
Royalties	(USDm)	**(46.0)**	(4.5)	(9.0)	(7.4)	(7.5)	(7.6)	(6.2)	(3.8)
Terminal benefits	(USDm)	**(16.3)**	0.0	0.0	0.0	0.0	0.0	(5.4)	(10.8)
Operating Profit	(USDm)	**301.6**	37.8	74.6	52.1	53.8	54.4	29.2	(0.3)
Capital Expenditure	**(USDm)**	**(76.5)**	(12.1)	(21.7)	(19.2)	(9.5)	(12.5)	(1.5)	0.0
Operational capital	(USDm)	**(31.9)**	(6.8)	(15.5)	(9.6)	0.0	0.0	0.0	0.0
Projects capital	(USDm)	**(35.1)**	(5.3)	(6.3)	(9.7)	(8.0)	(6.0)	0.0	0.0
Sustaining capital	(USDm)	**(9.5)**				(1.5)	(6.5)	(1.5)	
Working capital movements	(USDm)	**12.0**	(1.0)	0.1	1.9	(0.1)	(0.1)	1.7	7.5
Company taxation	(USDm)	**(92.7)**	(14.4)	(27.4)	(15.4)	(15.0)	(15.0)	(5.6)	0.0
Net Free cash before debt service (real)	**(USDm)**	**144.4**	10.2	25.6	19.4	29.1	26.9	23.8	7.2
Reporting Statistics									
Cash Operating cost	(USc/lb Cu produced)	191	162	164	192	189	189	224	240
Total working cost	(USc/lb Cu produced)	225	185	186	214	212	211	266	372

4.18.4 WACC

The parameters used to generate the WACC for Chibuluma are set out in Table 4.21.

Table 4.21: Chibuluma Mine – parameters to calculate WACC (for Zambia)

Parameter	Value
Un-levered beta (1)	1.42
Re-levered beta	2.23
Market risk premium (2)	5.00%
Company risk premium	11.17%
Risk free rate (3)	2.49%
Country risk premium (4)	5.11%
Cost of equity	18.77%
USD cost of debt (5)	5.68%
Tax rate (average LoM)	42.00%
After tax cost of debt	3.29%

(1) This is the median beta for eight mining companies at June 2013, as extracted from Bloomberg.
(2) The market risk premium was based on the 2012 valuation methodology survey conducted by PriceWaterhouse Cooper, and provided by Metorex to SRK.
(3) The risk free rate is the rate quoted for United States 10-year government bonds at 30 June 2013.
(4) The country rating for Zambia is 36.76 relative to the United States of America given as 75.43, as extracted from http://www.euromoneycountryrisk.com/Home/Return/Countries#ucCountryTable. The country risk premium was calculated as as (75.43 / 36.76) x 2.49%.
(5) The cost of debt is taken as the 12-month Libor rate at 30 June 2013 of 0.68% plus a 5.00% premium, to convert the Libor rate to an equivalent interest rate in Zambia.

At a 45 / 55 debt / equity ratio (see section 3.18.4), the parameters in Table 4.21 yield a nominal WACC of 11.80%. Using a USA inflation rate of 2%, the real WACC for Chibuluma is 9.61%.

4.18.5 Sensitivities

The following tables present the NPVs of the real post-tax pre-finance cash flows as determined from the Chibuluma FM. In summary they include the following:

- The variation in real NPV with discount factors (Table 4.22);
- The variation in real NPV based on twin (revenue and operating expenditure) sensitivities (Table 4.23);
- The variation in real NPV based on changes to the Cu price (Table 4.24).

Table 4.22: Chibuluma Mine – variation in Real NPV with discount factors

Discount rate	NPV (mid-year) (USDm)
6.00%	120.1
7.00%	117.0
8.00%	114.0
9.00%	111.2
9.61%	109.5
10.00%	108.4
11.00%	105.8
12.00%	103.3
13.00%	100.8
15.00%	96.3

Table 4.23: Chibuluma Mine – variation in Real NPV based on twin parameter sensitivities

NPV @ WACC (USDm)		Revenue Sensitivity						
		70%	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**
Opex Sensitivity	**70.0%**	64.9	96.7	129.0	159.3	190.0	220.6	250.9
	80.0%	47.5	79.5	111.8	144.0	174.0	204.8	235.3
	90.0%	27.3	62.8	94.4	127.0	158.6	188.8	219.6
	100.0%	6.6	44.4	77.4	109.5	142.1	173.1	203.5
	110.0%	(16.6)	23.4	60.5	92.2	124.5	157.1	187.6
	120.0%	(42.9)	2.6	40.4	75.3	107.1	139.6	172.0
	130.0%	(69.6)	(21.5)	19.3	57.4	89.9	122.1	154.7

Table 4.24: Chibuluma Mine – variation in Real NPV based on Cu price sensitivity

NPV in USDm		Copper Price Sensitivity						
	(USc/lb)	**259**	**297**	**334**	**371**	**408**	**445**	**482**
Discount Rate	**(USD/t)**	**5 720**	**6 537**	**7 354**	**8 171**	**8 988**	**9 805**	**10 622**
		70%	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**
6.00%	62.4%	6.4	48.2	84.8	120.1	156.2	190.2	223.5
7.00%	72.8%	6.4	47.1	82.6	117.0	152.1	185.2	217.7
8.00%	83.2%	6.5	46.0	80.6	114.0	148.1	180.4	212.0
9.00%	93.6%	6.6	45.0	78.6	111.2	144.4	175.8	206.7
9.61%	100.0%	6.6	44.4	77.4	109.5	142.1	173.1	203.5
10.00%	104.0%	6.6	44.0	76.7	108.4	140.7	171.4	201.5
11.00%	114.4%	6.7	43.0	74.9	105.8	137.3	167.2	196.6
12.00%	124.9%	6.7	42.1	73.1	103.3	134.0	163.1	191.9
13.00%	135.3%	6.7	41.2	71.5	100.8	130.8	159.3	187.3
15.00%	156.1%	6.7	39.5	68.3	96.3	124.8	152.0	178.8

4.18.6 Benchmarked Costs

In the budget pack for Chibuluma for F2013, Metorex had compiled benchmark cost statistics for C1 costs. The C1 cost for Chibuluma for F2013 is compared to the benchmarked costs as determined by Metorex in Table 4.25.

Table 4.25: Chibuluma Mine – C1 cost benchmarking for F2013

Location	C1 Cost
Worldwide	2 987
Chile	2 826
China	3 038
South Africa	4 931
DR Congo	3 672
Zambia	**4 582**
Chibuluma	**4 151**

This shows that the budgeted C1 cost for Chibuluma in F2013 is below the average for the copper producers in Zambia.

4.19 Summary of Key Risks

[SV2.10]

A summary of the key risks identified for Chibuluma is provided here. Metorex advised SRK that it has a comprehensive risk management process in place which is aimed at identifying and ranking risks across all of the group's operations to determine an overall risk profile for the group. The risks identified by SRK have broadly been incorporated into the overall group risk management process and are being addressed through this.

4.19.1 Tenure

The Government of Zambia announced an increase in the royalty rate to 6.0% in 2011. There is no guarantee that this royalty rate will remain constant during the LoM plan. Metorex reports that Chibuluma interacts with the

Zambian authorities through the Chamber of Mines. Mining companies throughout the world face the risk of increased royalties being levied by the government of the territory in which they operate.

4.19.2 Mineral Resources

SRK considers that there are procedural inaccuracies in the modelling and estimation process, coupled to data quality, drill hole spacing issues and lack of QA/QC. Isolated drill hole data points do not demonstrate continuity of any form and therefore cannot be used as a basis for classification. The classification should be based on drill locations that are spaced closely enough for geological and grade continuity to be interpreted. Metorex has noted SRK's concerns and accepted the reclassification of the resources.

SRK's audited Mineral Resource estimate has reduced the Measured and Indicated Resources available to support the LoM plan for Chibuluma. In the process, some 1.2 Mt of material was removed from the LoM plan and hence Mineral Reserves for Chibuluma and Chifupu. The risk that the Mineral Resources are overstated is considered low.

4.19.3 Rock Engineering

The LHS method is appropriate at the current depths, but may need to be modified for greater depth to cater for increased amounts of stress damage. There is a risk that revision to support layouts may reduce the extraction rate of ore. Metorex has advised that an assessment of the rock engineering requirements for the lower mining level will be initiated.

4.19.4 Hydrogeology

Chibuluma is at risk for claims from surrounding water users related to contaminated water, although a ground water monitoring programme is in place which should provide information to monitor and assess trends.

Groundwater contamination at Chibuluma West can be expected, given soil contamination and seepage from the tailings dam that has been detected. The extent of this has not been quantified but ground water monitoring is taking place. Initial results from an AMD investigation indicate the potential for AMD exists, but that post closure the impact could be negated by rapid inflows of water.

Concern was raised over possible groundwater contamination that may affect Kaputula Village, which is located approximately 500 m from the TSF. Metorex advised that arrangements are in place for people potentially affected by this to be moved.

4.19.5 Mining

Detailed planning is essential to ensure that production targets are achieved as the LHS method is implemented on a wider scale.

4.19.6 Metallurgical Processing

While there are some differences in the metallurgical properties between the Chifupu and Chibuluma ores, Metorex believes that the higher sulphur and iron content of the Chifupu concentrate will provide free energy units and free acid production benefits for the smelter. Metallurgical results on 6 additional boreholes confirmed that the Chifupu ore can be successfully treated in the Chibuluma plant.

The concentrator crushing circuit is a single line plant. A breakdown of any of the major equipment pieces can stop the whole plant. The two stockpiles in the plant provide a buffer. Metorex has advised that a Hazemag crusher provides some flexibility in the crushing circuit while attention is being given to improve the availability of critical equipment such as the cone crushers, screen and conveyors.

Due to single 66 kV line to the mine coupled to insufficient power in the region, there is a risk of power disruptions during the LoM. Metorex advised that 4 MW standby generator sets have been installed at Chibuluma which are sufficient to run the entire operation in the event of a loss of the grid power.

4.19.7 Tailings

There were no risks identified with respect to the TSF or its operation.

4.19.8 Engineering and Surface Infrastructure

The present site maximum demand is close to incurring under declaration penalties from CEC, and will need to be closely monitored in future. The mine has a low power factor of 0.85, which should be 0.97 to 1.0. The engineering team is planning to improve on this by installing power factor control equipment in the future.

Metorex advised that the power situation is closely monitored on a daily basis to ensure the peak demand limit is not exceeded.

SRK understands that an amendment to the power supply agreement with CEC was signed which extended the term of the agreement by ten years from October 2012 to October 2022. Chibuluma should consider negotiating an increased declared maximum demand to 5 MW, especially in light of the planned electrical load increase outlined above. The company expects to be successful in securing this power and has standby generator capacity should the need arise.

Unless the drainage system is improved, there is a risk that Chibuluma will have increasing torque convertor and transmission failures on loaders and trucks as a result of water ingress into the units.

4.19.9 Logistics

Currently all the Cu concentrate produced at the Chibuluma South Mine is purchased by the CCS. The risk that CCS will no longer purchase the copper concentrate from Chibuluma is minimal.

The transportation method of the copper concentrates does not pose any risk to the Chibuluma South Mine.

4.19.10 Human Resources

There is a risk that the termination benefit at closure which has been set equal to a 6 month obligation may be understated. Metorex advised that the calculation will be reviewed on an annual basis to ensure that adequate provision and funding is in place.

4.19.11 Occupational Health and Safety

The Lost time accidents are of concern, with three of the four lost time accidents occurring due to contravention of mine laws and management procedures. Contravention of safety requirements tends to suggest that workers are not working safely. The incidents were fully investigated by management and necessary corrective actions reinforced. Metorex advised SRK that the government inspector was satisfied with the standard of safety at Chibuluma.

The number of planned task observations carried out in the work place by supervisors and managers has increased. The number of lost time accidents and lost days due to accidents has reduced accordingly.

Despite a decrease of nearly 50% in reportable injuries and lost time injuries in F2012 relative to F2011, the level of total reportable injuries has increased in H1-F2013 and needs to be targeted as part of a safety drive.

SRK has been appraised by Metorex that policies and management systems to educate employees on workplace health and safety have been put in place. This needs to include increased safety awareness and risk awareness in the work place, and focus on employees' behavioural aspects towards safety and health in the work place.

4.19.12 Environmental

It appears that Metorex may be liable for environmental damage at Chibuluma East not caused by Chibuluma. There is thus a risk that the projected environmental rehabilitation and closure costs may be understated. Metorex reports that Chibuluma East is included in the current liability assessment.

SRK did not ascertain strict compliance with all the requirements of the EIA or other permits. However, provided the mine adheres to the remedial measures and obligations of the EIA, there should be no reason that would prevent the mining licence from being renewed.

It is reported that no problems with salinity or heavy metals content are experienced for water discharged at the mines effluent discharge control point, the Emerald Road Bridge. Compliance at this point will not necessarily address possible liabilities associated with other discharges, such as the overflow at the RWD. Effluent quality leaving the mine at the control point is monitored but a more intense monitoring programme would provide a better understanding of impacts on the mine site. Metorex indicated that the extent of the pollution and treatment methods are being evaluated by AMC.

According to the 2012 SHEC report, sulfides in waste rock and in-situ rock in the underground workings at 4 and 5 Shafts pose a risk of AMD. Metorex is rehabilitating an existing water treatment plant at Chibuluma West which will be managed by Nkana Water (state owned water utility) to treat water from 5 Shaft. The intention is to use the water for domestic use and distribution.

Storm water management systems require, and are receiving attention.

There are 80 affected households living in close proximity to the TSF at Chibuluma South that have expressed concern regarding impacts, including air quality and possible AMD. Metorex reports that it has allocated a budget of USD1 million for the resettlement of these people according to an approved RAP.

Metorex has a group-wide provision for post-closure water treatment of around USD5 million. In SRK's experience, this figure is likely to be considerably more. In the absence of any proper evaluation of the extent (quantities) and severity (pH or TDS) of water to be treated, SRK has in agreement with Metorex increased this provision for post closure water treatment to USD25 million for the group for evaluation purposes, of which USD5 Million is allocated to Chibuluma.

Metorex is actively assessing the situation regarding ground water contamination and has implemented measures for its control in the operational phase.